The Role of Nutrition Education in cardiac rehabilitation. Evaluation of current practice to inform a New Education Programme.

by

April Anne Melia

A thesis submitted in partial fulfilment for the requirements for the degree of Doctor of Philosophy, Master of Philosophy at the University of Central Lancashire

January 2020

STUDENT DECLARATION FORM

Type of Award **PhD via MPhil**

School **School of Sport and Health Sciences**

1. Concurrent registration for two or more academic awards

*I declare that while registered as a candidate for the research degree, I have not been a registered candidate or enrolled student for another award of the University or other academic or professional institution

2. Material submitted for another award

*****I declare that no material contained in the thesis has been used in any other submission for an academic award and is solely my own work

3. Collaboration

Where a candidate's research programme is part of a collaborative project, the thesis must indicate in addition clearly the candidate's individual contribution and the extent of the collaboration. Please state below:

4. Use of a Proof-reader

*No proof-reading service was used in the compilation of this thesis.

A A Melia

Signature of Candidate

Print name: **April Anne Melia**

Publications

Published abstract

Melia, A.A., Lowe, N.M., Sinclair, J.K. and Dillon, S.A., 2016. Evaluation of nutritional knowledge, understand and practice of patients who attend a cardiac rehabilitation program in Preston. *Proceedings of the Nutrition Society*, *75*(OCE3).

Acknowledgments

I would like to thank all the members of my supervisory team Dr Stephanie Dillon as my Director of Studies you have provided help advice and support with your expertise and knowledge in addition to an abundance of patience and being the voice of reason when I most needed it, for which I will be eternally grateful. Dr Jonnie Sinclair for your support and encouragement throughout and especially your invaluable knowledge of all thing's statistics. Professor Nicola Lowe for seeing something in me and giving me the opportunity to start my academic journey all those years ago and for your continued support throughout this PhD research.

Thank you to Louise Bache CEO of HBNW for your enthusiasm and continued support for this research project watching it grow from an idea into practice reaching beyond this body of work. Also thank you to all HBNW staff for their encouragement and of course all of the wonderful patients who volunteered to take part in each of the studies giving their time, commitment and enthusiasm for the project your words of encouragement have inspired me to continue with this work.

Thank you to so many of my colleagues past and present for words of support and encouragement, and a special mention to my office son Robert Graydon for our continued chats, cups of tea and coffee and laughs when I needed them the most, you are a star. Brigit thank-you for our brilliant chats about anything and everything and sharing your experiences knowledge and friendship. Christine for your help advice and an objective view of all things PhD.

To my wonderful family and friends so much has happened during the past six years but through heartbreak comes strength, for those that are here you have given me strength and always believed in me, and to those no longer here I feel you beside me encouraging me all the way.

Finally, to my wonderful husband Lee, I have no words to express how much your support means to me, your strength and your unwavering belief that one step at a time anything is achievable has made the past six years possible thank-you for sacrifices you have made along the way and being my rock, always.

Abstract

Background

The efficacy of Cardiac rehabilitation (CR) programmes in delivering effective secondary prevention has long been established. Improvements are recorded in cardiovascular endurance, muscular strength and endurance, balance, co-ordination, and quality of life. However, many patients see little or no change in body mass with exercise alone. Dietary intervention coupled with exercise prescription has the greater potential to reduce body mass index (BMI) and other key indicators of nutritional status. Interestingly, the inclusion of nutrition education is rarely reported within specific CR settings as it is often delivered “in house” therefore evidence of best practice remains elusive and warrants further investigation.

Aims

To design, deliver and evaluate a new nutrition education programme (NEP) that addresses perceived barriers and increase engagement with the NEP for a specific CR programme (Heartbeat North West HBNW) that can be delivered by exercise professionals at the point of contact for their patients.

Methods

A sequential explanatory mixed methods research design within the pragmatic paradigm was used. Four research strands were conducted, the first three were the health needs assessment to inform the content and delivery of the NEP.

Strand one evaluated archival data from the “biggest loser” (BL), a 6-week weight loss programme following a specific topic each week relating to the Eatwell plate, delivered by HBNW exercise professional (EP) to highlight the risks associated with elevated waist circumference (WC).

Strand two investigated the eating habits, nutritional knowledge, and activity levels of current HBNW patients using two previously validated questionnaires (nutritional knowledge questionnaire (NKQ) and the international physical activity questionnaire (IPAQ) and the third “how healthy is your diet?” a British heart foundation (BHF) resource.

Strand three adopted a qualitative approach with focus groups (FG) and thematic analysis with HBNW patients to investigate potential barriers to attending the NEP and making dietary change.

Results from the first three strands informed the content and delivery of strand four. The NEP “Healthy Heart Happy You” which was subsequently tested in a 6-week randomised control trial (RCT) with follow up at 12-weeks, against the BL and usual care (UC).

Results

Strand one the BL intervention resulted in significant reductions in body mass (BM) waist circumference (WC) and BMI following the 6-week intervention ($p=<0.0001$), nutritional assessment was conducted.

Strand two data from 254 completed questionnaires revealed 55% of participants did not meet the 5-a-day recommendations for fruit and vegetables, 84% chose low fat products where possible, 63% do not add salt to cooking and (BHF). A total of 39% of participants did not identify bananas as low in added sugar, and 47% of participants identified tinned fruit (in natural juice) as being high in added sugar. Another example is low fat spread and polyunsaturated margarine being incorrectly identified as a low-fat product by 83.5% and 66.9% of participants respectively (NKQ). Patients remained active outside of their 2 X 1 hour prescribed exercise sessions per week and exceeded the recommended 150 minutes of moderate or 75 minutes of vigorous exercise per week (IPAQ).

Research strand three used focus groups and three main themes emerged: **Barriers**, **Confusion,** and **Inclusion**. Barriers to attending nutrition education included not wanting to go on a diet, not needing to lose weight, time constraints and trustworthiness of the person delivering the nutrition education session. Confusion surrounding how to meet the low salt, sugar, and fat targets and appropriate portion size were identified. Inclusion was underpinned by patients in each FG wanted to know what they could and should eat rather than what to omit as well as simple recipes and meals for one.

Strand 4. The final research strand involved the delivery of a RCT comparing the new education programme with BL and UC. Analysis of the data from the RCT identified a significant reduction compared to baseline in all three groups for WC at 6-weeks (p=0.01) but not at 12-weeks (p=0.09), BMI at 6-weeks (p=0.02) and 12-weeks (p=0.02), and BM at 6-weeks (p=0.02) and 12 weeks (p=0.03). Med diet score significantly increased in the NE group compared to UC group (p=0.02) but not between BL and NE (p=0.15) or between BL and UC (p=1.00).There was also a significant increase in Med score from baseline to 6-weeks (P=0.01) and baseline to 12-weeks (P=0.01). The NE programme resulted in greater minimal clinically significant changes (MCID) in some key outcome measures when compared to UC or BL, these were: WC, SBP and and Med diet score when compared to UC or BL.

Conclusion

This study evaluated a previous nutrition education programme, engaged patients (strands two and three) in the needs-assessment section of the research, and identified many barriers to engaging with nutrition education and making dietary change. Misinformation from media and medical professionals alike were cited as adding to confusion and dissatisfaction with current guidelines. Nevertheless, through their shared experiences it was possible to change the negative connotations of healthy eating into positive, evidence-based nutrition advice that provided tangible results. The act of being involved in the original BL or the RCT produced positive outcomes on the selected parameters and improved risk factor profile for many individuals who participated.

Contents

Chapter 1 Introduction

1.1 Cardiovascular disease

Cardiovascular Disease (CVD) is the term that is used to encompass all disorders of the heart and blood vessels including; coronary heart disease, stroke, heart failure and peripheral arterial disease British Association for Cardiovascular and Pulmonary Rehabilitation (BACPR, 2012). It is reported that CVD is the second main cause of death in the UK (Townsend et al., 2015), although death rates continued to decline (52% between 1990 and 2013) the rates of morbidity are not reducing at the same rate (Newton et al., 2015).

The decline in death rates from the late 1970's (Figure 1.1)

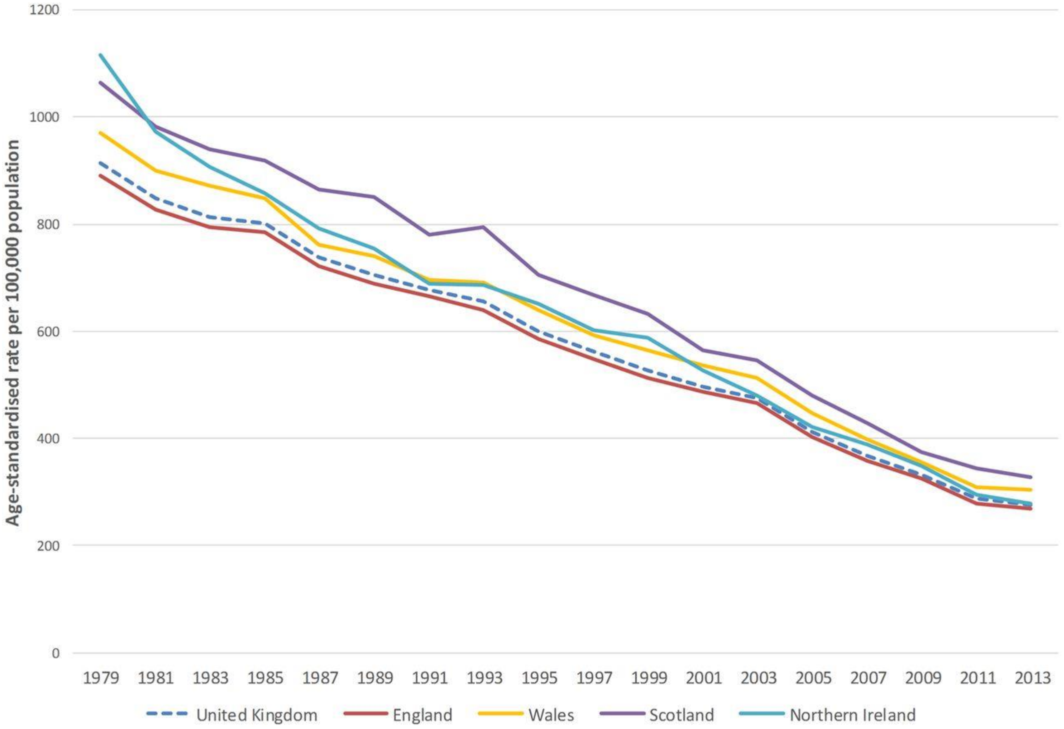


Figure 1. 1 Age-standardised death rates per 100 000 from cardiovascular disease, all ages, UK and England, Wales, Scotland, Northern Ireland, 1979–2013(Bhatnagar et al., 2016).

Government guidelines to address morbidity and mortality associated with heart disease and improve health have been set for over two decades. Our healthier nation" (McAvoy et al., 1999) provided targets to reduce the death rates from CVD and stroke, this was followed by "The national Service framework for Coronary Heart Disease (CHD)" which outlined guidelines for primary and secondary prevention of CHD focusing on major modifiable risk factors such as smoking and high blood pressure as well as dietary measures to improve serum blood lipids (Hobbs, 2002). Continuing the theme of prevention the government White Paper “Choosing Health, making healthier choices easier” was released in 2004 (Health, 2004). The Choosing Health paper recommended an increase in funding for the National Prevention Research initiative to focus on prevention of CHD and Diabetes and other non-communicable diseases (NCD). This was achieved through promotion of healthy eating, reducing physical inactivity and reducing health inequalities in the UK (Allmark et.,al., 2006). Improvements in cardiac care and the rise in older adult populations has seen an increase in people living with coronary heart disease in the UK to around 2.3 million (Dalal et al., 2015).

CHD is the most common form of CVD disease and according to British Heart Foundation (BHF) figures, approximately 64,000 deaths each year are attributed to CHD. Although the downward trend in death rates observed in CVD as expected is apparent in CHD (figure 1.2) (Doherty and Harrison, 2017).

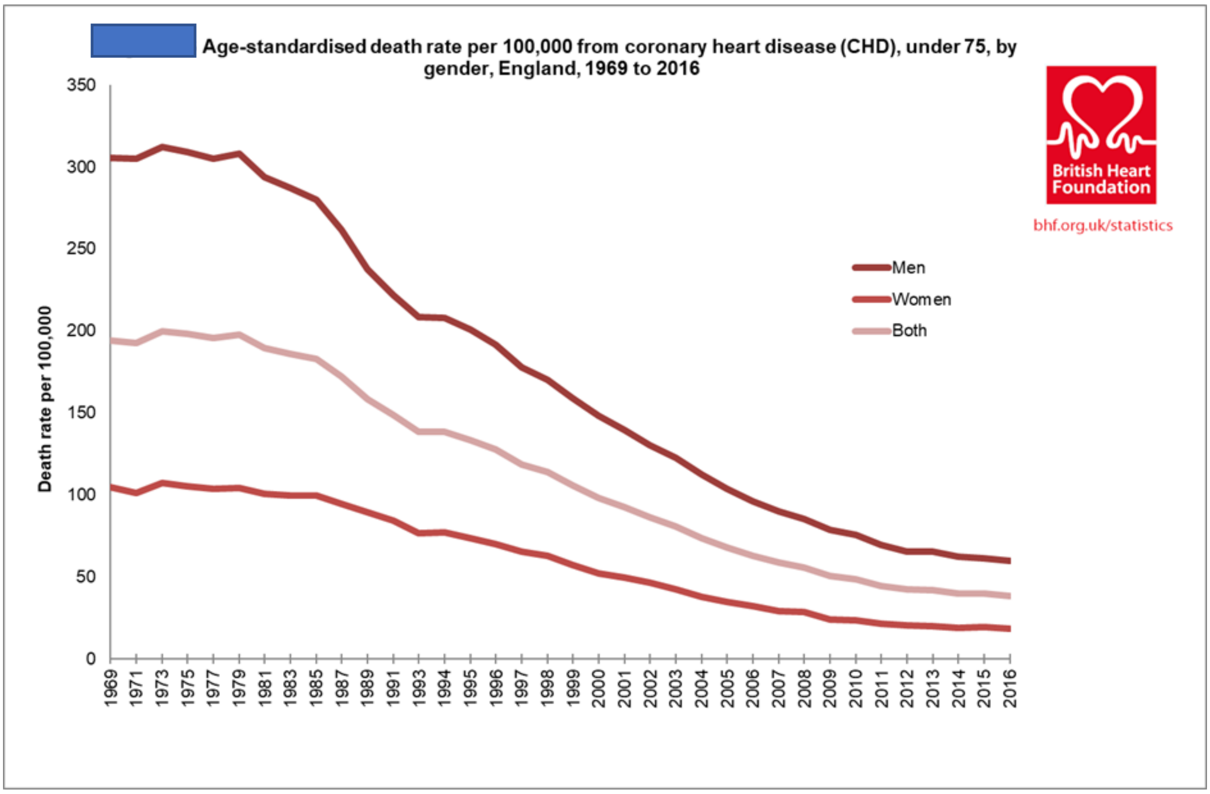


Figure 1. 2 Death rates from CHD have reduced in both males and females from 1969-2016 (Foundation, 2017)

This downward trend was first noted in the mid 1970's in the United States of America (USA) and confirmed in a 1978 report from the National Heart, Lung and Blood Institute (NHLBI) and recently reviewed by Mensah and colleagues (2017) {Mensah, 2017). They accredited the downward trend to improvements in the pharmacological treatment of high serum cholesterol with statins. Statin therapy is shown to be an effective way to reduce serum cholesterol by inhibiting hepatic synthesis of cholesterol (Charlton-Menys, 2008) . Cigarette smoking has reduced since the 1970's, and this, in addition to better control of other risk factors for CHD such as hypertension have all contributed to the decline in death rates from CHD (Bhatnagar et al., 2016; Mensah et al., 2017). These trends were seen across many countries globally however, the downward trend has seen deceleration in more recent years and is thought, in part, to be accredited to the global rise in obesity (Lopez and Adair 2019).

1.2 Coronary Heart Disease

Several factors are known to be causal in development and progression of CHD, for example smoking (Pan et al., 2015), heavy alcohol consumption (Movva and Figueredo, 2013), hypertension (Escobar, 2002), obesity (Kannel et al., 2002) non-familial hypercholesterolemia and physical inactivity (Malhotra et al., 2017). Exposure to environmental toxins from chemicals, smoke and vehicle fumes may also contribute to the development of CHD (White, 2016, Malhotra et al., 2017). These factors are classified as modifiable risk factors as they can be modified by changes in environment, physical activity levels, and nutritional status Whereas, non-modifiable risk factors include Age, gender, ethnicity, and familial history of hypercholesterolaemia or hypertension (Goldstein, 1974, Gidding et al., 2015).

Several of the risk factors described are metabolic disorders which contribute to the pathophysiology of CHD and an accumulation of these metabolic conditions can be described as Metabolic Syndrome (Grundy, 2016). Metabolic syndrome is a “cluster” of metabolic conditions that can substantially increase the risk of CHD and Type 2 Diabetes Mellitus (T2DM) (Vassallo et al., 2016).Diagnosis of metabolic syndrome requires a combination of anthropometric, clinical and biochemical measures which assess the presence of obesity, hypertension, hyperglycaemia (or insulin resistance) and dyslipidaemia (Grundy 2016, Table 1.1).

Table 1.1 Criteria for clinical diagnosis of metabolic syndrome is at least three of the following disorders

Criteria	*Measure*	*Categorical cut points*	
Obesity	Elevated waist circumference	≥102cm in males	≥88cm in females
Dyslipidaemia	*Elevated triglycerides	≥1.7mmol/L	
	*Reduced HDL-C	<1.00mmol/L males	<1.3mmol/L females
Hypertension	*Elevated Blood Pressure	≥130mm/Hg systolic and/or	≥85mm/Hg Diastolic
Hyperglycaemia	*Elevated fasting Glucose	≥5.6mmol/L	
	A patient requiring drug treatment is an alternate indicator for metabolic syndrome (Grundy, 2016). Criteria adapted from A Joint Interim Statement of the International Diabetes Federation Task Force on Epidemiology and Prevention (Alberti, 2009)		

The increase in visceral adiposity observed with excessive caloric intake and a sedentary lifestyle is key in the development of CHD and T2DM as well as diagnosis of MetS (Bremer and Jialal, 2013). The excess energy is stored as fat in adipose tissue and this tissue is not metabolically equal and visceral fat compared with subcutaneous fat is associated with greater insulin resistance as well as smaller HDL and LDL particle size; (Fox et al., 2007., Neeland, et al., 2012). . Kohlgruber(2015) investigated the role of adipose tissue in the development of T2DM. They discussed the changes that occur in the transition from lean normal weight where regulatory cytokines such as interleukin factor-4 (IL-4) and interleukin factor -10 (IL-10) work to regulate inflammation. However, in obesity a state of sterile inflammation occurs, stress signals emit from adipose tissue in response to increasing size activating a type 1 immune response. Further, cytokines including tumour necrosis factor alpha (TNF- α), interleukin -6 (IL-6), interleukin factor-1 beta (IL-1 β), interferon gamma (IFN-γ) react to the stress signals, which over time will lead to increased inflammation. Chronic inflammation caused by increases in adipose tissue could potentially result in development of type2 diabetes

(Wentworth et al., 2010; Wu et al., 2011; Kohlgruber and Lynch 2015). The important thing to note here is that not all adipose tissue elicits this response, and not all obese individuals will develop type2 diabetes (Preis et al., 2010; McLaughlin et al., 2011). Rather, it is the site of adipose tissue that is reported to play a crucial role in the inflammatory process. Increases in visceral fat, measured by WC (Table 1.4), increases the likelihood of developing insulin resistance (Hardy et al., 2012). McLaughlin et al., (2011) reported that subcutaneous fat actually decreased the chances of developing insulin resistance by around 48% for each one standard deviation (SD) increase in fat compared to an 80% increased chance of development for each SD increase in visceral fat (McLaughlin et al., 2011). Nonetheless, the overall morbidity and mortality associated with increased BMI and WC still exists, and weight management should form an integral part of any cardiac rehabilitation programme. An estimated 80% of cardiac rehabilitation patients are overweight or obese (Wilson et al., 2002; Aides and Savage 2017). Obesity has long been associated Endothelial dysfunction (Steinberg et al., 1996; Al Suwaidi et al., 2001; Achari and Jain 2017), additionally, many of the aforementioned cardiovascular risk factors are consistently allied to changes in endothelial function and subsequent damage (Libby et al., 2002).

Once the endothelial lining is damaged it becomes more permeable to circulating LDL particles (LDL-P) can infiltrate the Tunica Intima (TI) which become trapped in the sub-endothelial intimal space. The damaged endothelium also expresses vascular cell adhesion modules (VCAM-1) which allows monocytes to migrate into the damaged sub-endothelial space where they differentiate into macrophages (Shrivastava et al., 2015). The oxidative and inflammatory environment created in the TI can modify LDL and this oxidative modification if LDL (OxLDL) results in unregulated uptake by the monocyte-derived macrophages (Tabas, 2017).. This results in macrophages becoming lipid-laden foam cells and form the first visible signs of atherosclerosis described as a “fatty streak” (Lyon et al., 2003). These foam cells contribute to the pro-atherogenic environment by releasing reactive oxygen species and inflammatory cytokines. This triggers further monocyte activity to the area continuing the inflammatory process (Tabas, 2017), a chemotactic response recruits more monocytes to the affected area to deal with the increased OxLDL in a self-propagating sequence known as the “cascade effect” contributing to the atherosclerotic development (Witztum and Steinberg, 1991). The foam cells release interleukin growth factor -1 (IGF-1) causing smooth muscle cells (SMC) to migrate into the TI layer and proliferate. This results in the formation of a fibrous cap surrounding the plaque, at the same time releasing calcium deposits which harden the fibrous cap. Both foam cells and SMC die within the plaque space and release their lipid contents along with pro-inflammatory cytokines and reactive oxygen species adding to the plaque formation increasing blood supply to the TI space which increases inflammation (Libby et al., 2009, Libby et al., 2002). Cytokines trigger Nitric Oxide (NO) release, NO gives individual vessels their elasticity and ability to adapt to the conditions within the vessel and can dilate to allow more blood flow through the artery and release pressure caused by the increasing plaque formation (De Caterina et al., 1995). Damaged endothelial cells are not able to function efficiently and thus production of NO is compromised reducing the vessels ability to dilate in turn reducing the blood flow through the artery (Tabas, 2017). Once the atherosclerotic plaque has developed, the enlarged arterial wall may remain intact, with the thick fibrous cap covering a lipid rich core and the repair process stabilises the encapsulated plaque (Tabas, 2017). In contrast, unstable plaques (damaged by the development of lesions in the same way as initial plaque development) may develop over time leaving it vulnerable to rupturing causing cardiovascular and cerebral events (Choi et al., 2017). It was thought that all atheroma developed in a progressive manner and ultimately cause angina pectoris and Myocardial infarction (MI) however Libby et al., (2002) postulated that many plaques will stay intact and individuals would remain asymptomatic

(Libby and Aikawa, 2002). It is the conditions surrounding the plaque that that influence the fate of the fibrous cap, meaning that the inflammatory signalling to the damaged area may be improved by altering traditional risk factors such as LDL-C levels, reducing obesity and other metabolic conditions (table 1.1) therefore reducing the pro-inflammatory environment (Libby, 2012). In more recent research atherosclerotic plaques have been identified in babies, children and young adults suggesting that plaque formation is not a sudden reaction of the immune system but rather a lengthy process occurring over many years. Diet has been shown to reduce the damage to the endothelial surface counteracting lifestyle influences (Furukawa et al., 2017). Therefore early inclusion of antioxidants, in the diet, in addition to maintaining a normal body weight, could potentially reduce the damage (lesions) to the artery walls and produce a subsequent slowing of the disease process (Furukawa et al., 2017). Vitamins and minerals consumed as part of a healthy diet play a vital role in the appropriate functioning of cells within the body (Castiglione et al., 2018). In human and animal studies antioxidant levels of fat-soluble vitamins including: vitamin A (retinol and beta-carotene) which promote normal vision, plays a role in immune function, growth and protecting the integrity of epithelial cells (Dennehy and Tsourounis, 2010, Haskell, 2012). Vitamin E (α-tocopherol) which inhibits aggregation of platelets reducing clot formation (thrombus) and helps maintain the integrity of erythrocytes which transport oxygen to, and removal of carbon dioxide from, tissues (Chung et al., 2018).Earlier researched reported that serum levels of α-tocopherol were reduced in morbidly obese patients(Aasheim et al., 2008), potentially suggesting that increased dietary intake could potentially reduce some of the associated complications between obesity and atherosclerotic plaque formation (Higdon and Frei, 2003, Vincent et al., 2005, Furukawa et al., 2017).

1.3 Cardiac rehabilitation

.

Cardiac Rehabilitation (CR) services offer multidisciplinary support to people with an array of cardiovascular conditions including stable angina, heart failure, had valve surgery, have an implanted defibrillator and previous myocardial infarction with or without surgery (Bethell et al., 2009). It is common for patients to initially attend CR with one or more metabolic disorders associated with further progression of CHD and around 52% of patients have two or more co-morbidities (Doherty and Harrison, 2018). Therefore, the rehabilitation programme aims to provide lifestyle modifications to improve both the medical prognosis but also improve quality of life in these individuals. Cowie et al., (2019) reported that there was an absolute reduction in risks for cardiovascular mortality (from 10.4% to 7.6%) for those who attend CR when compared to those who do not (Cowie et al., 2019).

CR has been provided for over 50 years and is a multi-faceted intervention for those diagnosed with heart disease (Bethell et al., 2009). Herman Hellerstein (1968) provided a comprehensive rehabilitation that included nutritional analysis and education, recommended the attainment of normal body weight, take adequate rest, smoking cessation, participating in normal social life, and continuing employment. This was in addition to providing the exercise prescription that is still used today of a graded exercise programme modified for individual ability and health restrictions, performing at 60-70% of aerobic capacity over a period of months (Hellerstein, 1968). His work was adopted by much of Europe and the United States and still today CR follows the same template (Bethell et al., 2009, Bethell et al., 2008b). Conversely, in much of Europe and the USA guidelines recommend patients should proceed to moderate-to-vigorous-intensity exercise (80% VO_{2max}) rather than remain in the moderate range (40-70% VO_{2max}) used by the UK and France (Price et al., 2017). Australia and Japan, however, adopt a lighter protocol consisting of light to moderate-intensity exercise (60% VO_{2max}), demonstrating that there is no real consensus between recommendations (Piepoli et al., 2010). A structured programme of exercise, in addition to promoting lifestyle changes, and has been shown to reduce the incidence of cardiac mortality in patients that attend CR (Bethell et al., 2008a, Bethell et al., 2008b, Dalal et al., 2015, Dalal et al., 2010, Balady et al., 2007).

In Europe and the UK the rehabilitation programme consists of graded exercise prescription and contains 4 distinct phases from hospitalisation at **Phase I** where patients will be given physiotherapy and occupational therapy., **Phase II** is usually home based care (adapting to normal daily living) and GP visits., **Phase III** patients will be referred onto a rehabilitation scheme in their local area, this phase is medically supervised with a suitably qualified fitness professional to prescribe exercise/activity sessions suitable for each patient. **Phase IV** is the maintenance programme, with a qualified fitness professional and usually within the rehabilitation centre. The programme will encompass many aspects of rehabilitation from practical advice on pain management, medication, psychological and emotional support, risk factor modification (RFM) and lifestyle changes (Medicine, 2013, Bethell et al., 2008b). Phase IV (described above) normally lasts for nine months with 1 or 2 exercise classes per week. Following this, patients are encouraged to continue with their new lifestyle changes by either offering subsidised exercise membership or signposted to other activities available within their local area, e.g. swimming, health walks, cycle schemes etc. Patients are generally given a variety of literature and information on specialist services including smoking cessation when leaving hospital, in some authorities, there may be access to counselling services. Literature will include the publication from The British Heart Foundation (BHF) entitled “The Heart Manual”. This publication offers self-help guide to secondary prevention addressing aspects of lifestyle change (Bethell et al., 2009).

CR programmes (CRP) in the UK follow guidelines set by the British association of cardiovascular and pulmonary rehabilitation (BACPR) who recommend standards and core components for CRP (Cowie et al., 2019).

The six core components of CR include:

- Health behaviour change and education
- Lifestyle risk factor management
    - Physical activity and exercise
    - Healthy eating and body composition
    - Tobacco cessation and relapse prevention
- Psychosocial health
- Medical risk management
- Long-term strategies
- Audit and evaluation

The list of patient groups that would benefit from attending CR (table 1.2) is not exhaustive and some CR programme providers also include those with vascular disease such as stroke and "at risk" individuals to improve their risk factor profile (Bethell et al., 2009).**Table 1.2** The different patient groups that benefit from attending a cardiac rehabilitation programme. British Association for Cardiovascular and Pulmonary Rehabilitation (BACPR)

Priority Patient groups offered a cardiovascular prevention and rehabilitation programme (CPRP)
Acute coronary syndrome
Coronary revascularisation
Heart failure
Other patients known to benefit
Stable angina
Peripheral arterial disease
Post-cerebrovascular event
Post-implant of cardiac defibrillators and resynchronisation
Post heart valve repair/replacement
Post heart transplant and ventricular assist devices
Adult congenital heart disease

Adapted from Cowie et al, standards core components for cardiovascular disease prevention and rehabilitation (Cowie et al., 2019)

1.4. Cardiac Rehabilitation and Physical Activity

The link between physical activity and longevity have been studied for centuries, with some of the earliest known works from Hippocrates who suggested that a moderate amount of exercise, but not too much, was good for overall health (Katz and Katz, 1962). In the mid 1900's prominent figures such as Jeremy Morris, who in the 1950's studied workers on London transport with different roles. He found that there was a relationship between CHD and activity levels with the conductors developing CHD much later in life and less severe than their inactive counterparts (Morris et al., 1953). His work also made links between diet and CHD and in 1977 found that individuals with higher fibre, polyunsaturated fatty acid intake, who did not smoke and were more active had less incidence of CHD than those with lower intakes and who smoked and were less active (Morris et al., 1977). Which is still very much at the forefront of contemporary research and discussed in the following section on CR and nutrition (Estruch et al., 2018, Estruch et al., 2013). Whilst in the 1960's Ralph Paffenbarger was conducting similar research in the Harvard Alumni Health Study that continued into the 1980's. This research also found an inverse relationship between exercise and longevity (Lee et al., 1995). Both Morris and Paffenbarger were pioneers of their time and demonstrated great insights into the relationship between physical activity and long term disease development (Lee et al., 2009a). Both researchers were awarded the first Olympic prize medal for sport sciences in 1966. They demonstrated that physical activity of moderately vigorous intensity will reduce risks from CHD and other metabolic diseases, even in older age (Lee et al., 2009b). Thus, supporting recommendations for exercise as an integral part of risk reduction and improved health. The purported benefits are also seen in individuals with established CHD, therefore secondary prevention in the form of exercise following MI or other vascular condition is strongly recommended (Heran et al., 2011a). Similarly, other researchers report benefits to providing exercise as part of the rehabilitation process (Taylor et al., 2004, Thompson et al., 2003, Fletcher et al., 2013). Improvements in cardiovascular endurance, muscular strength and endurance, and self-efficacy are well documented, and exercise plays a pivotal role in any CRP (Tsechkovski, 1993, Chua and Lipkin, 1993, Fletcher et al., 1996, Costanzo, 2006, Heran et al., 2011a). In 2016 Anderson et al., updated a Cochrane systematic review and meta-analysis investigating health related quality of life, mortality, morbidity, and cost-effectiveness of CR programmes across Europe and North America. A total of 66 studies were included in the update which showed that all-cause mortality was not significantly reduced following exercise-based CR. However, the updated review now included a more diverse population than previous reviews, and now included increased ethnic groups, females and older people, in addition to advances in provision of medication to control CHD, for example statin use. The authors did however find reductions in CV mortality, improvements in health-related quality of life and reductions in hospitalisations which reduces costs to health services, their results support previous recommendations for provision of exercise based CR (Anderson et al., 2016). Attending regular CR sessions alone has been less successful in making positive changes to body composition (White et al., 2011). Similarly, Atkins et al., (2017) highlighted the need for further research into body composition changes in this largely elderly population., An evaluation of 10 years' worth of data into the efficacy of a CRP in North West England found that both risk factor assessment (RFA) and VO_2 Max significantly improved (p= 0.02 and p= 0.01 respectively) whilst body mass index (BMI) reduction and /or weight loss were not significant, and suggested further investigation into possible reasons for this (Atkins et al., 2017). Conversely, a randomised control trial was conducted where participants were randomised to either of two exercise groups at differing intensities and a non-exercising control group, both exercise groups saw significant weight loss ($P < 0.05$) with the higher intensity group (600kcal/session) losing more weight when compared to the lower intensity group (400kcal/session) (3.9±4.9kg 4.3%) and 5.2±5.6kg 5.7%) respectively., Whilst those in the non-exercise group increased in weight over the same period (0.5±3.5kg 0.5%) no significant differences between were seen between men and women. Exercise alone significantly ($P < 0.05$) reduced body mass and BMI, reporting a 5% body mass reduction in both males and females over a 10-month period of exercising five days per week at prescribed intensities, participants in the study were overweight (BMI >25 kg/m²) and sedentary at baseline. Conceivably the intensity of prescribed exercise should be investigated further to substantiate these findings within a CR setting (Donnelly et al., 2013). Subsequently, body mass is an important factor in contributing to CHD and in CR many patients are likely to be overweight when they first attend and are more likely to gain weight over time despite exercise prescription provided as part of the CR Programme (Rea et. al. 2001). The latest figures by National Audit of Cardiac Rehabilitation (NACR) state that around a third of patients begin CR with a BMI of >30 kg/m^2 (Ryan and Bernard, 2003, Doherty and Harrison, 2017). Earlier discussion around varying intensities of exercise prescription globally could hold the key to making body composition changes in CR patients. In the UK CR programmes are governed to providing moderate intensity exercise, however several studies report the additional benefits of adopting a higher intensity prescription for additional gains and this certainly warrants further investigation (Price et al., 2017). Furthermore, the addition of resistance exercise has shown more positive results for weight loss than aerobic exercise alone. Thirty- six CHD patients were allocated to either aerobic exercise (AE) only or AE+ resistance (R) each group performed 30 minutes of AE 3-days per week over a 6-month period, whilst the AE+R added resistance exercises after each AE session. This comprised of; 2 sets of 10 repetitions performed on seven different resistance machines. The AE+R group showed greater gains in strength ($P < 0.05$), sub maximal exercise heart rate and rate-pressure product ($P < 0.01$), body fat ($P < 0.05$). Lean mass was found to be significantly correlated with strength increase. Both groups saw improvements in VO2 peak with no difference between groups (Pierson et al., 2001). Thus, demonstrating that the intensity and addition of resistance training within CR could increase muscle mass and reduce body fat, and should be implemented (Bjarnason-Wehrens et al., 2004; Wenger et al., 2008; Villareal et al., 2017). Weight loss alone has been shown to reduce risks associated with further progression of CHD (Singh et al., 1992) therefore, those who first attend as overweight should be counselled in weight management in addition to the structured exercise prescription received as part of their CRP.

1.5 Cardiac Rehabilitation and Nutrition Education

Nutrition education forms one of the core components of CRP, however, the quality and quantity of advice given can vary greatly dependant on the skills, background and education levels of those administering it and the resources available to them (Ma et al., 2010a). Current guidelines recommend that rehabilitation programmes should offer advice on making dietary changes and record baseline anthropometric measures that include height, weight, BMI, WC and WHR for evaluation purposes (BACPR, 2012, BPhil, 2012, Taylor et al., 2010). In 2008 Ma et al., studied the dietary quality of patients 1 year after being diagnosed with CHD, they recruited 689 patients aged between 30-80yrs with at least one cardiac event at baseline, data was collected using a self-administered questionnaire containing questions on smoking and physical activity along-side dietary information. Body weight and height were recorded, and BMI calculated, patients were randomly assigned to “usual care only” which was provided by their physician (type of treatment was at physician discretion), or to the “special intervention” group, this group received 5 telephone-counselling contact sessions. At 1-year registered dietitians conducted telephone interviews with patients using a 24-hour-recal method. The alternative healthy eating index (AHEI) was used as a measure of diet quality, nine criteria of a healthy diet were used to determine the intake of: Fruit, vegetables, nuts and soy, ratio of red and white meat, cereal fibre and trans-fat, ratio of polyunsaturated fat to saturated fat, alcohol, and duration of multivitamin use. The results showed that at 1 year follow up patients scored low on the AHEI index with (30.8 ± 13.1) out of a possible maximum score of 80. In their discussion they note that poor diet quality was the major finding and patients in this study were free living and not assigned to a CRP nor is there any evidence of participation in regular physical activity.. It was proposed that future behavioural interventions should include both physical activity and diet modification for optimum results (Ma et al., 2008). According to 2018 NACR figures, 53% of CRP have access to a dietitian, however, in practice this access is often limited to one session shortly following phase II of the rehabilitation process unless patients have other clinical factors that require an individual assessment (Foundation, 2018).

Nutrition advice can be complex and even the BHF, BACPR, and American Heart Association (AHA) may not agree to a specific diet template, possible reasons for such disagreement include; cultural, socio-demographic, physical, and psychological factors making it difficult to produce a one size fits all solution (Popkin, 2011). However, the evidence in support of nutrition interventions has substance; through nutritional intervention individuals are more likely to see a reduction in body weight and waist circumference (Savage et al., 2002). Policy makers and researchers have debated the exact components of a healthy diet (Krauss et al., 2000, Mozaffarian and Ludwig, 2010, Scarborough et al., 2012, Buttriss, 2016a, Parker and Taylor, 2018, Estruch et al., 2016, Martinez-Gonzalez et al., 2004).

There is a scarcity of published research on the efficacy of nutrition interventions specifically for cardiac rehabilitation patients, although other secondary prevention settings have shown to be successful. The Lyon Diet Heart Study was a landmark study publishing valuable information on the effects of a Mediterranean diet high in alpha-linolenic acid (ALA). ALA is reported to maintain normal heart rhythm and pumping, compared to what they referred to as a "prudent diet" recommended by the American Heart Association (AHA), on different outcome measures aiming to reduce further heart disease in previously diagnosed CHD patients (De Lorgeril et al., 1994; 1999). One important finding was that the Med-ALA group saw no sudden deaths when compared to prudent diet where there were 8 sudden deaths over the study period. This added support to the beneficial effects of ALA in reducing heart arrhythmias (Burr et al 1989; Riemersma 1989; De Lorgeril et al., 1999). Further, at 1-year follow-up, plasma vitamins C and E were increased even though only vitamin C was increased via the diet pattern. The protective role of vitamin C on vitamin E or the overall increased intake in antioxidants were thought to be the reason for these findings, suggesting that vitamin E appears to have an inverse relationship with heart disease (De Lorgeril et al., 1994). It is important to note here that the recommendations should also include increased fish intake to ensure adequate amounts of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) as ALA is plant derived and only modest amounts are converted to EPA or DHA, the latter being superior in reducing CHD risk (Harris et al., 2008). Although many researchers have attempted to substantiate the influence of vitamin E (α-Tocopherol) on atherosclerosis development, there remains uncertainty on the beneficial role. One major consensus is that there are no apparent adverse effects of supplementation. If α-Tocopherol is consumed as part of a variety of antioxidant containing foods, the benefits may be greater than in isolation (Yusuf et al., 2000; Hodis et al., 2002; Jilal and Devaraj 2005; Aune et al., 2018).

In another secondary prevention study, the CORonary Diet Intervention with Olive oil and cardiovascular PREVention study (CORDIOPREV), patients with existing CHD were randomized to the Med diet or low fat (LF) diet groups, recruiting over 1,000 patients from a Spanish CR programme. Their main outcome measures were cardiovascular events (myocardial infarction, revascularization, ischemic stroke, peripheral artery disease and cardiovascular death) between the groups over a 7-year period. Whilst the study is still ongoing, researchers further divided participants into sub-categories for diabetes, pre-diabetes and no diabetes, to investigate the level of endothelial dysfunction (one of the key drivers of CHD previously discussed) at baseline and following 1.5years of following the CARDIOPREV diets of Med or LF. Adherence to either diet maintained flow mediated vasodilation (FMD) in non-diabetic patients, whilst the Med diet group showed improvements in FMD in those with T2D (5.2±0.4 at 1.5yrs compared to 3.8± 0.4 at baseline $p=0.04$), and pre diabetes (4.9±0.4 compared with 3.8± 0.4; $p=0.04$). The med diet also saw larger improvements in FMD when compared to the low fat (LF) diet in diabetic patients only ((med) 5.2 ±0.4 compared to (LF) 3.7±0.4; $p=0.01$) supporting the advice to consume a med diet pattern (rich in olive oil) to improve endothelial function in diabetic patients, and as 28% of CHD patients are currently living with diabetes, this advice would seem prudent (Delgado-Lista et al., 16 Virani et al., 2020;).. Monounsaturated fatty acids (MUFA), the main constituent of olive oil along with increased intakes of F&V, nuts, seeds consumed in the Med diet are thought to elicit preferential changes in lipid profile and insulin sensitivity (Bos et al., 2010).

A study by Boss et al., (2010) investigated the impact of a diet high in MUFA (20% total energy), a Med diet (MUFA 21% total energy plus increased intake of plant foods, decreased meat and dairy and moderate intake of wine), or a high saturated fatty acid (19% total energy) diet for 8-weeks on insulin sensitivity and serum lipid levels. 60 non-diabetic individuals with mild abdominal obesity participated in the study there were no significant differences between the groups on glucose levels., The high MUFA group showed a reduction in total and LDL-C levels and the total C/HDL-C ratio when compared to the high SFA diet. The MUFA Med diet increased HDL-C levels and reduced total C/HDL-C ratio but did not decrease LDL-C levels, weight loss and waist circumference reduced marginally but there were no significant differences between the groups (Bos et al., 2010)

There is strong evidence to support the increased consumption of foods containing wholegrains, fish oils, fruit and vegetables and a decrease in the consumption of salt, saturated fats and sugar (Mozaffarian and Ludwig, 2010). Many diet “types” are used as templates to base nutritional guidelines, along with several high quality longitudinal studies such as: CORDIOPREV study (Delgado-Lista et al., 2016), MOLI-SANI study (Bonaccio et al., 2016) the LYON DIET heart study (De Lorgeril et al., 1999, Leaf, 1999) to name but a few One diet pattern that utilizes these recommendations is the DASH- (dietary approaches to stop hypertension) which is used in the treatment of hypertension, and recommends the above eating pattern (Most-Windhauser, 2001). The DASH diet originally designed by Sacks et al., (1995) has also showed improvements in the levels of blood lipids and is potentially useful for CHD patients (Salehi-Abargouei et al., 2013, Shirani et al., 2013).t

The standard DASH diet additionally suggests consuming less than 2300mg/d of sodium per day, whereas the lower-sodium DASH diet recommends intakes of less than 1500mg/day (Soltani et al., 2016), the lower figure is in line with American Heart Association (AHA) 1500mg/day (Whelton et al., 2012). Whereas The World health Organization (WHO) recommend less than 2000mg/day (Drewnowski et al., 2015). Both the DASH and the Med diet have been extensively researched over many years using large-scale studies adding a substantial amount of weight to the recommendations that a whole diet approach rather than concentrating on specific nutrients provides some protection from CHD (Bhupathiraju and Tucker, 2011a). Strong evidence to support the Med style diet was investigated in the EPIC-Elderly study by Trichopoulou et. al., (2007) and was shown to be associated with lower incidence of total mortality in previously diagnosed CHD patients (Trichopoulou et al., 2007). In addition to this, the implementation of the Med diet has shown improvements in mental and physical health (Bonaccio et al., 2013a, Bonaccio et al., 2013b, Bonaccio et al., 2016), as well as a reduction in the risk of developing some cancers, diabetes type II, and hypertension (Shen et al., 2015).

Nutrition intervention for weight loss in those who are obese (BMI>30 kg/m^2) has the potential to reduce other risk factors for CHD. Shai et.al., (2010) conducted a 2-year randomized controlled trial where 140 males were recruited in the workplace for a nutritional intervention. The men were eligible if they had a BMI of > 27kg/m^2, had T2D and/or CHD. The mean age of the study population was 51±6.15years with a mean BMI of 30.4±3.2 kg/m^2. Participants were randomized to one of 3 different diet groups, Low-fat, Low carbohydrate, or Med. The study investigated carotid artery intima-media thickness and measurements were taken at baseline using standard ultrasound and 3D ultrasound to measure thickness. After 2 years of intervention measurements showed a significant (*P*_0.001) improvement (5%) in mean carotid vessel wall volume (VWV) and those who had a greater weight loss also showed a greater decrease in systolic blood pressure (SBP). These findings were across all three diets, once again supporting nutritional interventions to halt or slow down the progression of atherosclerosis but without a clear indication that one diet outperformed another.

In a review of education in cardiac rehabilitation it was found that many education studies are poorly reported, so the full extent of behaviour change advice within CR is limited. Although benefits have been seen through education interventions for smoking cessation, medication adherence and body composition improvements, it was difficult to identify a specific reason for these improvements with poorly conveyed research measures and outcomes (de Melo Ghisi et al., 2014). To deliver education programmes that meet the needs of a population it is important to understand what individuals within that population need, that includes how the education is delivered. Lectures, books and discussions with healthcare providers were the preferred methods to receive information by CR patients (de Melo Ghisi et al., 2014, de Melo Ghisi, 2015). As previously sated CR programmes follow guidelines set by the BACPR and naturally they recommend dietary changes as an important element of lifestyle change, over 50% of CRP's are reported to have a dietitian within their multidisciplinary team (MDT) (Doherty and Harrison, 2018). However, the contact time with patients is very limited and many patients report having little or no dietary advice following diagnosis with CVD or those that did receive education found the advice they were given added to their confusion on what changes to make (Meyer et al., 2014). There is clearly a need for education programmes within CR as evidence of best practice for nutrition education is limited and warrants further investigation. Modifiable risk factors are just that, modifiable, currently research supports exercise prescription as part of the CRP with evidence-based practice, it is now time to think of nutrition education in the same way to provide a more holistic approach to lifestyle change within CR. The current research will provide much needed evidence of the efficacy of nutritional education in the secondary prevention setting (de Melo Ghisi et al., 2014). Further, it will use the whole diet approach rather than focusing on single nutrients, to increase adherence to dietary change (Bonaccio et al., 2016).

1.6 Nutritional Assessment

Nutritional assessment is the first stage in gathering evidence to assess nutritional status of individuals, to make informed decisions on any nutrition related health issues and identify those at risk of inadequate nutrition (Hickson and Smith, 2018). Domains of nutritional assessment include dietary analysis and making comparisons of nutritional intakes with current standards. Dietary measures include 24-hour recall, food frequency and diet diaries, in addition to this, anthropometric measures should be recorded including weight, height, body mass index, skinfolds, waist circumference, bioelectrical impedance, grip strength and physical activity questionnaires. Biochemical measures include vitamin and iron status, lipid, and glucose status, whilst clinical measures are blood pressure, medication, physical appearance, and finally environmental measures of shopping habits, cooking facilities, level of education and housing status need to be taken into consideration. These are collectively known as the 5 domains of nutritional assessment and any or all of the measures may be used dependent on circumstances, needs of the individual and availability of assessment equipment (Hickson and Smith, 2018).Therefore, a selection of methods were chosen for the present study and are discussed further in the following sections, they are presented in the form of ABCDE of nutritional assessment where A-anthropometric measures, B- Biochemical measures, C- clinical measures, D- dietary measures, and E- environmental measures.

1.7 Anthropometric measurements.

Many patients who are in the normal BMI range have still been shown to have visceral fat deposition (Gómez-Ambrosi et al., 2011, Oliveros et al., 2014).Both waist circumference (WC) and body mass index (BMI) have been used as measures of central adiposity and obesity respectively. Increases in both categories have been seen to increase the risk of developing type II diabetes, hypertension, hypercholesterolemia, some cancers and other medical conditions in addition to CVD disease (Zaninotto et al., 2010). Regional fat deposition has been seen to be more important when assessing CHD risk than by body weight alone. Central adiposity is strongly linked to CVD risk (Pischon et al., 2008, Despres et al., 1990). Obesity, measured as a BMI of ≥30 kg/m^2, is categorized as an independent risk factor for CHD, meaning that even without the presence of other risk factors, there is an increased risk for CHD in direct relation to increased BMI (Hubert et al., 1983, Calle et al., 1999, Rashid et al., 2003, Litwin, 2008). Conversely, there are limitations with BMI and these should be noted (Nevill et al., 2006). Factors that may have an influence on BMI are age, gender, ethnicity, muscle mass and site of fat deposition. In older adults (over 65yrs) waist-hip-ratio (WHR) was seen to be a more accurate measure of CHD mortality (De Koning et al., 2007). In 2002 Woo et. al. conducted a study of older individuals (70 years or over) where WHR is not thought to be a good predictor of health outcomes, and found WC to be similar to that of BMI when compared to younger adults (Woo et al., 2002). Whereas Chan et.al., (2003) compared WC, BMI and WHR in middle aged men, to magnetic resonance imaging (MRI) as a measure of central adiposity and concluded that WC was more accurate than BMI or WHR when compared to the MRI, the authors of that study noted that participants were all white male, aged 44-49 years without diagnosed CHD so the potential accuracy for other populations would need to be further investigated (Chan et al., 2003). Taylor et. al., (2010) investigated if BMI should be replaced by other methods of measuring fat mass or regional adiposity, such as Skinfold thickness, WC, WHR. They used data from four cohorts of adult studies, and these were: 3,937 women from the British women's heart and health study (BWHHS); 2367 from phase 1 and 1950 men from phase 3 of the Caerphilly prospective study (CaPS), 403 men and women from the Boyd Orr study, and 798 men and women from the Maidstone-Dewsbury study. They concluded that at this time evidence does not support a recommendation to replace BMI measurements in a clinical setting in favour of waist or fat mass measurements. They noted that they did not compare findings to MRI or computed tomography as these methods are unlikely to be used in many clinical settings due to their expense, their recommendations are to use BMI along with other measures for greater accuracy (Taylor et al., 2010), thus supporting the use of WHR and WC measurements when assessing for CVD risk (De Koning et al., 2007).

Below are the measurement cut points used to categorize individuals; Table 1.3. The measurements for WC and the level of risk as these measures increase. Table 1.4 shows the WHR parameters and Table 1.5 the categories of obesity defined by a BMI score.

Table 1.3. Measurements for waist circumference in adults and risk factor scale.

Waist Circumference	*MALES*	*FEMALES*
Low risk	≤94cm	≤80cm
High Risk	94-102cm	80-88cm
Very High	≥102cm	≥88cm

Data from HSE 2010

Table 1.4. Waist hip ratio WHR *(calculated as waist/hip cm)*

Waist Hip Ratio	*MALES*	*FEMALES*
Low risk	≤0.95	≤0.80
High Risk	0.96-1.0	0.81-0.85
Very High	≥1.0	≥0.86

Tables 1.3 and 1.4 display the measurements used to risk stratify individuals. The waist circumference can be used independently (Table 1.3). or in conjunction with the hip measurement, waist measurement is divided by the hip measurement to provide the WH ratio.

***Table 1.5*. BMI classification based on Health Survey England 2010 and World Health Organization (WHO)**

	BMI (kg/m^2)
Underweight	Below 18.5
Normal weight	18.5-24.9
Pre-obesity	25.0-29.9
Obesity I	30.0-34.9
Obesity II	35.0-39.9
Obesity III	≥40

Table 1.5 BMI levels are calculated and used in conjunction with WC and WHR to establish risk status of patients *BMI calculated as weight in kilograms/height in meters squared*. (Organization, 2008)

Mortality risk was found to be increased by 7% in men and 9% in women for each 5cm increase in WC above the recommended measures and that higher WC increased mortality at all levels of BMI including normal weight (Cerhan et al., 2014). In 2013 Burke et al., conducted a randomized control trial (RCT) investigating a physical activity and nutrition programme for an older population using waist hip ratio (WHR) and BMI in the physical activity and nutrition for seniors (PANS) study. This was a home based 6-month trial which used mail and telephone calls to distribute information and support to 478 (n=248 intervention and n=230 control) participants. Physical activity and dietary behaviors in addition to measurements of weight, height waist and hip measurements were all self-reported and collected via questionnaires. The intervention group showed a significant reduction in WHR (p=0.03) compared to the control group with no change in BMI in either group. They also reported that males had a significantly higher WHR than females and that co-morbidities contributed to a higher BMI overall, although WHR improvements were small they equated it to a 2.11cm decrease in WC thus initiating an improved risk factor profile (Burke et al., 2013). Improved diet quality to a Med-style diet has been shown to produce favorable changes in visceral and pericardial fat deposition in middle aged and older adults with the associated reduction in risk factors and that males see greater improvements than females over a 12-week intervention period (Hennein et al., 2019).

There has been some speculation that a higher BMI in older populations is beneficial, so the topic is worthy of a brief discussion here. A study investigated type II diabetics (10,464) and non-diabetics (31,020) for BMI-mortality obesity paradox, the diabetic population were overweight 33.6% and obese 53.5% and non-diabetic 40.1% were overweight and 24.7% obese. Smoking history was also used to further categorize each population into never smokers or ever smokers, over an 8.7 year follow up 1175 deaths were reported in the diabetic group and 2613 deaths in the non-diabetic group. The authors of this study state that they found that never-smokers either with or without diabetes saw an increase in all-cause mortality with increased BMI therefore weight management is still prudent in diabetes treatment and smoking as well as obesity may be more of a determining factor in the obesity paradox (Badrick et al., 2017). Obesity escalates the risk of developing CVD and non-obese individuals who are diagnosed with CVD are more likely to have other risk factors associated with the disease which could be more related to mortality than obesity alone. In addition to this BMI has its limitations (Nevill et al., 2006) and it is possible that these limitations have had some bearing on previous findings and there is no need to change current guidelines on dietary and weight management advice (Chang et al., 2017). The fact that the paradox may not be a paradox after all is discussed in greater detail elsewhere (Banack and Stokes, 2017).

1.8 Biochemical measures

Dyslipidaemia increase with age and it is thought that a reduction in physical activity, diet high in saturated fat and development of metabolic conditions all contribute to increased cholesterol levels (Félix-Redondo et al., 2013). Almost 32% of patients attending CR have some form of elevated lipid levels and will be medicated as a first line of defense (Foundation, 2018). Often little attention is paid to lifestyle changes such as; regular physical activity and healthy diet, which are reported to positively impact on lipid profile providing improvements in total cholesterol, triglycerides, an increase in HDL-C and a lowering of LDL-C (Kelly, 2010). Elevated triglyceride levels have been found to pose a long-term mortality risk in patients with diagnosed CHD independent of HDL-C levels (Klempfner et al., 2016). Therefore, other lifestyle factors should be addressed to maximize the benefits of CR and secondary prevention. Dietary intervention for reduction in triglycerides and LDL-C have mainly focused on a reduction in saturated fat with a compensatory increase in carbohydrate to balance energy intake. However, few studies have focused on the balance of fats within the diet. For example, Binkoski et al., (2005) suggested that a reduction in saturated fat and increased intake of unsaturated fats, in particular n-3 PUFA such as eicosapentanoic acid (EPA) and docosahexaenoic acid (DHA), found in fish oils (Tapiero et al., 2002), was shown to decrease cholesterol (Binkoski et al., 2005). Whilst Houston et al., (2011) investigated claims that dietary cholesterol from eggs raised blood cholesterol levels in the Health ABC study. It was found that only individuals with T2DM showed an increase risk for CVD with increased intake of eggs, but noted that further research was needed into the underlying mechanisms involved in these outcomes (Houston et al., 2011).

Table 1.6. Recommended blood lipid levels for Total cholesterol HDL-C, LDL-C, and Triglycerides.

Lipid	***Level (mmol/L)***
Total Cholesterol	≤5.00 (≤4 if high risk)
LDL Cholesterol	≤3.00
HDL Cholesterol	≥1.00
Non-HDL	≤4.00
Triglycerides	<1.70 (fasting)
	<2.30 (non-fasting)

NHS/Heart UK desirable lipid values in adults (Medicine, 2013)

Table 1.7 Glucose levels recommended by Diabetes.UK from normal (not diabetic) to Diabetic (Dyson et al., 2011)

Glucose	***Level (mmol/L)***	
Normal	≤ 7.8mmol/L	
Pre-Diabetes	7.8-11.0mmol/L	2 hours post meal
Diabetes	> 11.1mmol/L	

Elevated blood glucose levels trigger pancreatic β-cells to release insulin aiding glucose uptake into muscle and liver cells where it can be used as fuel or stored as glycogen for later use (Martin and McGee, 2014). Chronic Elevated blood glucose levels activate metabolic pathways triggering changes in the mitochondrial enzymes (xanthine oxidases, lipoxygenases, cyclooxygenases, nitric oxide synthases, and peroxidase) increasing reactive oxygen species (ROS) (Volpe et al., 2018), further exacerbating metabolic dysfunction leading to the impaired cell functioning (Bhatti et al., 2017, Dasu and Jialal, 2010). A growing body of research is uncovering the links between mitochondrial dysfunction insulin resistance and development of metabolic disorders (Bhatti et al., 2017, Dasu and Jialal, 2010, Henriksen et al., 2011, Martin and McGee, 2014). These studies will continue to develop the understanding of metabolic disorders and assist in the fight against non-communicable diseases (NCD). Almost a quarter of CR patients are type II diabetics (Foundation, 2018). Dietary intervention has the potential to reduce the need for medication or even reverse T2DM. The Med diet has been investigated for its potential to reduce risk from T2DM complications, Esposito (2009) compared Med diet score with a detailed list of outcome measures including weight, BMI, WHR, energy intake, physical activity, fasting measures of glucose, HbA_{1C} (a measure of long-term glucose control) lipids, cholesterol and hypertension in addition to dietary intake. They found that those with a higher Med diet score had lower HbA_{1C} and post-prandial glucose levels regardless of BMI, BM, and other lifestyle factors (Esposito et al., 2015), whereas other research has consistently found that a higher BMI significantly increases the risk of developing T2DM (Tonstad et al., 2009).

1.9 Clinical Measures

Almost 50% of CR patients are hypertensive (Foundation, 2018) and dietary measures to reduce blood pressure have shown to be successful in studies using the DASH diet (Appel et al., 1997, Sacks et al., 2001). The rich phytochemical content provided by a high intake of fruit, vegetables and wholegrains is thought to be responsible for BP lowering and overall CV risk reduction (Most, 2004). Free living healthy but overweight (BMI 29 kg/m^2) individuals participated in a 30-day study trial where the DASH diet was modified using UK foods. Participants saw a reduction in sodium intake and although weight reduction was not one of the primary aims participants showed a significant weight loss of 1kg in addition to a significant reduction in systolic BP (SBP) by 4.6 mmHg and diastolic BP (DBP) by 3.9 mmHg, suggesting the diet should be adopted in primary and potentially secondary prevention of CHD (Harnden et al., 2010). A systematic review conducted by Siervo et al., (2015) reported effects of the DASH diet on CV risk factors, they reported that significant improvements were seen in SBP and DBP, total cholesterol and LDL-C levels, whereas glucose HDL-C and triglyceride concentrations remained unaffected. It was also shown that participants with elevated BP measurements at baseline saw the greatest reductions therefore making the DASH diet an effective tool in BP and CHD management (Siervo et al., 2015). The Med diet and the DASH diet are similar in that they advocate a whole diet approach rather than focusing on one particular nutrient or group of nutrients (Mozaffarian et al., 2016) thus potentially enabling individuals to adopt either dietary pattern with relative ease when compared to other diet patterns such as: low fat, low CHO, Paleo (Mozaffarian et al., 2016). A 2mmHg reduction in SBP decreased mortality from CHD by 4%, stroke by 6% and from all causes by 3% and a SBP reduction of 5mmHg resulted in a 9% reduction in CHD mortality, 14% from stroke and all cause by 7% (Stamler et al., 1989) therefore minor reductions in SBP could yield positive outcomes for general populations as well as CR patients.

Table 1.8 *Normative blood pressure levels from normal to hypertensive crisis.*

Blood pressure category	Systolic (mm\Hg)	Diastolic (mm/Hg)
Normal	< 120	<80
Elevated	120-129	<80
Stage 1 hypertension	130-139	80-89
Stage 2 hypertension	>140	>90
Hypertensive crisis	>180	>120

American Heart Association (AHA) (Bertoia et al., 2012)

1.10 Dietary measures

Monitoring and analyzing the diet quality of free-living individuals is usually performed using a diet diary that could be one day or several days, where the participant records all foods and drinks consumed over the required duration. The 24 hour recall requires an interviewer to tease out the food intake of the participant, usually from the previous day and can be conducted via telephone or in person (Casey et al., 1999, Brustad et al., 2003). The disadvantage to this method is that the participant needs to be able (and willing) to disclose everything consumed and to be able to estimate portion sizes and it is not suitable for large population samples and only provides a snapshot of the individuals dietary intake. Whilst advantages are that the interviewer can ask relevant questions to gather detailed information, the participant doesn't need to be literate and different ethnicities can utilize the method without altering food choices and different durations can be used for dietary information collection (Biro et al., 2002). Food frequency questionnaires (FFQ) are commonly used in nutrition education trials and can be very useful (Bingham et al., 1994, Day et al., 2001, McKeown et al., 2001), , The FFQ may not contain the level of detail of a multi-day diet diary however, they can produce useful information on the intakes of a specific food or nutrient over a longer period of time (McKeown et al., 2001). Members of the EPIC-Norfolk study were recruited to validate an FFQ and a 7-day diet diary (7DD), 179 participants completed both the FFQ and 7DD on entering the study and 18 months later. 24hour urine samples were also taken at these timepoints and on a further 4 occasions throughout the study period., Following analysis it was found that the 7DD was better at estimating average intake compared to the FFQ in measuring nitrogen, potassium and sodium but no other nutrients (Day et al., 2001). Similarly in another study the FFQ was found to lack the level of detail needed to make diet-disease associations and a diary was better able to identify these associations (Stephen, 2007). Both measures of recording dietary intake have limitations and advantages over the other, the FFQ are usually much simpler to complete and do not require respondents to weigh foods or provide portion sizes, they are also suited to larger populations and are less of a burden on the researcher when analyzing the results when compared to diet diaries which require a great deal of time and effort for the respondent with additional reliance on their motivation to complete them in adequate detail. Further, specialist nutritional databases are required to input individual foods which is laborious for the analyzer, however a much more detailed analysis of macronutrients and micronutrients is possible from the diet diary method. The Med diet score sheet (appendix 1) has consistently been shown to provide a reliable measure of adherence to a Med style diet, it is simple to use questionnaire that assesses the patients food choices in the Med diet eating pattern, the questions include; how many portions of fish are consumed each week, do you use mainly olive oil for cooking, do you consume nuts, how many portions of fruit and vegetables do you consume daily, a higher score indicates greater adherence to the med diet eating patterns (Sofi et al., 2014, Estruch et al., 2016). The questionnaire was developed for use in the PREvenscion con Deita Med (PREDIMED) trials initially conducted in the early 2000’s and was seen to be so successful that the study was ended early. The Med diet score sheet was adopted for use in primary prevention of CVD in high-risk individuals, with additional studies conducted based on the intake of extra virgin olive oil (EVOO) and/or nuts to reduce risks of CVD (Martinez-Gonzalez et al., 2004, Estruch et al., 2013, Estruch et al., 2018). The questionnaire has been modified for use in different countries including Italy (Gnagnarella et al., 2018) and Canada where they have recently developed a toolkit for nutrition professionals (Ghisi et al., 2019) and validated for use in the UK (Papadaki et al., 2018). The Med diet score sheet is a simple tool for patients to use and for the researcher is less laborious than traditional questionnaires. Patients (and other populations) are easily able to identify foods that should be included to increase adherence to the Med diet and improve risk factor profile including reduction in WC, BMI, blood lipid profile and insulin sensitivity (Estruch et al., 2016, Estruch et al., 2013, Salas-Salvadó et al., 2015). Whilst the PREDIMED study has been influential, it is noted that the positive results seen in primary prevention may or may not provide similar results in secondary prevention, again highlighting the need for more research into secondary prevention (Estruch et al., 2018).

The inverse association between intake of fruit and vegetables and disease prevalence is well documented, an increase in vegetable intake to 600g/day has been linked with improved cognitive function and quality of life for older adults, as well as those with chronic disease (Pomerleau et al., 2005a, Pomerleau et al., 2005b) . Reactive oxygen species (ROS) are important in cellular function and have several roles including acting in the immune response however, overproduction in the case of inflammation can lead to damaging effects and it is thought that ROS are involved in the aging process of cells in addition to development of Non communicable diseases (NCD) as in the case of CHD (Liu et al., 2018). The antioxidant properties of fruit and vegetables are thought to help to protect against damage by scavenging

ROS and reducing the oxidative stress caused by inflammation, researchers support the recommendations to increase intakes within the diet, however these benefits are from whole foods and studies using individual nutrients or supplements have been less consistent (Alissa and Ferns, 2017).

1.11 Environmental measures

The main issue with lifestyle interventions for most populations is adherence (Sabaté and Sabaté, 2003).In an older population this is even more apparent. In the initial stages following myocardial infarction (MI) or other heart surgery (e.g. Coronary artery bypass graft (CABG) percutaneous coronary intervention (PCI) or other procedure) patients may see a dietitian, and, faced with their own mortality will be eager to make changes. Whist patients are in hospital (CR phase I) or home recovery period (CR phase II) of recovery they are provided with written information regarding changes they should make. Once the fear of what happened to them has reduced they may resume normal work or activities and slowly slip back into old eating habits without further support in implementing these changes into their everyday lives (Doyle et al., 2012). Recommendations to incorporate nutrition education into CRP and to address the barriers to making changes have been made, however, the lack of funding available to implement nutrition education makes this challenging (Ma et al., 2010a). In a qualitative study CRP patients were interviewed to gain their perspective on diet and lifestyle changes and found that the only dietary changes that were maintained were those that they perceived to be directly responsible for their condition, one patient reported that his diet was “ok, as we don’t eat a lot of fat” inferring that the diet was now improved (White et al., 2011).

Many older adults take prescribed medication which may interfere with appetite and food choices (Fitzgerald and Bean, 2010). Diminished taste sensation with age and reduced dental health may alter food choices, thus limiting the intake and availability of vital vitamins and minerals (Roininen et al., 2004, Walls and Steele, 2004). According to National audit of cardiac rehabilitation programs (NACR) in the UK, around 70% of patients are male, aged 66years and retired (Rehabilitation, 2015).It was reported that males tend to consume less fruit and vegetables than females and are less likely to attend weight loss programmes, whereas females are more likely to be on a "diet" of some sort (Baker and Wardle, 2003). Consuming a variety of fruit and vegetables (≥600g/day) has provided consistent evidence of reduced CVD events (Pomerleau et al., 2005b, Dauchet et al., 2006). Additionally, earlier findings from Panagiotakos et al., (2001) suggested that ≥5 (vs <1) serving of fruit per day and ≥5 (vs no consumption) of vegetables at least 3 times per week produced a 72% and 70% reduction in risk from CHD respectively (Panagiotakos et al., 2003). Perhaps this was initiated by a decrease in C-reactive protein activity and consequent lessening of the inflammatory process, adding weight to the recommendation to increase FV intake (Bhupathiraju and Tucker, 2011b). Antioxidants such as vitamin A, vitamin C, vitamin E, β-carotene, Lycopene, Lutein and selenium, play an important role in reducing oxidative stress and free radical formation where compounds from the antioxidants can permeate cell walls to help reduce inflammation and development of atherosclerosis. CHD develops slowly over many years and it is thought that initiation of antioxidant therapy (through dietary intakes) from a young age would be beneficial in primary prevention of CHD (Gatenby et al., 2015). Older populations may face barriers to making dietary changes, and poor nutritional practice before diagnosis of CHD may be continued following diagnosis without correct education and support (Ma et al., 2010a). Nutrition education that is tailored to the specific needs of an older population could reduce some of the barriers to making dietary changes and improve outcomes for patients attending CRP. With most CR patients being male, there are specific barriers to making dietary changes and unless there is adequate social support it is increasingly difficult for men to implement changes (Gough and Conner, 2006). There is a masculine view that healthful foods may not satisfy their appetite, may be boring or they may not trust the individuals who are making the recommendations, for example government guidelines. Therefore, these issues demand consideration when designing education programmes (Gough and Conner, 2006). This is particularly important in men that live alone, in a study with 39 older males and diet quality, Hughes et al., (2004) conducted interviews and questionnaire responses to explore the food quality and quantity of these free-living men. She found that those with good cooking skills consumed more fruit and vegetables and were in better health than those with lower cooking skills. Many men found that motivation to prepare foods was low and micronutrient intakes including vitamins A and D and trace mineral were low, as was total energy intake (Hughes et al., 2004). Similarly, in the EPIC UK cohort supports these findings with males consuming lower fruit and vegetables than women and less variety. This was more prominent in males that lived alone or were widowed, for example; widowed men had a -2.17-unit difference ($p < 0.001$) in the variety of vegetables, this was significantly different from widowed females with a -0.79-unit difference ($p < 0.001$) (Conklin et al., 2014).The effects of pollutants on health risk have not been discussed presently and is beyond the scope of the current research. However, with NCD accounting for over 70% of global deaths it seems that this should be higher on the risk factor agenda than it currently is, Fuller and colleagues (2018) discussed the lack of emphasis that is being placed on environmental pollution and the fact that it is not currently on the agenda as a risk factor for NCD (Fuller et al., 2018). This area of research is significant if we are to offer a holistic approach to primary and secondary prevention of NCD diseases, from a global perspective it is the developing countries that are seeing the greatest increases in avoidable deaths from pollution (Rajagopalan et al., 2018; Brewer et al., 2019). These findings suggest there is a need to identify those at greater risk from poor nutrition and offer support for those who live alone to address the environmental issues that they are faced with.

1.12 Nutrient requirements for older adults.

Although resting metabolic rate (RMR) deceases with age, meaning there is a reduced calorie requirement, the demand for many other nutrients is not altered therefore a diet rich in nutrients rather than energy is recommended (Shlisky et al., 2017). Protein requirements for general populations is 0.75g/kg/body weight (bw) but in recent years it has been suggested that this should be increased to between 1.2g-1.5g/kg/bw/d for older adults to compensate for the reduced ability for muscle protein synthesis and to reduce risks of sarcopenia (Clegg and Williams, 2018). This should be met through dietary intake although many older adults have less than optimal total energy intake, so it is less likely for them to meet their protein requirements even at the lower required level (Tieland et al., 2012). Additionally, B-vitamins which play an important role in regulating homocysteine production, aerobic respiration and cellular energy production can be diminished due to the age-related reduced absorption rates (Castro-Quezada et al., 2014). This could potentially lead to increases in homocysteine levels which have previously been linked to lower cognitive function and increased cardiovascular disease (Collaboration, 2002)., A deficiency in any of the B-vitamins will negatively impact on overall health of the individual (Jones et al., 2018). It is thought that long term use of acid-blocking medications such as metformin contribute to low levels and even deficiency in vitamin B12 in type II diabetic patients (Phillips, 2003). Additionally, anti-acid medication such as Zantac could also intensify the age-related reduced absorption rates (Stover, 2010). Dietary sources of B_{12} include fish, meat eggs and dairy and many older adults may reduce their intake of these foods believing they are less healthy or previously mentioned, changes in dental health, taste preferences and motivation to prepare foods may all contribute to lower consumption of B_{12} in the diet (Appleton, 2016).

Antioxidant vitamins A, C and E, and minerals including selenium, play an important role in reducing oxidative stress and help to moderate atherosclerotic formation (Gatenby et al., 2015, binti Othman et al., 2017). consequently, nutrition education should ensure adequate attention is paid to the inclusion of antioxidant rich foods adding weight for the endorsement of a Med Style diet. Vitamin D deficiency is said to affect 1 in 5 adults in the UK, with up to 46% of white British adults thought to be deficient (<40nmol/l) (Davies and Shaw, 2010). This has a large impact on the health of individuals of all ages but in particular has been linked to increased incidence of hypertension and elevated serum cholesterol levels and other metabolic disorders (Judd and Tangpricha, 2008). Furthermore, individuals who have low glucose tolerance (as in diabetes) tend to have lower vitamin D status compared with those with no diabetes (Ahmed et al., 2011), lower vitamin D concentration results in reduced calcium stores in the bones increasing risk of osteoporosis and falls in the elderly (Shlisky et al., 2017). Other nutrients thought to be important in healthy aging and slowing the progression of CHD are presented in Table 1.9.

Increased intakes of PUFA, more importantly omega PUFA have been advised in secondary prevention as potential benefits are widely accepted (Prisacaru, 2016). Conversely Abdelhamid et al., (2017) conducted a systematic review of over 49 RCT's including over 24,000 participants in long term studies (up to eight years). with supplementation or increased dietary intakes of PUFA on several different CHD risk factors including; reduced triglycerides, and adiposity, and the effects on long term mortality from stroke or heart disease. Intakes of n-3 were shown to have slight benefits on risk factors where increased (above RNI) n-6 was shown to have adverse effects on health, therefore, concluding that caution be used when modifying intakes and ensure adequate n-3 PUFA intakes meet the RNI (Abdelhamid et al., 2018). The effect of supplementation appears to be strongest in secondary prevention and in the recent REDUCE-IT (Reduction of Cardiovascular Events with Icosapent Ethyl–Intervention Trial) patients who had elevated triglyceride levels; ≥150 mg/dL and <500 mg/dL and LDL-C >40 mg/dL and ≤100 mg/dL; and currently prescribed with statins (were randomised to either the Icosapent ethyl (a purified ester of EPA supplement) or to a placebo group. This is a large study with over 8,000 patients from 470 centres around the globe taking part. The major difference between the REDUCE-IT study and similar studies is the dose of EPA, several studies are described by Ito (2015) where dosage varied in marine n-3 content between 376mg/d in the Alpha Omega study (Kromhout and Giltay., 2010) to 4000mg/d in the REDUCE_IT study (Bhatt et al., 2019).

Table 1.9 British Heart Foundation (2019) dietary recommendations of importance for the health of older populations.

AGE (YRS)	MALE (KCAL)	FEMALE (KCAL)	
55-64	2581	2079	
65-74	2342	1912	
75+	2294	1840	
Reference nutrient intake (BNF 2019)	**Important nutrients for older populations**		Lower reference nutrient intake (LRNI) where applicable
Carbohydrate	Total 50%	Of which sugars – no more than 5%	
Fat	Total 35%	Of which saturates -no more than 11%	
Protein	Total 15%	0.8g/kg/bw	
Fibre	30g/day		
Sodium	1600mg/day	As salt no more than 6g/day	575mg/d
Vitamin D	10µg/day		
Vitamin E	15mg/d		
Vitamin A	700 µg/day M 600 µg/day F		300 µg/day M 250 µg/day F
Vitamin C	40mg/day		10mg/d
B Vitamins	M	F	
Thiamin B1	0.9mg/d	0.8mg/d	0.23mg/d
Riboflavin B2	1.3mg/d	1.1mg/d	0.8mg/d
Niacin B3	16mg/d	12mg/d	4.4mg/d
Biotin B7	40µg/d	40µg/d	*10-20µg/d
Vitamin B6	1.4mg/d	1.2mg/d	
Vitamin B12	1.5µg/d	1.5µg/d	1.0 µg/d
Folate (folic acid)	200µg/d	200µg/d	100 µg/d
Calcium	700mg/day		400mg/d
Potassium	3500mg/d		2000mg/d
Iron	8.7mg/d		4.7mg/d
Zinc	9.5mg/d M 7mg/d F		5.5mg/d 4.0mg/d
Selenium	75µg/d M 60µg/d F		40 µg/d 40 µg/d

*safe intakes are provided here as there is no lower reference nutrient intake (LRNI) recommendations.

Total kilocalories, macronutrients, and micronutrients per day. Some recommendations differ for males and females and are shown by gender.

1.13 Summary and rationale for further research.

CVD is the second main cause of death in the UK which encompasses all the diseases of the vascular system. CHD one component of CVD can be caused by modifiable risk factors including; obesity, increased WC, inactivity smoking and a diet rich in saturated fats, sugar and salt, and non-modifiable risk factors including; age, gender, ethnicity, and genetic inheritance. Overweight and obesity are the leading cause of many metabolic disorders including hypertension, hypercholesterolemia, type II diabetes and CV disorders., Visceral adiposity is seen as an independent risk factor for increase in metabolic disorders and for each 5cm increase in WC the increased risk from CHD is 7% in men and 9% in women, weight loss alone decreases risk and reduces WC (Stamler et al., 1989).

CR programmes have consistently shown to elicit improvements in health-related quality of life, CV strength and endurance, muscular strength, muscular endurance, improve posture, balance, and co-ordination, however changes in BMI see little or no change. It was identified that exercise alone did not illicit the favourable reductions in anthropometric measurements of BMI, WC and BM required to reduce risk of further progression of obesity, hypertension, type II diabetes, and hypercholesterolemia in addition to CHD (Savica et al., 2010).

The Med diet or similar eating patterns help improve heart health and make the necessary changes in body composition often required by CR patients, even in those with normal BMI the Med diet has shown to reduce risks of further progression of the disease (Bhupathiraju and Tucker, 2011a).

1.14 Gaps in nutrition education

This review has identified gaps in the provision of nutrition education for cardiac rehabilitation patients, with limited access to appropriately trained staff to provide the necessary education programmes being one major problem. Dietary modifications in addition to increased activity are required to facilitate change in high risk individuals, much of the research presently focuses on primary prevention (pre-diagnosis) in high-risk populations. However, limited evidence is available in secondary prevention, it is apparent that further investigation is warranted within a cardiac rehabilitation setting.

The overreaching aim of this research was to provide a nutrition education programme for patients attending a cardiac rehabilitation scheme in Preston, North West England. The intention was to provide an education programme that, in time, can be delivered by the exercise professionals (EP). These EP's are at the forefront of providing a professional graded exercise programme for patients enrolled onto the programme and have daily/weekly contact with patients thus potentially overcoming barriers they may have in engaging in such a programme.. The targeted cardiac rehabilitation programme is a registered charity and inherently has limited funds available to provide such a service. Therefore, it was important to utilise dietary guidelines form contemporary research and current guidelines on diet for cardiac health (Mozaffarian et al., 2016, Buttriss, 2016a, Lacroix et al., 2017). Additionally, addressing specific nutrient requirements for an older population (Bhupathiraju and Tucker, 2011a, Vannice and Rasmussen, 2014, Clegg and Williams, 2018). This will allow exercise professionals to deliver the programme in the future whilst ensuring professional boundaries remain intact. This is a unique aspect of the study as ordinarily nutritionists and dietitians would be employed to deliver nutrition programmes.

1.15 Introduction to Heartbeat North West (HBNW)

HBNW are a charitable organisation who have been providing clinical testing, exercise rehabilitation, health education, advice, and support to adults with heart disease for over 40 years. They provide services to over 950 people weekly at their main centre in Preston and seven satellite sites across Lancashire North West England. The programme has grown considerably during the process of this research project, at the time of studies 1 and 2, there were just over 700 patients accessing services from HBNW. They have since moved to larger premises to accommodate more people in Lancashire and provide services to over 900 individuals. The British Association for Cardiovascular and Pulmonary Rehabilitation (BACPR) provide the foundation on which exercise programmes are designed and delivered to both phase III (clinical phase of rehabilitation) and phase IV (maintenance phase of rehabilitation) patients (Cowie et al., 2019). All instructors hold the REP's level 4 BACPR certificate in exercise prescription.

Heartbeat exercise professionals (EP) deliver graded exercise programmes but also offer advice on lifestyle changes. Interventions have historically been delivered "in-house" by the EP and were not designed to be used for research purposes. The "biggest loser" intervention was a weight loss programme delivered by one of the EP's and as such limited data was available. Importantly, the evaluation of this data will provide the basis for comparison with a new education programme and with usual care (exercise only).

1.16 Aims of the research

The overarching aim of this research was to gain an understanding of barriers to engaging with nutrition education. And to use this information to design, deliver and evaluate a new nutrition education programme (NEP) that addresses perceived barriers, facilitates engagement, and improves outcomes in CR patients.

1.17 Hypothesis

The new nutrition education programme will be more successful in meeting anthropometric, clinical, and biological changes required to reduce overall risk in CR patients when compared to usual care (UC) and biggest loser (BL).

1.18 Research strand 1 aims and objectives

The Aim of this research strand was to evaluate the current nutrition intervention "the biggest loser" delivered by heartbeat EP when measured against set parameters of waist circumference and body mass reduction.

Objectives

1. Analyse archived anthropometric data from six cohorts of the biggest loser

Statistically compare WC,BM and BMI measurements pre and post the 6-week intervention.

1.18.1 Research strand 2 aims and objectives

The aim of this research strand was to investigate the eating habits, nutritional knowledge, and physical activity levels of HBNW patients.

Objectives

1. Identify current eating habits when compared to nutritional guidelines (BHF) British heart foundation questionnaire,
2. Determine patient knowledge and understanding of current healthy eating messages and the impact of poor nutrition on health status using (NKQ) Nutritional knowledge questionnaire.
3. Assess current patients' activity levels using the (IPAQ) international physical activity questionnaire.

1.18.2 Research strand 3 aims and objectives

The aim of this research strand was to investigate patient perspectives on nutrition education provided within CR and identify barriers to engagement with nutrition education programmes.

Objectives

1. Conduct focus groups (FG)

1.18.3 Research strand 4 aims and objectives

The aim of research strand 4 was to develop, deliver and evaluate a nutrition education programme based on the needs of the HBNW patients, informed by research strands 2 and 3.

Objectives

1. Design the new education programme informed by research strands 2 and 3
2. Investigate efficacy of the NEP on outcome measures: WC, BM, BMI, BP, cholesterol, glucose, triglycerides and Mediterranean diet score.

1.19 Thesis Structure

The sequential structure of the thesis is presented in figure 1.3 and shows each of the individual studies. Results from research strands 1 and 2 helped to inform the focus group questions used in study strand 3. Ultimately all 3 research strands inform the new education programme. The quantitative and qualitative elements of the current research are integrated, whilst conducted sequentially, each one provides its own unique snapshot of “what is” to feed into the final new education programme and final research study “what should be”. (Creswell and Clark, 2017, Creswell et al., 2003).

Chapter 1 provided the background and literature review of nutrition interventions in primary prevention of CHD. It also identified gaps in provision nutrition education and/or reporting of such interventions in secondary prevention and specifically cardiac rehabilitation.

Chapter 2 describes the research design and methodological approach used for this research. Each research strand has its own qualitative or quantitative method of data collection and the tools and equipment used in each is described in detail.

Chapters 3, 4 and 5 describe research strands 1, 2 and 3 providing a profile of the target population in addition to analysis and results from each study. At the end of each chapter there is a summary of the main points that feed into the subsequent study.

Chapter 6 describes the new nutrition education programme, how the previous studies have helped to inform the content and structure of this new intervention. The RCT allocation and outcomes of the study are presented along with a detailed discussion of the findings, how patients' diet compared to general populations and to CR populations where applicable. The results are examined, and their significance reported in both scientific terms (p=≤ 0.05) and in clinical importance (MCID).

Chapter 7 results and discussions from all research strands are presented in this final chapter and consideration given to findings and future direction.

Chapter 2. Methodology

2. Introduction and methodological approach

The interactions of diet and disease have been studied for centuries in one form or another and in the early 1900's the discovery of single vitamins provided a significant turning point in treating disease resulting from deficiencies. An example of which would be treating scurvy with vitamin C supplementation and vitamin D supplementation to treat rickets (Mozaffarian and colleagues 2018). Later, the emphasis would turn from single nutrients to dietary patterns such as those by Yusuf et al., 2000; Hodis et al., 2002 and Aune et al., 2018 who supported the whole diet approach as opposed to single nutrients.

In diet and nutritional studies formerly discussed in chapter one (De Lorgeril et al., 1994, 1999; Bos et al., 2010; Delgado-Lista et al., 2020) have been predominantly quantitative in design with strong positivist view dealing with facts and figures evident from the axiom of quantitative research (Morse et al., 2009). Other researchers employ a constructivist perspective, interested in learning from experiences and that reality is determined by these experiences (Elliott et al., 2000). Qualitative methods as employed by Macario et al., (1998) used interviews and focus groups with patients and care providers to investigate health outcomes in people with low literacy skills, whereas Pettigrew et al., (2012) used an inductive, qualitative approach to gain an understanding of older adults diet and nutrition beliefs, focus groups were employed to gleam personal insight into their lived experiences. Historically the two domains have created controversy with purists wanting to keep the differing approaches separate and the qualitative research seen as "soft science" with its legitimacy being questioned (Greene et al., 1989). In fact, Guba and Lincoln (1994) describe how quantitative data was seen as the "queen of sciences" inferring that anything less quantifiable was inferior in some way. Since the late 1990's researchers in health and social sciences have understood the complex nature of their domain and a mixed methods research (MMR) design that utilises both approaches within the same study have emerged (Tashakkori and Teddlie 1989; 2003). Whilst this appears to be a simple "mixing" or joining of the two domains it is far more complex, Tashakkori and Teddlie (2003) describe the existence of around forty different research designs. Whereas Creswell (2003) details six of the most frequently utilised methods, Johnson and Onwuegbuzie (2004) provide a detailed analysis of the differences between the two.

Three perspectives have been described; purists, situationists and pragmatists, suggesting that purists lie at one end of a continuum and pragmatists at the other leaving situationists between the two (Rossman and Wilson (1985) cited in Onwuegbuzie and Leech (2005)). The nature of research in this thesis adopts a more pragmatic view aligning with that of Creswell (1995, 2003) stating that both methods have limitations and strengths and in a MM study each can complement the other to help lessen the limitations and add to the strengths (Creswell 2017). It is commonly accepted that striving for an "epistemological purity" does not always acknowledge that research methods are a way of researchers making sense of the world (Onwuegbuzie and Leech 2005).

In the complex domain of nutrition and exercise (physical activity) research it is accepted practice to apply pragmatic approaches without consideration of ontological or epistemological methodological considerations. Schoonenboom and Johnson (2017) paper titled "how to construct a MMR design" explicitly describes the methodology on which to base a valid and reliable study citing the works of Greene (1989, 2007). The decision on how to weight the study, for example the main focus and drive in the qualitative or quantitative elements of the research, is left very much in the hands of the researcher informed by the philosophy used (e.g. Pragmatic or pluralism) (Schoonenboom and Johnson 2017). Similarly, a study using FG discussion to investigate physical activity levels in college or university students, describe their procedure.

This chapter outlines the use of mixed methods (MM) to investigate the role of nutrition education in a cardiac rehabilitation setting. Utilising different methodological approaches to data collection helps to gain an understanding of the research problem adding to the existing body of knowledge enriching current understanding and improving practice (Creswell 2008). Creswell describes mixed methods as "a procedure for collecting, analysing, and "mixing" or integrating both qualitative and quantitative data within a single study". The way in which the data is collected and analysed depends very much on the research problem being investigated however, the general concept is to utilise both qualitative and quantitative research methods to explore different aspects of the research problem. In this study there are initial quantitative studies conducted to evaluate and investigate and the qualitative arm seeks to understand the real-life experiences of patients within HBNW.

Study Methods

The chapter provides a comprehensive narrative of the methodological approach used to address the aims of the research. A mixed methods, sequential explanatory design was used as it provided a way of utilising the strengths of both quantitative and qualitative analysis to counterbalance potential weakness in either method of data collection alone (Creswell, 2017;Morse, 1991;Creswell, 2003; Ivankova, 2006). As described by Creswell (2003) qualitative studies were employed in the first two studies with analysis of archival data to investigate the efficacy of a previous nutrition intervention, followed up with questionnaires used to provide a large amount of data in a short space of time, they also provided an impartial means of gathering information on people's beliefs, knowledge and behaviours (Boynton and Greenhalgh, 2004). These first two studies were performed to gather data to generate meaningful questions and discussion topics for the qualitative element of the research that followed (Ivankova, 2006). Qualitative focus group research was conducted in study 3 as they can provide a relaxed setting where patients can express their personal experiences and views on healthy eating and food choices that would not be uncovered using other research methods alone. Dialogue from focus groups often evolves through the shared experiences of others, enabling each individual to listen and comment or question at various points in the conversation (Parker and Tritter, 2006). One of the main purposes of a focus group is to investigate a topic that little is known about (Stewart and Shamdasani, 2014) therefore a vital element of the whole research project. These first three studies formed a health needs assessment required to design the new education programme. One key aspect of a health needs assessment is to involve the target population in the planning of new services and influence changes to current provision but also to identify any gaps or areas for improvement (Cavanagh, ND; Haughey, 2008; Gupta, 2011)

The sequential structure of this research is presented in figure 2.1 and clearly shows how each of the individual studies were conducted to inform the new education programme. The quantitative and qualitative elements of the current research are integrated, each one provides its own unique snapshot of "what is" to feed into the final new education programme and final research study "what should be". (Creswell and Clark, 2017, Creswell et al., 2003).

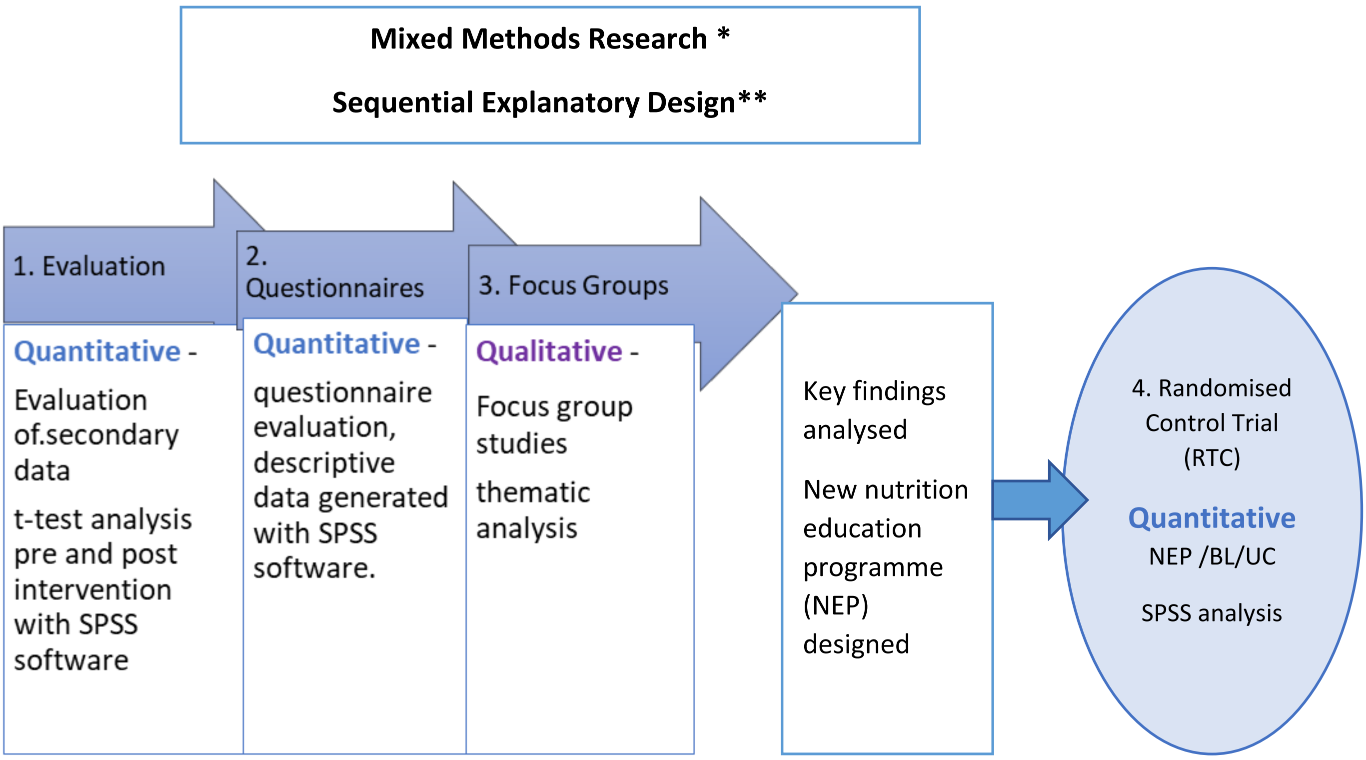


Figure 2.1 Theoretical framework. The quantitative and qualitative stages of the research conducted sequentially. Randomised control trial (RCT), new education programme (NEP), biggest loser (BL), usual care (UC).

* (Creswell, 2017; Creswell, 2003)

** (Creswell, 2003; Ivankova, 2006)

2.1 Sample population

Demographic data shows that patients attending HBNW are generally older than patients attending CR programmes within the UK, more of them are married and retired at the time of data collection. Most HBNW patients (81.3%) were Male, White-British (96.7%) with a mean age of 65 years compared to the UK wide mean of 66 years reported in the NACR statistical report in 2015 (Doherty et al., 2015). Therefore, results of this research may not be generalizable to the wider CRP population, table 2.1 provides a comparison of typical UK and HBNW CRP populations.

Table 2.1 A comparison of HBNW and UK CRP population.

Category	Heartbeat average (%)	UK national average (%)
Male	81.3	70
Age	65yrs	66yrs
Married	78.9	70
Retired	70.3	56
White British	96.7	81

NACR statistical report 2015 (Doherty et al., 2015)

HBNW patients are similar in age to the average CR patient across the UK, they are 11.3 years older and more of them are married. There is also a larger proportion of retired individuals. Interestingly current ethnicity within HBNW is predominantly white British.

2.2 Inclusion criteria

All HBNW patients attending the main centre or one of the satellite centres across Lancashire were eligible to participate in any or all the studies. Patients were recruited from phase IV of their rehabilitation and attended at least two structured exercise classes per week delivered as part of Heartbeat NW rehabilitation service. Different individuals were therefore recruited on each occasion.

2.3 Recruitment procedures

Recruitment drives for research studies 2, 3 and 4 followed the same procedure:

Posters were placed on the reception desk and three exercise areas of the main centre (Preston North End (PNE) and distributed to all outreach centres. In addition to this, the researcher attended usual exercise classes in the main centre and the outreach centres across Lancashire to introduce the purpose of each study as they were conducted. A risk assessment to attend these venues was completed as part of ethical approval (STEMH 303, 634) (Appendix 3) Participant information sheets were distributed (Appendix 4) and any questions answered. The researcher returned the following week, and any members wishing to participate were provided with further details of the study. HBNW patients were eligible to participate in any, or all, of the research studies, (participation in one study did not commit the individual to participating in any of the future studies) providing they met the specified inclusion/exclusion criteria.

2.4 Ethical approval.

Ethical approval was provided by BuSH ethics committee (STEMH 303,634 appendix 3) from The University of Central Lancashire. Permission was granted by Heartbeat North West Cardiac Rehabilitation CEO for data analysis (study 1) and to attend sessions (studies 2,3 and 4) and distribute questionnaires (study 2). Permission to use The British Heart Foundation (BHF) and the nutritional knowledge (NKQ) was given by the authors and was not required for The International Physical Activity Questionnaire (IPAQ). Copies of the questionnaire and authorisation emails can be found in Appendices 5,6 and 7. Once recruited, participants provided written informed consent (Appendix 8), if an individual participated in more than one study separate informed consent was required. All data collected was stored in accordance with GDPR standards (Bhaimia, 2018).

2.5 Methods for Chapter 3. Study 1 Biggest loser evaluation

The use of archival data has been shown to be very useful especially when trying to understand previous practices. Advantages and disadvantages were discussed by Shultz et al., (2005) with some advantages being the ease of transferring data from one source to another, time saving and needing limited resources. Possible disadvantages being incomplete data sets, detecting errors in the data itself or methods of collection, and the overall quality of the data (Shultz et al., 2005). These findings were later corroborated by Jones (2010) who noted that many archived data sets are often incomplete and were not necessarily intended for research purposes (Jones 2010) as is the case in the present study. HBNW exercise professionals delivered The Biggest loser challenge to encourage long standing members of the cardiac rehabilitation programme to make the association between increased WC and increased risk of secondary CHD highlighting current guidelines on healthy WC and BMI. Each intervention was delivered to coincide with either Christmas or summer holidays as an incentive to joining, additionally those that entered paid a fee which was then offered as financial reward for the biggest percentage weight loss over the intervention period The six-week nutrition intervention was delivered for one hour per week at HBNW's main centre in Preston by the same exercise professional (EP) on each occasion.

2.5.1 Intervention and data collection

The six-week "Biggest loser" nutrition intervention was delivered for one hour per week at HBNW's main centre in Preston by the same EP on each occasion. An identical protocol was followed with each cohort, the EP covered one topic each week and initiated discussion on each healthy eating topic. Education materials supplied by British Heart Foundation "so you want to lose weight for good?" were used to support the dietary advice offered to the patients (Appendix 9), (BHF, 2012).

The EP recorded gender, height, weight, and waist circumference (WC),

a diet diary was provided for patients who wished to complete one, their meal patterns were then discussed at the next meeting. These diet diaries were not retained by the EP.

The topics followed the Eatwell plate guidelines as follows:

1. Increased intake of fruit and vegetables
2. Increased intake of fish
3. Reducing intake of saturated fat
4. Reduction of salt
5. Alcohol, safe limits
6. Meal planning and goal setting

The total number of patients completing the six-week intervention was 42 (12-F, 30-M) aged between 45 yrs and 84 yrs, mean 65 ± 10.45 yrs, a mean height of 1.68m ± 0.07. The EP recorded participants height, weight, age, and gender on the first session followed by weekly a weigh-in at the start of each nutrition talk.

2.5.2 Data analysis

Data were input into SPSS software package for statistical analysis using IBM, Version 22 (Field, 2013). Tests for normality were performed, normal distribution allowed Paired samples t-tests to be conducted on each of the physiological outcome measurements: WC, BMI, and body mass (BM). Significance was accepted at the $p<0.05$ level. Finally, correlation tests were performed with baseline and change measures for all three test parameters.

Effect sizes were calculated using partial eta^2 (pη^2)**.** Finally, minimal clinically important differences (MCID's) were calculated as being 1 * standard error (Den Oudsten et al., 2013) .

MCID are the smallest changes in the parameters being measured, in this case BM, BMI and WC that will bring a clinically meaningful improvement in risk factor profile of individuals, it is something tangible that can be conveyed to patients to demonstrate the positive changes they are making and can be useful for behaviour change goal setting. Other examples of how MCID can be used are: minimal concentrations of antibiotics needed to kill an organism (Nahler, 2009), changes in quality of life (QOL) (Jaeschke et al., 1989) and the WHO QOL instrument (Den Oudsten et al., 2013).

2.6 Methods for Chapter 4. Study 2 Questionnaires

Questionnaires are well-established research tools frequently used in mixed methods research; they are particularly useful when collecting relatively large amounts of data in a short space of time. They can be very simple to administer and a variety of methods can be employed to reach the chosen population, these include; web based, or postal questionnaires, or as in this case, self-administered to specific group or population(Bartram, 2019). The benefits of self-administered questionnaires are that they can be delivered to a group or population and details of the study can be explained, potential participants can then take home the questionnaire and study it in their own time. it is also reported that there is likely to be a greater response rate using this method (Mathers et al., 2007, Aksu, 2009). The advantages of using pre-existing questionnaires are that many are previously validated and tested, they may also potentially have normative data for comparison of results with previous research. Mathers et al.,(2007) acknowledged that a disadvantage to self-administered questionnaires is the potential to have a biased responses from a “captive audience” as they may provide the answers they think the researcher is looking for (Mathers et al., 2007).

A total of 3 questionnaires were chosen, to address the research questions outlined (figure 2.1), the first BHF "how healthy is your diet" (appendix 10) was used to investigate patients current eating habits and how/if their diet conformed to government guidelines in place at the time of delivery, the Eatwell Plate (Choices, 2011). The second was the Nutritional Knowledge Questionnaire (NKQ) which was chosen for its ability to investigate patient's knowledge and understanding of nutritional guidelines and choosing healthy food options (appendix 10). It also extracts useful descriptive data such as ethnicity, age range, and education levels so that a profile of current HBNW patients can be compiled (Parmenter and Wardle, 1999). The third questionnaire was the international physical activity questionnaire (IPAQ) (appendix 10), chosen for its reported ability to establish individuals' activity levels outside of the prescribed exercise classes provided by HBNW (Craig et al., 2003).

2.6.1 Questionnaire 1. How healthy is your diet?

British Heart Foundation (BHF) "How healthy is your diet?" questionnaire is designed to establish current eating patterns within a population and can be used to highlight any dietary changes that may be needed to meet current healthy eating guidelines set by public health England (FSA, 2007). The questionnaire is compiled of seven sections which aim to establish if the participants meet the current dietary recommendations including: consuming 5-a-day fruit and vegetables, basing meals on starchy foods, and eating 2 portions of fish each week. The questions require a Yes/No response and the responses are scored with "correct" or "incorrect" mark for each selection, according to scoring protocol (BHF 2012). Although commonly recommended for use in the workplace to assess the diet of workers, rather than for research purposes, therefore is not validated, however is still a very useful tool in establishing an overview of patient's current eating habits. Patients attending HBNW have a familiarity with materials from BHF as they are frequently used to support healthy lifestyle initiatives.

therefore, this questionnaire was chosen as it is simple to read and less onerous than the other questionnaires used in this study. Additionally, the questionnaire enables companies or organisations to assess the healthfulness of employees/members current diet based on the Eatwell plate*. As such it was considered a valuable resource to evaluate what Heartbeat patients currently eat in relation to current guidelines. BHF authors also suggest that it is useful for use within any group or population, therefore it was included in this study to gain an understanding of HBNW patients eating patterns. Permission to use the questionnaire was provided (Appendix 5).

The questionnaire asks questions based on the Eatwell plate* guidelines. Sections are:

1. Eating habits
2. Fruit and vegetables
3. Fat
4. Starchy foods
5. Sugar
6. Salt
7. Drinks and alcohol

*the Eatwell plate was current at the time of research study 2.

Example questions from the BHF questionnaire are: **a)** “how often do you add salt to foods? i) during cooking ii) at the table?” and **b)** “do you eat more than 5 fruit and vegetables every day”.

One limitation of this questionnaire is that it was not intended for use in research per say. It was a tool for measuring the diet quality of work force introduced by BHF in their compaign to increase awareness of poor diet and potential loss of productivity in the workplace, and as such has not been validated. Its inclusion was two-fold, firstly, it asked objective questions on food intake for example do you add salt to food whilst cooking/do you add salt at te table, do you regularly eat 5 portions of fruit and vegetables per day. The second reason for inclusion was that patients are familiar with BHF materials as they are often used within this particular CR scheme to promote various healthy lifestyle initiatives from the BHF.

2.6.2 Questionnaire 2. The Nutritional Knowledge Questionnaire (NKQ)

Originally developed by Parmenter and Wardle in the 1990's, with the aim of providing a reliable and valid measure of nutritional knowledge in UK populations. The questionnaire was designed to identify areas of potential weakness in peoples understanding of nutritional guidelines and if nutrition knowledge and dietary habits are related (Parmenter and Wardle, 1999).

The NKQ comprises of four main sections;

i) Expert recommendations for healthy eating (11)
ii) Food groups (69)
iii) Food choices and (10)
iv) Nutrition-related disease. (20)

A scoring protocol is provided for each section and maximum scores are shown in brackets, participant knowledge and understanding are measured against the scores for each section within the population being studied. A higher score indicates a higher nutritional knowledge (Parmenter and Wardle, 1999). In 2000 Wardle et al., proposed that those with higher education levels purportedly possess a higher understanding of healthy eating recommendations and therefore would have a higher intake score than those with lower education levels. They recruited 455 men and 584 women from three GP practices spread across the UK, participants had a mean age of 51.5 years (age range 18-75yrs), and were mainly White British, the self-reported postal study found that women scored higher than men, people educated to a higher level and middle-aged people scored higher than younger or older people, demonstrating a greater understanding of healthy eating and healthier food choices when compared to those less educated, they concluded that nutritional knowledge does potentially play a role in the diet choices of individuals (Wardle et al., 2000). The impact of education on dietary intake has been much debated over many decades, in the late 1990's and early 2000's when the NKQ was first developed Wardle's study was seen as influential in terms of linking nutritional knowledge and healthy eating (Worsley, 2002). The NKQ has been used in many validation studies and has been modified to suit the population using it, for example Alsaffar (2012) translated and modified the questionnaire for a Turkish population, recruiting dietetics students and engineering students replicating earlier works by Wardle and Parmenter (Parmenter and Wardle, 1999)., Results reported significant differences between the scores of the two groups with the dietetics students scoring higher in each of the sections than the engineering students (Alsaffar, 2012). For the purposes of the present study the questionnaire was used to establish the nutritional knowledge of HBNW patients, a lower score equates to lower nutritional knowledge and a higher score to a greater understanding.

2.6.3 Questionnaire 3. The International Physical Activity questionnaire (IPAQ)

The IPAQ "long- last 7 days" version was chosen as it has consistently been established as a reliable tool for assessment of activity levels, when compared to other physical activity measurement tools such as pedometers, and phone apps (Macfarlane et al., 2007, Hagströmer et al., 2006). The questionnaire categorises different activity into four domains suitable for different ages and ethnicity (Craig et al., 2003, Levy and Readdy, 2009). The IPAQ was added to the questionnaires with the aim of assessing how active participants were in their daily lives outside of their CRP as this will impact on their risk factor profile (Heran et al., 2011b, Craig et al., 2003). Conversely in 2011 Lee et al., conducted a review of 23 studies using the short form IPAQ-SF as it was seen as a more inexpensive method of assessment. They found that the IPAQ_SF faired lower than other the expected standard and overall was a weak indicator of physical activity. In another study Ryan et al., (2018) used the IPAQ-long- last 7-day questionnaire was used and had similar results to Lee et al (2011) suggesting it was not suitable for older populations. That being said the IPAQ was chosen as it is used worldwide and to assess moderate and vigorous physical activity.

All questionnaire responses were self-reported, participants were also asked to provide their height (m) weight (kg). Written instructions were provided for measurement of Waist circumference (cm), measurement to be taken around the naval and not trouser or skirt size. This information was not requested on any of the questionnaires; therefore, a separate sheet was attached to the questionnaires.

2.7 Methods for Chapter 5 Study 3. Focus groups (FG).

Focus groups were used to identify potential barriers to attending nutrition education programmes in the future and to making dietary changes to improve heart health. FG's are said to provide a unique opportunity to engage individuals in generating conversations to uncover opinions regarding a problem or issue (Morgan, 1999), however this is not without pitfalls and can be a complex process (Cyr, 2016). This research used previous guidelines on the duration (Krueger & Casey, 2014), group size (Redmond, Redmond, Curtis & Curtis, 2009) and suggested criteria for conducting effective and meaningful focus group sessions (Merton et al., 1990).

2.7.1 Pilot FG

A set of questions were developed by the researcher in order to guide the FG discussion, containing 2 simple engagement questions designed to break the ice with the group members, 6 exploratory questions, and an exit question (Morgan, 1996, Krueger and Casey, 2002). A pilot FG (5 male HBNW members) was conducted ahead of general recruitment, enabling the researcher to check the recording equipment worked correctly, identify the level of background noise and foot traffic past the room, assess the suitability of the room (size and comfort), and assess the audibility of the recording following the session. The pilot FG also allowed the researcher to refine the order and content of the questions based on the responses and direction of the discussion. Following the pilot FG, the questions were amended to reflect the flow of conversation, as shown in Table 4. and were used in each of the FG's to provide comparability between the groups (Stevenson et al., 2007).

2.7.2 Questions

The focus group session followed guidelines from Krueger (Krueger and Casey, 2002) providing a welcome, overview of the topic, outlining the ground rules and setting the first question to break the ice and allow each participant to speak early in the session. Audio recording equipment was placed in the centre of the table at which the participants were seated and switched on at the start of each session.

Table 2.2. The modified questions used for each focus group.

FOCUS GROUP QUESTIONS

Engagement Questions:

1. What did you have for tea last night?
2. Who decides what you eat?

Exploratory Questions:

1. What does healthy eating mean to you?
2. Do you think that you eat a diet that will reduce your risk of future heart episodes/problems or further progression of your disease?
3. How many portions of fruit and vegetables did you consume yesterday?
4. What would stop you from attending a nutrition education programme?
5. Is there anything that you feel you would like to know about certain foods and your condition
6. If someone said, eat like this and your cholesterol/BP/glucose levels would improve, (potentially reducing the need for medication), would you be interested in taking those steps?
7. Have you been given nutrition/healthy eating advice in the past? If so, was it helpful? And how long ago?

Exit Question?

1. Is there anything you would like to add about healthy eating advice that we have not covered here?

2.7.3 Recruitment

In addition to previously stated recruitment procedures, the dates and times of the FG's were printed and placed on the main reception desk, allowing participants to sign-up to a session that suited them. A maximum of eight places were available at each of the FG sessions (Krueger and Casey, 2002). FG times were either 10am, 2pm or 4.30pm allowing participants to attend either before or after their usual exercise sessions. All FG sessions were conducted between April and July 2017 in the main HBNW centre.

2.7.4 Data Collection and Analysis.

Seven FG were conducted, it was thought that saturation point was reached by the sixth FG with similar discussion being seen in each group, however one more FG was carried out for confirmation (Isaacs, 2014, Krueger and Casey, 2014). Each focus group contained between two and five participants lasting between 45-60 minutes (Morgan DL, 1998). At the start of each FG the researcher welcomed the participants, explained the format of the session, provided details of the researcher's role as the moderator, and as such would not participate in the discussion, other than to keep the dialogue on track. Participants were asked if they had any further questions before the start of the session.

Data was then analysed using Krueger's classic systematic analysis approach (Krueger and Casey, 2002).

i) Recordings were listened to without making notes or transcribing,

ii) They were then transcribed using pen and paper, verbatim.

iii) Transcripts were then read again

iv) The transcripts were cleaned, whilst being transferred into a PC word document, taking out "er"," um", and pauses in the conversation that did not add to the conversation (Morgan DL, 1998)

v) Each FG was coded. (cutting and sorting participant responses/words or phrases into piles (codes)(Ryan and Bernard, 2003).

vi) Following initial coding, the responses to each question were collected and re coded

vii) Then codes were compiled into categories

viii) From the categories emerging themes were identified.

2.8 Methods for Chapter 6. Study 4 Randomised Control Trial

The study consisted of a three-armed parallel group randomised control trial, and followed the consolidated standard of reporting trials (CONSORT) protocol to ensure reliability of reporting methods (CONSORT, 2010). The RTC involved an intervention period of 6-weeks with follow up at 12 weeks; participants were randomly allocated to one of three groups;

1*Usual Care –

Usual exercise sessions, full access to usual services provided as part of the CRP.

2*Usual Care plus –

Nutrition intervention group HBNW. Existing nutrition intervention delivered as per previous protocol.

3*Usual Care plus –

New Nutrition education group.

In the interests of flexibility sessions were repeated on three separate days and times (Monday Wednesday Friday) for both intervention groups in parallel, one in the morning (10am) one in an afternoon (2pm) and one early evening (4.30pm) allowing patients to attend a session of their choice each week over the six-week period.

2.8.1 Protocol

The biggest loser followed the same protocol and the same EP delivered the sessions, for BHF materials used see appendix 11.

The participants attended weekly sessions outside of their usual exercise class times. Each session followed a specific theme based on British Heart Foundation healthy eating guidelines (BHF, 2012) as follows:

1. Increased intake of fruit and vegetables
2. Increased intake of fish
3. Reducing intake of saturated fat
4. Reduction of salt
5. Alcohol –safe limits
6. Meal planning and goal setting

The New education programme was named "Healthy Heart Happy You" used the same weekly topics as the biggest loser, however the delivery materials and content were informed by findings from studies 1, 2 and 3. Lecture slides were compiled to provide colourful and informative information, with interaction encouraged throughout each session, heart healthy handouts were provided using literature from BHF on portion sizes, and simple recipes, and each week patients were given a challenge for example Week 1 include more vegetables.

Below are examples of slides used, additionally patients were provided with evidence-based information for the inclusion of foods/groups of foods for heart health, in addition to simple recipes and guidance of how to choose a Med style eating pattern. The myth busting true or false section was designed to encourage discussion between patients and allow them to interact with each other sharing their knowledge and experiences.

Figure 2.2. *week 1 title slide designed to be appealing with the 5-a-day and a heart to signify heart healthy eating and increasing fruit and vegetable intake.*

***Figure** 2.3 sets the weekly challenge whilst providing a visual interpretation of how to easily include vegetables into everyday meals.*

***Figure** 2.4. the myth busting slide to address a variety of common misconceptions or areas of confusion that were identified in studies 2 (questionnaires) and 3 (focus groups)*

On week one patients were provided with a simple ring binder, plastic wallets and dividers, over the duration of the intervention they were provided with printouts of the lecture slides, portion information for each of the food groups, recipes and additional information relevant to the weekly topic providing them with a comprehensive self help guide to heart healthy eating. The focus at each session was on what should be included for heart health with rationale and research informing these recommendations. Slides and materials from all six sessions can be found in appendix 12.

Randomised Control Trial

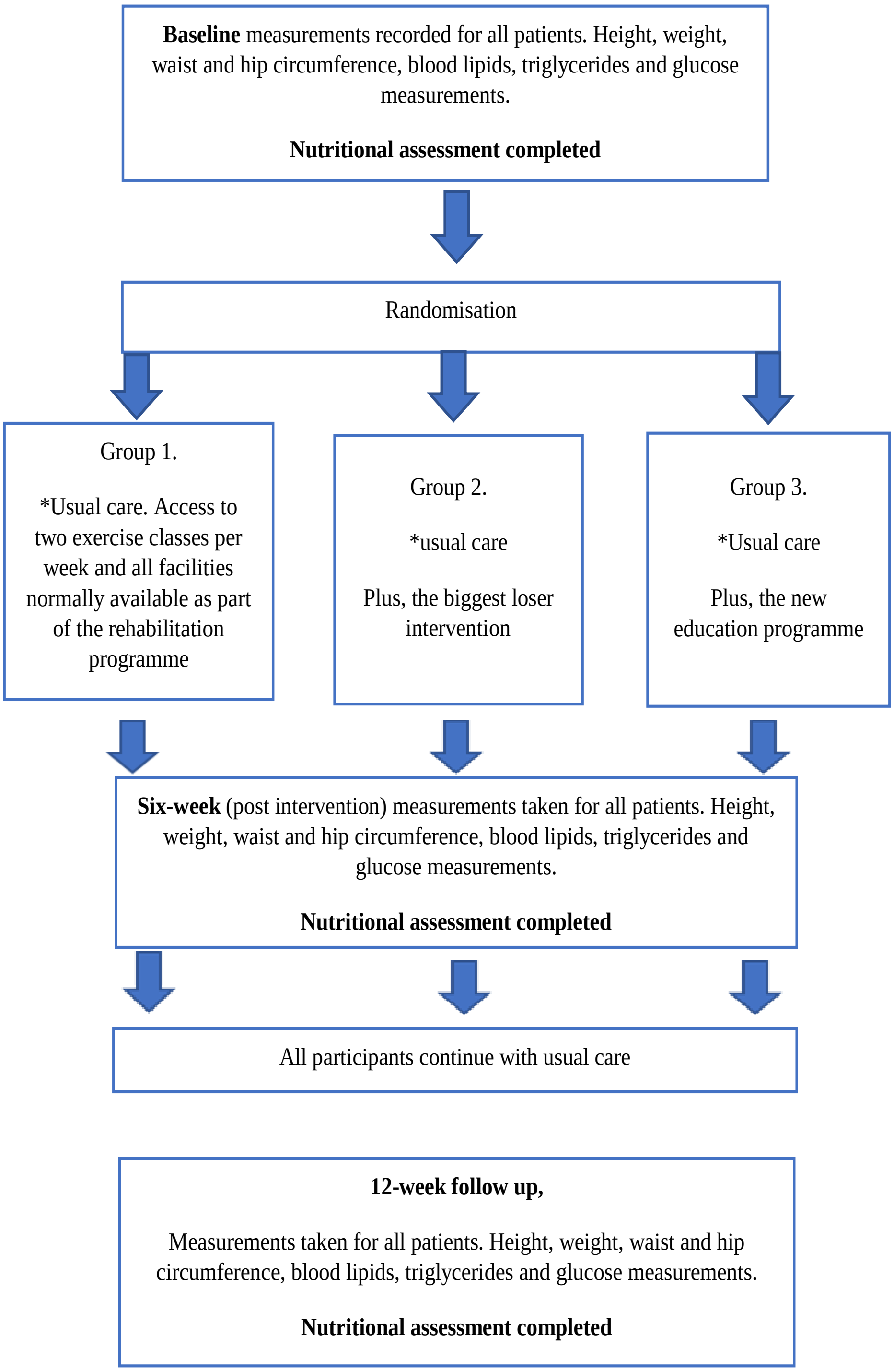


Figure 2.5 *shows the structure of the randomised control trial (RCT), patients were recruited and randomly assigned to one of three groups. Measurements and assessments were conducted at baseline, 6 weeks, and 12-weeks.*

Randomisation was performed using a computer-generated programme (Saghaei, 2004) a member of the supervisory team ran the programme, the researcher was then presented with the randomised code list. Additionally, each participant self-selected the date and time of their preferred first data collection appointment. further adding to the randomisation process, on arrival they were allocated a number assigning them to one of the three groups.

2.8.2 Venue

PNE main centre provided the venue for all data collection and weekly meeting for the two intervention groups, the control group continued with their usual programme.

2.8.3 Data collection

Participants provided written informed consent (appendix 8) the following data was collected:

2.8.4 Anthropometric measures

- Height: recorded in cm to the nearest 0.5cm, using a portable stadiometer (SECA 217, Birmingham, United Kingdom)
- Weight: measured in kg to the nearest 0.1kg, using mechanical personal scale (SECA 760, Birmingham, United Kingdom). Weighed in light clothing with no shoes.
- BMI calculated using weight (kg) divided by height m^2.
- Hip and Waist measurements taken using standard fabric tape measure (IDASS, Cornwall, United Kingdom). , Hip- tape placed around the widest part of the buttocks and waist measurement taken 2cm below the navel measurements taken to the nearest 0.5cm (Organization, 2011)

2.8.5 Biochemical assessment

When conducting field research, it is important to use equipment that is reliable, easy to implement and offers speedy results. This testing is commonly referred to as point of care (POC) testing and is a fast, reliable method of early diagnosis and monitoring that can be used in settings outside of routine hospital visits (Vashist 2017). Such instruments are used in outreach and community settings, for example; Martin and colleagues (2005) tested blood glucose levels in a remote community in Australia using the Glucose and HbA1c capillary assays. The researchers found that scores between lab results and POC results were very similar (The correlation coefficient *r* for POC and laboratory results was 0.98 for glucose and 0.99 for HbA1c). They did also add that POC testing is better used to monitor health rather than for diagnostic purposes (Martin et al., 2005). Similarly, in 2009 Rapi et al., assessed the sensitivity of POC testing for cholesterol and Triglycerides, in CHD patients. A total of ten multicare devices, using 5 different types of reactive strips were tested for total cholesterol and triglyceride and measurements were compared to venous blood samples. Researchers reported a good comparison between methods (3.5% and -2.3%) for both tests (Rapi el al., 2009). The national cholesterol education programme (NCEP) provide recommendations of bias and imprecision when using these POC tests of between 3% and 5% (for cholesterol and triglycerides), whereas Shephard (2006) proposed a goal of 5% for cholesterol and 7.5% for triglycerides and both researchers are in agreement that the POC tests using multicare devices offer a practical alternative to laboratory testing for health assessment in the community, and concur with Martin et al., (2005) that follow up diagnostics using the full laboratory assay should be used when additional diagnostics are required (Riley et al., 2016). POC devices are being more widely used due to the benefits in the ease, speed, and accuracy of the technology. It is apparent that the ability to assess the risk-status of individuals in clinical trials, community settings or self-monitoring (for example; patients themselves monitoring glucose levels) is important and any anomalies can then be investigated further using laboratory standards

(Pezzuto et al., 2019). Of course, comparisons have been made between results obtained by experienced medical professionals and non-professionals and results have shown that the more experienced an individual is in taking samples the more reliable the results (Rapi et al., 2009; Riley et al., 2016; Pezzuto et al., 2019). The researcher was fully trained in the procedures for capillary sampling and with the manufacturer's instructions for use of the multicare system (Rapi et al., 2009; Riley et al., 2016; Pezzuto et al., 2019).

The middle finger on the participant's non-dominant hand was used for simple capillary blood sampling, safety lancets were used to pierce the skin (Nicholls and Marshall, 2013). Capillary blood sampling and the PRIMA multi-care system, quality management system approval number EN ISO 13485 (PRIMA LAB SA, Balerna, Switzerland) was used to measure:

- Blood glucose
- Blood lipids (total cholesterol)
- Triglyceride (TG) levels

Image 2.1. Hand-held Prima multicare unit, showing the data chip being inserted into the side of the device.

Image 2.2 The different colour test strips corresponding to the relevant data chip.

The relevant data chip (image 2.1) was placed into the multi-care device (image 2.2), each of the test strips is chemically modified with specific enzymes that react with the triglycerides/glucose/cholesterol and a reading is provide for each measure.

All materials were disposed of in the appropriate receptacle for blood and sharps and taken back to university of central Lancashire for disposal.

Image 2.3. Shows the set-up of equipment used in the capillary blood sampling.

2.8.6 Dietary assessment

Food-frequency questionnaires (FFQ), diet interviews, 24hour recall and diet diaries of differing durations (between 1-7 days) are used as measures for estimating the diet intakes of individuals and groups of people. Measuring self-reported dietary intake is not without its limitations, and underreporting is common (Frankenfield et al., 2012; Woulters et al., 2016)When measured against recovery biomarkers such as doubly labelled water (DLW).

energy intake was under reported by 20-25%, nevertheless, 24-hour recall and 4-day diet diary measurements did deliver good estimates of diet intakes when compared to FFQ, particularly when used over time (Park et al., 2018).

Therefore, a 4-day diet diary was chosen for the present study and was used at three separate timepoints over the study period. Each participant completed the Med diet score tool in addition to the four-day diet diary (appendix 13). Detailed instructions were provided by the researcher on how to complete the diaries which they took away with them returning the completed version at their first intervention session. They then completed subsequent 4-day diet diary at week 6 and 12 for analysis.

2.8.7 Clinical measurements

Blood pressure

Field measurements of blood pressure (BP) should use simple non-invasive instruments that are not only easy to administer, but also reliable and accurate (Ruzicca et al., 2016). POC testing for BP is normally carried out using portable electronic sphygmomanometer devices, however it is important that devices are suitably calibrated and licenced to meet current standards from British hypertension society, European society of hypertension, and Advancement of medical instrumentation (Ruzicca et al., 2016). Automated devices use the oscillometric method to measure BP at the brachial level and standard Mercury sphygnomometer uses Auscultatory method, details of which are explained elsewhere (Lewis 2019). Several studies have been performed to ascertain accuracy of automated devices when compared to standard mercury sphygnomometer measurements taken by medical professionals. For example, Roland and colleagues (2010) evaluated three individual studies using the Omron M3, and Omron M2 which use brachial BP and the Omron R3-1 Plus which uses wrist measurements. The researchers followed the European Society of Hypertension protocol (O'brien et al., 2001), they found when compared to mercury measurements there was a mean difference of 1.9±3.0mmHg for systolic BP and -1.0±2.3mmHg for diastolic BP for the Omron M3, Omron M2 had a difference of 1.4±4.5 and -2.3 ±3.6mmHg for systolic and diastolic respectively, and the Omron R3-1 Plus was 1.4±4.5 and 0.8±4.6mmHg all of which were within the parameters set by the international protocol of <15mmHg, and as such are useful tools for use in the field and for patient self-monitoring at home (Asmar et al., 2010). Similarly, in the recent ACCU-RATE study, Hodgkinson and colleagues (2020) reviewed the accuracy of patient owned monitors which resulted in recommendations to ensure devices are chosen from a list of validated monitors, are replaced every 4-5 years and they discourage use wrist monitors (Hodgkinson et al., 2020).

Work is continuing to create a universal standard to validate automated BP devices and in a collaborative statement the association for the advancement of medical instrumentation (AAMI), European society of hypertension (ESH), and the international organisation for standardisation (ISO) state that devices are deemed agreeable if the level of tolerable error (≤10 mm Hg) is at least 85% (Stergiou et al., 2018). Use of Omron devices in special populations such as; children, pregnancy, pre-eclampsia, obesity, arrhythmia, diabetes and older populations have been shown to reach a grade of A/A for systolic and diastolic BP and meet the Association for the Advancement of Medical Instrumentation (AAMI) test protocol (O'brien et al., 1993; Topouchian et al., 2018). Therefore, the Omron M3 LED device was chosen and used in the present study.

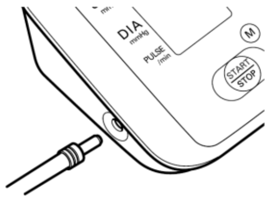
Blood pressure was measured using Electronic sphygmomanometer (OMRON, M3 LED)

Image 2.4 The electronic sphygmomanometer.

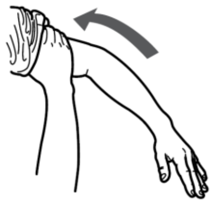
Monitor used in accordance with manufacturer's instructions (omronhealthcare.com).

APPLYING THE CUFF ON THE LEFT ARM

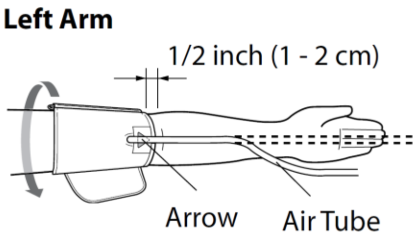
1. Make sure the air plug is securely inserted in the main unit.



2. Remove tight-fitting clothing from your upper arm.



3. Apply the cuff to your left upper arm so the arrow is centered on the inside of your arm and aligned with your middle finger. The air tube runs down the inside of your arm. The bottom of the cuff should be approximately 1/2" above your elbow.



2.8.9 Data Handling & Statistical Analysis

Following baseline data collection all participant information and measurements were input onto excel computer programme ahead of transfer into SPSS version 22 for statistical analysis.

Data was analysed using a 3x3 mixed factorial ANOVA (Field, 2013) Significance was set at $p = \leq 0.05$, tests of normality were performed and significant findings were correlated with baseline and change. All data were stored in accordance with GDPR guidelines for data protection. All paper copies were stored in a locked filing cabinet in a locked office in Darwin building University of central Lancashire and only available to the researcher (Bhaimia, 2018).

Chapter 3

Study 1 Evaluation of Biggest Loser

3. Overview of Chapter 3. Study 1

The following chapter will evaluate the efficacy of the current programme named the Biggest loser, which aimed to educate patients on the risks associated with increased visceral fat (WC) and BMI.

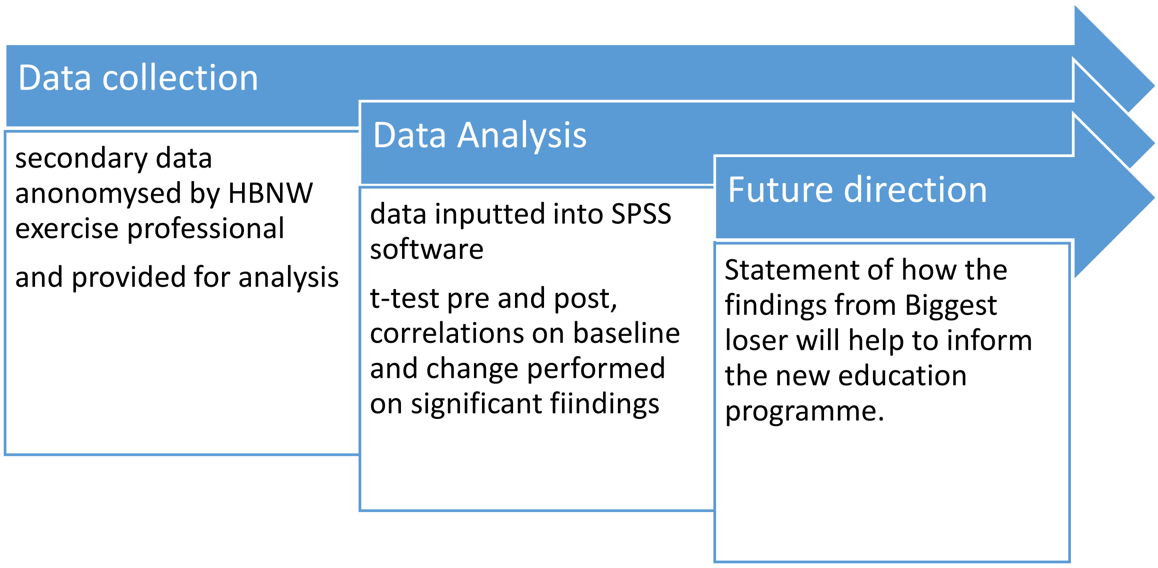


Figure 3.1 shows the sequence of events in the evaluation of the Biggest loser intervention. Permission to use the previously collated data was provided by HBNW CEO, statistical analysis performed by the researcher, and all results presented. (described in chapter 2).

3.1 Introduction

The Biggest Loser intervention was introduced to raise awareness of the risks associated with increased visceral fat (HSE 2010). As discussed in chapter one, a BMI >25kg/m^2 and WC >94cm (males) and >80cm (females) have a direct relationship with development of type2 diabetes, hypertension, hypercholesterolemia and certain cancers (Zaninotto et al., 2010), and are independent risk factors for CHD (Rashid et al., 2003; Litwin, 2008). The inflammation associated with the accumulation of visceral fat escalates fatty acid secretion and in turn C-reactive protein, TNf $\propto$, and IL-6 (Sanguankeo et al., 2017), potentially contributing to CHD progression. Typically, CR patients are educated on making dietary changes for weight management and to improve serum lipid profile (Timlin et al., 2002). Nonetheless, research into the efficacy of such programmes remains limited within secondary prevention (de Melo Ghisi et al., 2014) and dietary information provided can be contradictory or confusing for many individuals (White et al., 2011; Mayer et al., 2014; Lacroix et al., 2017; Butler et al., 2020). The BACPR have recently introduced guidelines on the ideal nutritional approaches in CR (Butler et al., 2020). However, if they are not being implemented by CR patients, the effects on CHD risk factors will not be evident. CR must be a multidisciplinary effort for the optimal results to be attained and in addition the results of such interventions need to be published for best practice policies to be formed (Lacroix et al., 2017).

Louisi et al., (2015) conducted a study to assess the effectiveness of an intervention to improve the diet quality of cardiac patients compared to usual care. 133 patients were randomized to either usual care (UC) or intervention group (IG). The IG attended two educational seminars and completed a questionnaire about their diet habits pre rehabilitation. BMI measurements were taken along with glucose and triglyceride measurements at baseline and at the end of the study 12 months later. IG also received an interim nutrition evaluation and personalized motivation from a dietitian at 6-months. The IG group saw a reduction in total energy, resulting in reduced protein, fat and carbohydrate intakes and a significant reduction in BM and BMI compared to the control group, the authors concluded that individual counselling sessions providing positive re-enforcement of diet information was effective in reducing total energy and BMI (Luisi et al., 2015). These findings were similar to an earlier study in which 104 men and women aged 35-85years (80% male) attending CR were assigned to either a control group (usual non-individualized diet advice) or intervention group (two nutrition education sessions and one personal counselling session) performed by a dietitian. Cholesterol-saturated fat index (calculation for the levels of cholesterol and saturated fat), reduced in the control group from 57 to 48 and in the treatment group from 51 to 42 (Connor et al., 1989). The authors also investigated the effects of the diet intervention and the patient's ability to make healthier choices when eating out and their level of confidence in making better dietary choices. Results showed that the intervention group scored better in the diet habit survey (2.6 compared to 1.0 respectively) and cardiac diet efficacy score (4.3 compared to 3.8). Thus, demonstrating that diet counselling can improve patients diet choices in the future, improve self-efficacy and lipid profile (Timlin et al., 2002). In a retrospective study Gaetke and colleagues (2006) analysed data from 175 patients referred to a registered dietitian (RD) by their GP. Only patients with diagnosed CHD and diabetes (not currently taking medication) were included in the study and further categorised by those who took up the offer of a diet consultation and those who did not (n=47 in each group). Patient data on clinical anthropometric changes (BMI) and biochemical measures (blood glucose, HbA1c, total cholesterol, HDL/LDL ratio and triglycerides) were analysed. Patients in the dietitian group had a 1-hour individualised counselling session using printed materials and were seen by the dietitian within three weeks of the initial GP appointment. All patients then received a follow up with their GP after 3 months, at 6 months and 12 months. They reported that there was a significant difference in age between the two groups at baseline MNT (medical nutrition treatment) group were 57.6±12.0 years where the NMNT (non-medical nutrition treatment) group was 63.0±12.4 years (*P*=.004),and baseline HbA1c 9.8%±2.5% MNT and 8.4%±1.7% (*P=.004) NMNT*. From baseline to 3 months BMI reduced significantly in MNT group ($P < .001$). Whilst there was no change in the NMNT group, mean glucose and HbA1c reduced significantly from baseline to 3 months ($P \leq .001$ for both measurements) in the MNT. Whereas NMNT glucose and HbA1c had significantly increased in the same time ($P \leq .001$). Total cholesterol, mean LDL, triglyceride levels and ratio of total to HDL cholesterol levels significantly reduced in the MNT group ($P \leq .001$, $P \leq .001$, P=0.3 and P=0.3 respectively). Whilst there was no change seen in mean HDL level, total cholesterol significantly increased (P=0.04), a non-significant increase was seen in mean LDL, triglycerides and ratio of cholesterol to HDL in the NMNT group (values not supplied) (Gaetke et al., 2006). These results would appear to support the importance of providing nutrition education to people with chronic diseases to induce improvements in key outcome measures. Nonetheless, Gaetke and colleagues found that at 6 months post dietitian visit differences remained significant, however, at 1 year all measures had returned to baseline figures raising an important point that diet education needs to be re-enforced regularly to maintain the improvements long-term and reduce confusion (Butler et al., 2020). Nutrition education should be as important as exercise in improving anthropometric and biochemical measures in secondary prevention (Butscher et al., 2016).

From these studies it is apparent that improvements are seen in key parameters like Connor et al., 1989 and Luisi et al., 2015. Nonetheless, longer term adherence remains unclear (de Melo Ghisi, 2015)and there is also much confusion and contradictory information available to patients in secondary prevention that needs to be addressed, and equally as important needs to be reported in the literature (White et al., 2011; de Melo Ghisi et al., 2014 Lacroix et al., 2017; Butler, et al., 2020). There is a clear need for additional research in the field of nutrition education, particularly in secondary prevention. Evaluation of data provided by Heartbeat NW will reveal the efficacy of the intervention and results will not only inform the basis of a new education programme but will contribute to the limited research currently available.

The novel aspects of Heartbeat's intervention The Biggest Loser are that it was supported with materials provided by BHF and delivered by the EP rather than a dietitian, in a group-based setting.

3.2 Methods

This retrospective study used archival data collected from several cohorts of people who attended the Biggest Loser. A pre-post research design was used (Estrada et al., 2019) and recruited patients attended a six-week nutrition intervention delivered for one hour per week at Heartbeat NW's main center in Preston. It was introduced to raise awareness of the risks associated with a high BMI and WC measurement and was offered to all existing clients attending the cardiac rehabilitation exercise classes.

The participants attended weekly sessions outside of their usual exercise class times. Each session followed a specific theme based on British Heart Foundation healthy eating guidelines (BHF, 2012 appendix 9) as follows:

1. Increased intake of fruit and vegetables
2. Increased intake of fish
3. Reducing intake of saturated fat
4. Reduction of salt

Alcohol –safe limits Meal planning and goal setting

Data were made available to the researcher from 6 separate cohorts of between 4 and 8 participants that had taken place over a two-year period between 2012 and 2014. The total number of participants completing the 6-week intervention was 42 (12-F, 30-M) aged between 45 yrs. and 84 yrs. mean 65 ± 10.45 yrs. A mean height of 1.68m ± 0.07, weight 84.35±15.55kg, starting BMI of 29.7± 6kg/m^2 and WC of 104.1±14.4cm (Table 3.1). The mean scores for both BMI and WC are in the overweight and high-risk categories, respectively. No details were given to the researchers regarding reasons for participants not completing the 6 weeks intervention and they were removed from this evaluation.

Table 3.1 Characteristics of participants attending the "biggest loser" intervention at the start of the intervention (mean ± standard deviation (SD).

Characteristic	**Mean**	**SD (±)**
Age (years)	65.8	10.45
Height (meters)	1.68	0.073
Pre-weight (kg)	84.35	15.55
Pre-BMI (kg/$m^{2)}$	29.7	6.0
Pre-WC (cm)	104.1	14.4

Mean baseline measures for BMI place patients in the obese category and WC measures place them as high-risk category.

An identical protocol was followed with each cohort and the same exercise professional (EP) led the sessions. For each cohort two data sets where made available to the researcher, these were collected by the EP at week one (pre intervention) and week six (post intervention), comprising of the following for each participant: age and gender; height, measured using a portable stadiometer, (Seca 213, Seca Medical Scales and Measuring System) and weight, recorded using a standard weighing scale (Salter Ltd, Tonbridge, UK). The final measurement taken pre and post intervention was waist circumference, measured using a standard fabric tape; BMI was calculated using Weight (kg) ÷ Height (m^2).

Details of patient's medication was not disclosed for this evaluation. All the data were anonymized before being given to the researcher. Once collected, data were stored on a password-protected computer in the interests of participant confidentiality and in accordance with the data protection act. Data were then collated into SPSS software package for statistical analysis (IBM, Version 22.0, SPSS, Chicago, IL). A summary of the results is presented in table 3.2. Paired samples t-tests were employed on each of the physiological outcome measurements: WC, BMI, and body mass. Significance was accepted at the $p<0.05$ level. Effect sizes were calculated using partial eta^2 ($p\eta^2$). Finally, minimal clinically important differences (MCID's) were calculated as being 1 * standard error (Den Oudsten et al., 2013). The MCID is defined as a "statistical model that attempts to define the smallest change in a treatment outcome that a patient would identify as important" (Meltzer 2016) described in chapter 2.

3.3 Results.

Results indicate that there was a significant difference in all three anthropometric measurements when compared to baseline (pre-intervention) values (Table 3.2). Firstly mean WC measurements were significantly reduced by 4.93±12.40cm (p=0.001) and the MCID was calculated at 2.14 cm. Secondly, the mean BMI measurement was significantly reduced by 0.89±5.69kg/m^2 (p=0.001) with an MCID of 0.90kg/m^2. Finally mean BM was significantly reduced by 2.50±15.04kg (p=0.001) and the MCID is 2.36kg

Table 3.2 Anthropometric measurements taken Pre and Post intervention (mean ± SD. The % change and the MCID at the end of the 6-week intervention are also presented.

	Pre-intervention		Post-intervention		MCID	change	p-values
	Mean	SD (±)	Mean	SD (±)			
Waist circumference (cm)	104.10	14.39	99.17	12.40	2.14	4.93	*0.001
BMI (Kg/m^2)	29.71	5.97	28.82	5.69	0.90	0.89	*0.001
Body mass (Kg)	84.35	15.55	81.85	15.04	2.36	2.50	*0.001

(Significant Difference ($p<0.05$) from pre-intervention indicated by *, (see appendix 10 for SPSS output)

Patients' mean WC show a significant decrease from baseline to 6-weeks (p=0.001) BMI also reduced significantly (p=0.001) as did BM (p=0.001).

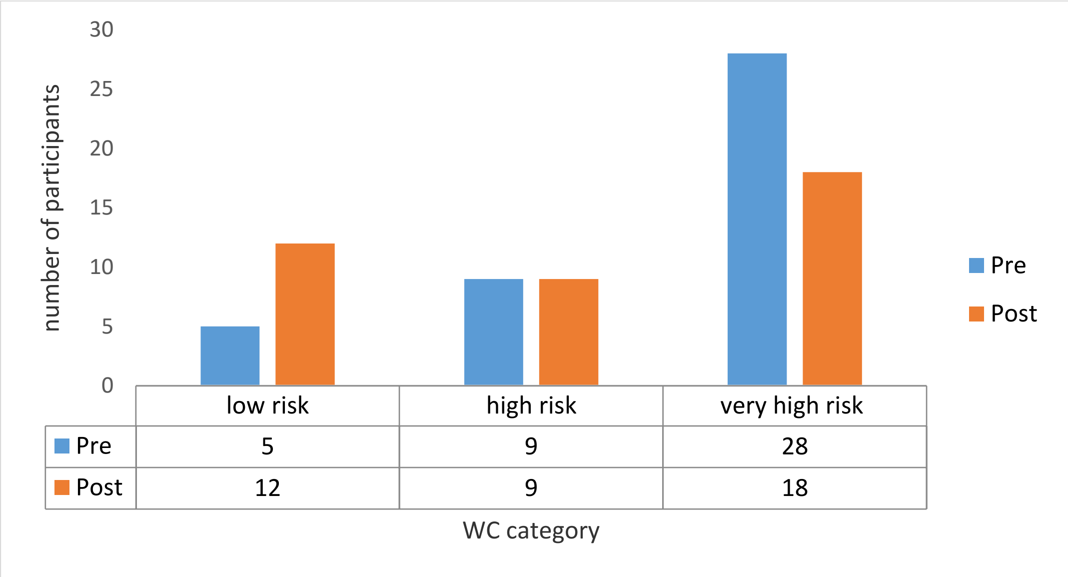


Figure 3.2 The number of participants in each of the WC categories at baseline and end of the 6 weeks. Pre-intervention participants were categorised as normal, high, or very high risk with increased WC measurements the number of participants in each category are as follows; low n=5, high n=9 very high n=28. Post intervention the numbers in each category were; low risk n=12, high n=9 and very high n=18.

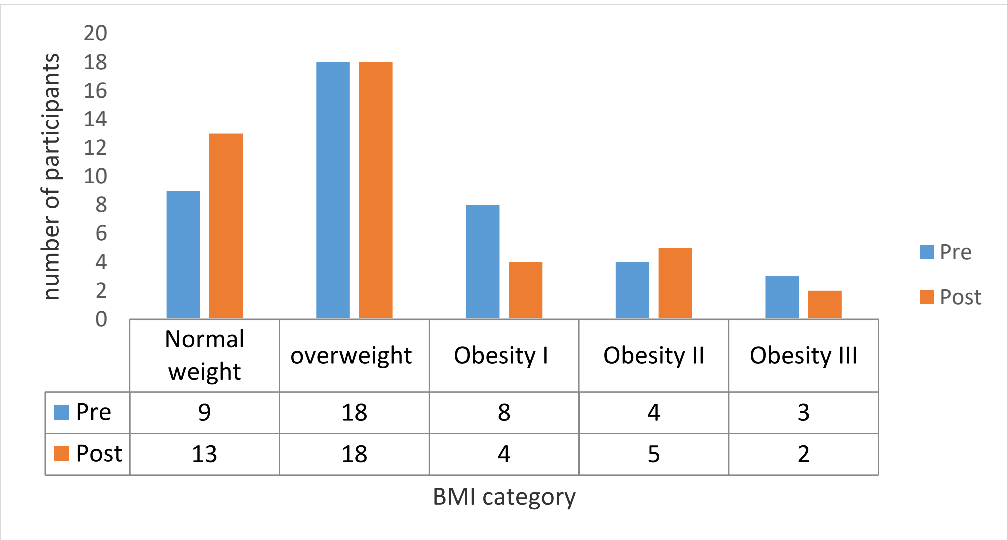


Figure 3.3. The number of participants in each of the BMI categories at baseline and end of the 6 weeks. Pre-intervention participants were categorised as Normal weight n=9, overweight n= 18, obesity I n=8, obesity II n=4, and obesity III n=3. Post intervention those numbers changed to; normal weight n=13, overweight n=18, obesity I n=4, obesity II n=5 and obesity III n=2.Individual variability in responses to the intervention was noted when examining the data in that some patients experienced greater changes in BMI and WC measures over the intervention period Figures 3.3 and 3.4 illustrate this individual variability in responses to the intervention for WC (Figure 3.3) and BMI (Figure 3.4).

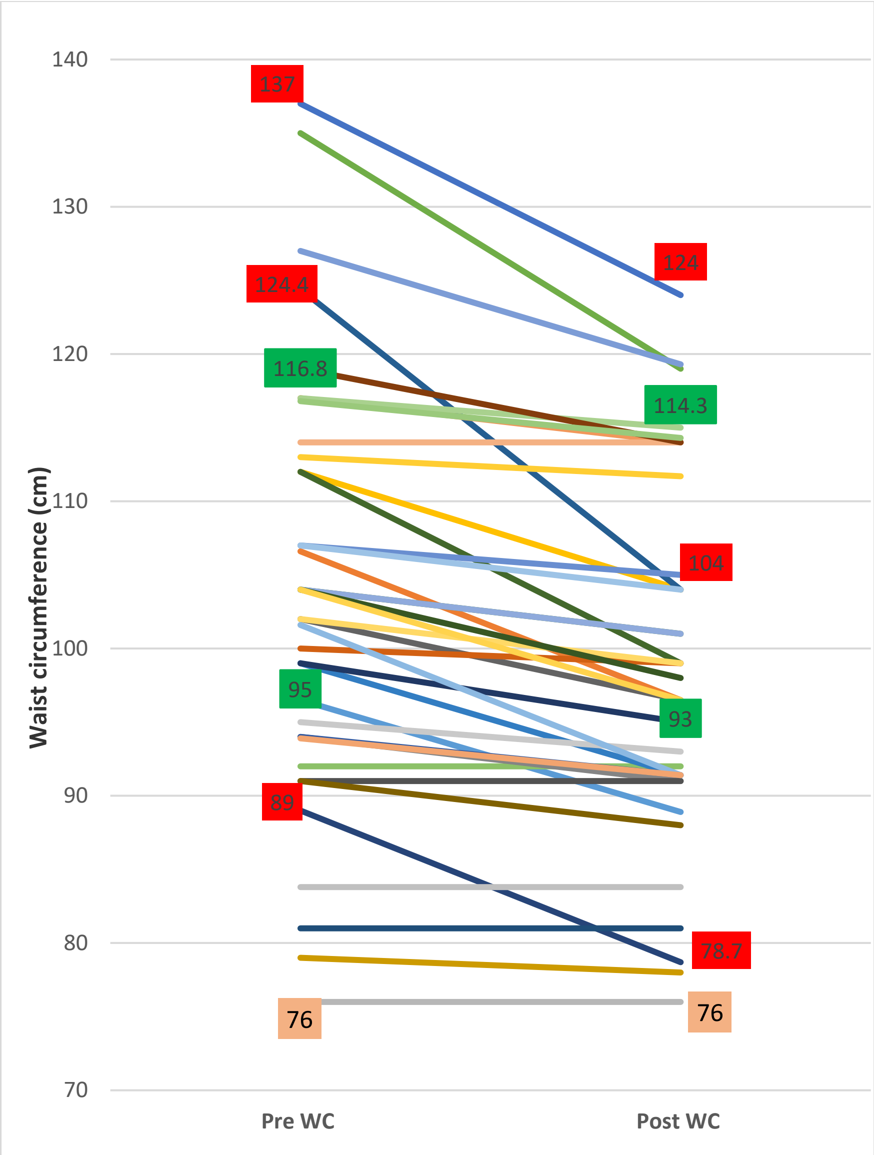


Figure 3.4 Changes in pre- and post-intervention WC measurements (cm) for individual participants. Highlighted in red are participants who saw the greatest reductions in WC, green indicates some reduction in WC, and amber indicates no change in WC. Pearson correlation test indicated a significant association between a high pre-intervention WC and a greater decrease in WC following the intervention (r = .485, p = 0.001, N =42), (for SPSS outputs see appendix 10).

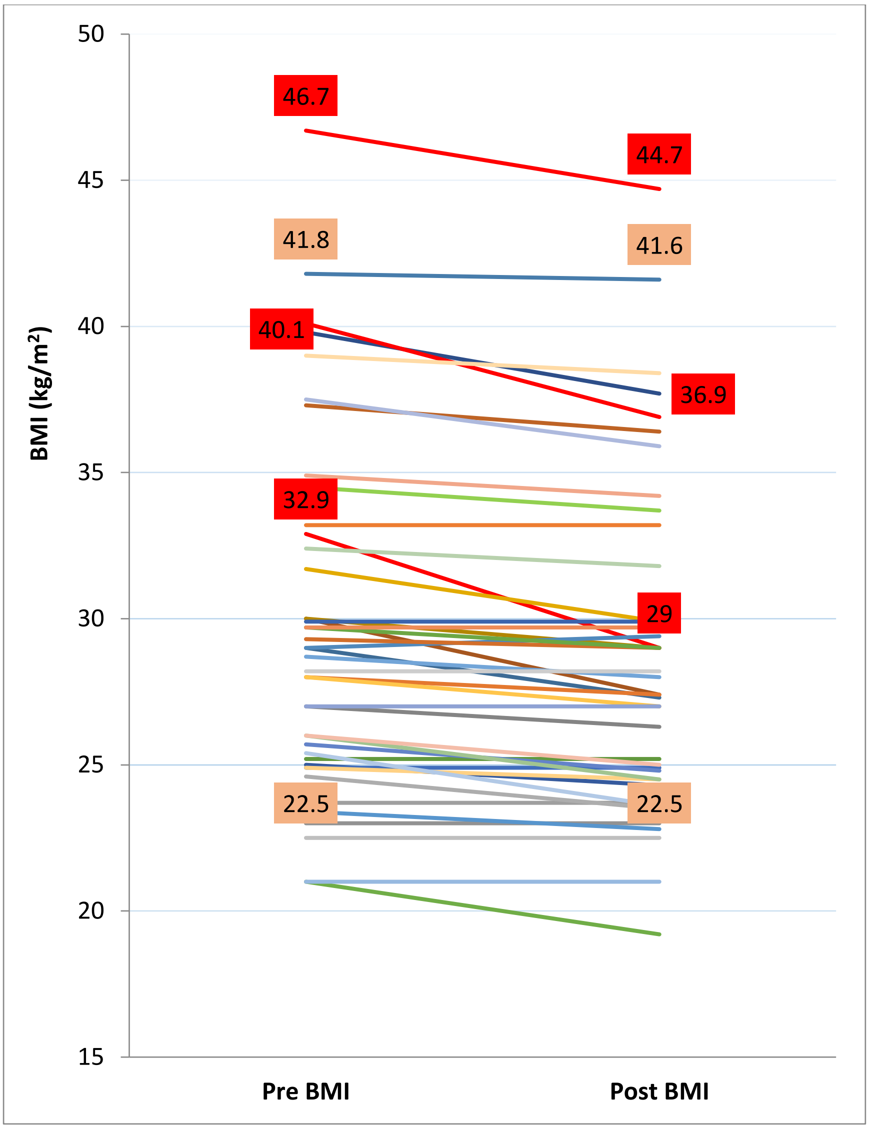


Figure 3.5

Changes in pre- and post-intervention BMI measurements (kg/m^2) for individual participants. Highlighted in red are participants who saw the greatest reductions in BMI, and amber indicates no change in WC. Pearson correlation test indicated a significant association between a high pre-intervention BMI and a greater decrease in BMI following the intervention (r = .344, p = 0.026, N =420, (for SPSS outputs see appendix 10).

3.4 Discussion

Heartbeat is a charity-based CRP; individuals are normally referred onto the programme by the hospital or GP following diagnosis of CHD or post-surgery. Patients can also self-refer onto the scheme if they have one or more risk factors that would increase their risk of developing CHD. Patients usually attend at least two exercise sessions per week as part of the rehabilitation programme. Exercise sessions are delivered by qualified exercise referral specialists who are also trained in the use of automated external defibrillator (AED). Participants are encouraged to remain as active as possible in their daily lives outside of the exercise classes, nevertheless, many participants are overweight when they first attend the CR programme and for some their weight is likely to increase over time (Hankey et al., 2002). This sample of the population from Heartbeat is similar to an average CR programme user according to the NACR (Rehabilitation, 2015). Baseline measurements show that most of the participants (n=33) had a BMI score that put them into the overweight or an obese category (>25 Kg/m^2) it is also apparent that many participants (n=37) had a WC measurement that categorized them as; High or Very High risk, (Male ≥94cm, Female ≥80cm). Following the intervention some participant's (n=11) had a BMI and WC measurements that remained unchanged, and only n=12 participants WC scores measured in the Low risk category and the remainder of participant's (n=27) still remain in the High or Very High risk category despite reduction in WC, there were incomplete data for WC measurements on three participants (n=3). Whilst the findings are statistically significant for the whole group, on closer inspection some patients saw reductions in WC whereas some saw little or no change. This finding is not uncommon, as only around 40% of participants will respond positively to a diet intervention (de Roos and Brennan, 2017). Additionally, group-based education may not allow for the inter-individual variation in response to diet interventions, and a more individualised approach to diet education could be the key to initiating long term change (Mutch et al, 2007; Celis-Morales et al,. 2017; Swinton et al., 2018).

An individual follow-up of each participant would be recommended to monitor progress in the following weeks and months It may benefit patients if, following the initial 6-week intervention, they had a follow-up appointment where individualised modifications could be introduced for those with little or no change. For those individuals who had seen positive changes, personalised plan could offer additional motivation to sustain these changes.

The notion of responders and non-responders is complex and personalised nutrition programmes using techniques such as phenotyping (using an individual's genetic make-up) and genotyping (using DNA sequencing) could offer future advances in nutrition planning (Valsesia et al., 2020). However, when these techniques were compared to individualised diet education using baseline dietary data, no significant improvements were seen in weight loss, and insulin sensitivity (Celis-Morales et al., 2014; Celis-Morales 2016; Coletta et al., 2018; Valsesia et al., 2020). Therefore, in the context of CR where resources may be limited, the use of dietary analysis offers satisfactory results.

For Heartbeat the focus of the Biggest Loser intervention was to increase awareness of the risks associated with increased weight, WC and BMI. These are important measures in secondary prevention and as previously discussed, increased BMI and obesity have been shown to be independent risk factors for development and progression of CHD. Abdominal adiposity in particular is a major concern because of the reported links with impaired glucose metabolism, hypertension and hypercholesterolemia, (Emdin et al., 2017). Consequently, the results from the biggest loser are encouraging. There were significant reductions in all three variables (table 3.2), and further analysis also highlighted that those with the most risk (higher baseline BMI, WC and BM) benefitted from the greatest reductions in these measurements meeting the aims of the Biggest Loser intervention. More importantly the MCID for WC (2.14cm) was exceeded (4.93cm) resulting in a mean WC measurement of 99.17cm reduced from 104.10cm, which is an encouraging positive change, for every 5cm above normal range there is an increase in total mortality for all BMI ranges of around 7% in men and 9% in women (Cerhan et al., 2014). Although this still leaves some patients in the high/very high-risk category, figure 3.1 shows the number of individuals in the very high risk category has decreased from 28 at baseline to 18 at week 6; additionally there are now 12 individuals in the low risk category at week 6 where at baseline there were just 5 individuals, thus providing tangible results that can be relayed to these individuals. Decreases in WC confer health benefits far superior to weight loss alone, in 2017 Rothberg et al, found positive changes in systolic BP, total cholesterol, LDL-C, and MetS risk in general following decreases in WC. Figure 3.3 provides details of individual changes in WC measurements over the intervention period, those indicated in red show those with higher starting WC measurements have made the greatest improvements. Similarly, BMI scores improved and figure 3.2 shows the number of patients in each category. At baseline there were 9 patients in the normal range and at week 6 there were 13, in obesity I at baseline there were 8 patients and at week 6 there were 4 patients, one person moved from obesity III into obesity II category. Figure 3.4 shows individual patients changes with those with the greatest change highlighted in red.

These significant changes show that the Biggest loser intervention met the desired outcomes, there are however some limitations that should be discussed. There are several questions regarding the dietary change in this population, older adults have been shown to “cut things out” of their diet they deem to be less healthy (refined carbohydrates: cakes, biscuits, pastries) without replacing them with nutrient dense foods (wholegrain cereals, fruit and vegetables, nuts, beans and pulses) potentially leaving them with a reduced energy intake (White et.al. 2011) which could account for a reduction in weight, BMI, and WC over the 6-week intervention. There was no follow up on the participants of this study and as results were anonymous it is not possible to retrospectively interview them. The positive results need to be investigated further with the addition of dietary analysis to assess diet quality pre and post intervention. Additionally, favourable changes in body composition have been shown to improve glucose sensitivity (Esposito, 2009), reduce blood pressure (Esposito, 2015), potentially improve blood lipid levels (Bibkoski et al., 2005; Kelly, 2010) therefore these measures should also be included in any future intervention.

3.5 Key points

- The biggest loser saw a significant reduction in BMI, WC and weight following the six-week intervention, the changes provided patients with MCID therefore reducing their risks from progression of CHD.
- Dietary assessment was not conducted making it impossible to determine exactly what dietary changes had occurred, if any, leading to speculation that some patients may have simply cut out foods they considered less healthy in their diet without replacing them with nutrient dense foods to ensure nutrient requirements were met (White, 2011).

3.6 Implication for new education programme (chapter 6)

The findings from this study indicate that a 6-week nutrition intervention successfully met the outcomes of reducing WC, BM and BMI, these changes offer favourable and tangible results not only for clinical benefits of reduced risk factors, but results may also be used as a motivation tool for the patients who undertook the intervention.

However, dietary intake was not recorded. Thus, there is no evidence of patients replacing foods that are less health with healthier options. In the new education programme this will be addressed by the addition of dietary analysis using diet diary and food questionnaire at baseline, 6-weeks and an additional follow at 12 weeks will also be added. Furthermore, nutritional intake has been shown to positively influence other risk factor markers, one example would be the CARDIOPREV study utilising the Mediterranean diet on reducing CHD recurrence in secondary prevention (Delgado-Lista, 2016). Therefore, biochemical, and clinical measures of blood pressure, and biochemical measures of total cholesterol, glucose and triglycerides will be added to the new intervention.

Chapter 4

Study 2

Investigation into current eating habits, Knowledge of current healthy eating messages and activity levels of Heartbeat patients

4. Overview of Chapter 4. Study 2 Questionnaires

The following chapter provides details of the three questionnaires distributed to Heartbeat patients to gather information on their current eating habits (BHF), their understanding of healthy eating messages from professionals and the media (NKQ) and their activity levels (IPAQ) outside of their 120 minutes exercise provided by Heartbeat further details of the questionnaire are discussed in chapter 2 Methods.

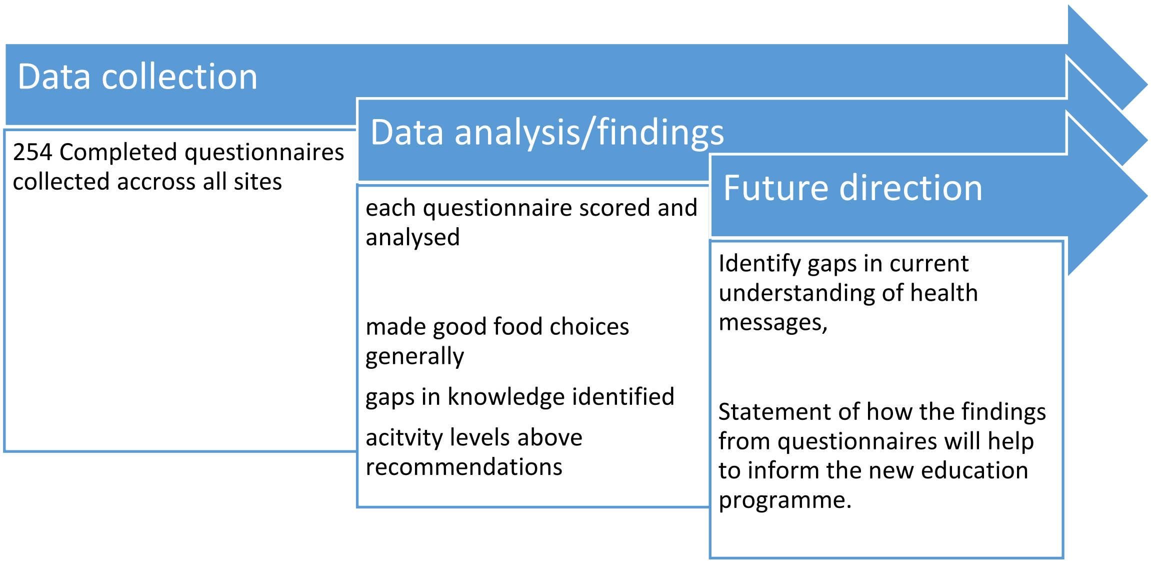


Figure 4.1 shows the sequence of events in the data collection and evaluation of the three questionnaires with a summary of findings to inform the new education programme.

4.1 Introduction

In Secondary prevention, the first line of treatment is medication (Wright et al., 2018). Medication is used to reduce cholesterol, regulate/reduce blood pressure, control glucose levels and regulate the heart rhythms and many patients take a combination of medications for their individual needs (Halcox et al., 2011). The importance of nutritional aspect of treatment is still underutilized in the initial stages of recovery for many individuals and the amount and quality of this information can be limited. In some cases, the total amount of time dedicated to nutritional advice is just one session lasting between 1 and 3 hours within lifestyle modification counselling. Unfortunately, the reporting of methods, structure and content remains elusive (Ghisi et al., 2014; Dalal et al., 2015; Cowie et al., 2019) It has long been established that improvements in the quality of diet can positively influence the health and wellbeing of individuals (Esmaillzadeh, 2006; De Lorgeril, 2006; De Lorgeril, 2011; Luisi, 2015).

The Eatwell Plate was the UK based government diet guidelines and provided a visual representation of the components of a healthy diet (FSA 2010). Different food groups were depicted on an image of a plate using colorful photographs of foods in the different groups. There are five groups depicted in the plate:

(i) bread, rice, potatoes, pasta, and other starchy foods (starchy) (which should make up approximately 33% of the diet)

(ii) fruit and vegetables (F&V) (33%)

(iii) milk and dairy foods (dairy) (15%)

(iv) meat, fish, eggs, beans, and other non-dairy sources of protein (protein) (12%)

(v) foods and drinks that are high in fat or sugar, or both (HFHS), (8%)

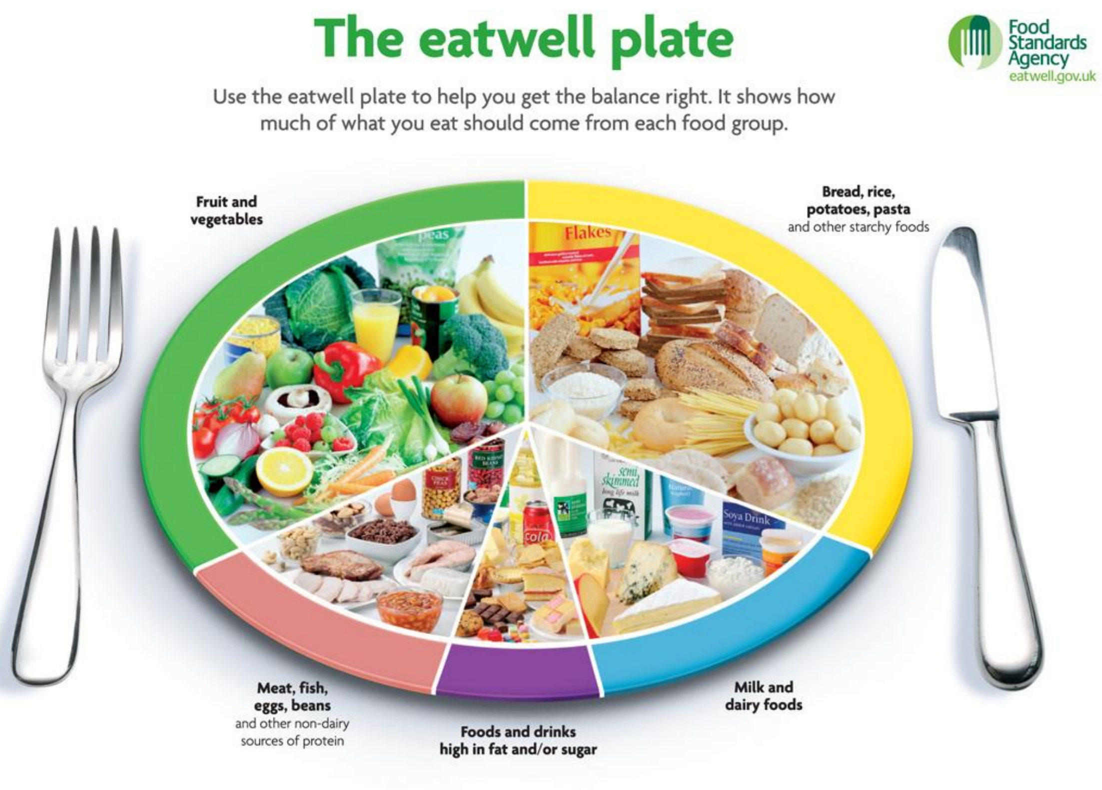


Figure 4.2 The Eatwell Plate from the food standards agency (FSA 2010), shows the five different food groups and the various sizes of each segment depict the order of importance in in the diet.

However, in secondary prevention, the Med diet has been investigated for its potential to reduce risk from T2DM complications. Esposito (2009) compared Med diet score with a detailed list of outcome measures including weight, BMI, WHR, energy intake, physical activity, fasting measures of glucose, HbA_{1C} (a measure of long-term glucose control) lipids, cholesterol, and hypertension. Additionally, those with a higher Med diet score had lower HbA_{1C} and post-prandial glucose levels regardless of BMI, BM, and other lifestyle factors (Esposito et al., 2015) whereas other research has consistently found that a higher BMI significantly increases the risk of developing T2DM (Tonstad et al., 2009). The main ingredients of the Med diet as previously described (Chapter 1) have many similarities with the more recently updated Eatwell Guide (Buttriss 2016), such as increased F&V intake, cereals and wholegrain products, less processed foods including meat and meat products, a moderate intake of dairy, increased intake of fish especially oily fish and addition of olive oil (or similar such as canola),increased fibre intake with the introduction of beans and pulses and less reliance on animal proteins (Sofi the introduction of beans and pulses to fulfil both of these et al., 2014).

In phase II of CR patients undergo physiological testing to assess their functional capacity, to risk stratify them and to set HR parameters for safe and effective exercise prescription (Cowie et al., 2019). Guidelines suggest that 150 minutes of moderate intensity exercise or 75 minutes of vigorous exercise should be completed each week (Medicine, 2013; Riebe et al., 215), and with over 50% of CHD patients taking up the offer of a CR place it is evident that more than ever are benefitting from increased physical activity (Doherty 2017). When patients attend phase III and phase IV CR (previously described in Chapter 1) they attend 2x 1-hour exercise sessions aimed at increasing muscular strength, muscular endurance, core stability, and improve self-efficacy. Additionally, the physiological benefits of reductions in circulating catecholamines, increased circulatory and pulmonary capacity decreased systolic BP, total cholesterol and increased HDL-C and improvements in glucose sensitivity are all well documented in CR patients (Balady 2007, Bethel et al., 2008; Dalal et al., 2010; Piepoli et al., 2010). Prolonged endurance training slows or halts the decline in exercise capacity and heart function associated with increased age, furthermore, increases in cardiovascular exercise shows a linear increase in aerobic capacity (Fujimoto et al 2010) so it is apparent that exercise plays an important role in secondary prevention is a major component of CR programmes (Cowie et al., 2019).

The change in PA from pre-CR to post-CR was increased in the UK by 28.1% in the NACR 2017 report, this is encouraging (Doherty et al., 2017). How many continue this following CR was the subject of a 2019 review by Martinello and colleagues, they investigated the success of a variety of methods to increase PA following CR. The researchers only included RCT and the methods used in the research studies included, pedometers, online and mobile consultations, cognitive behavioural therapy (CBT) plus PA strategies. They found that all these methods reported greater adherence when compared to control groups who did not receive the follow up support (Martinello et al., 2019).

This still leaves the question of how active patients are during CR and if they meet or exceed PA guidelines, to investigate this in Heartbeat patients', study 2 utilises the IPAQ (previously discussed in chapter 2 Methods), with the hypothesis that CR patients exceed the recommended 150m/wk. moderate to vigorous activity or 75m/wk. vigorous activity.

Questionnaires are well-established research tool frequently used in mixed methods research; they are particularly useful when collecting relatively large amounts of data in a short space of time. They can be very simple to administer and a variety of methods can be employed to reach the chosen population, these include; web based, or postal questionnaires, or as in this case, self-administered to specific group or population (Bartram, 2019). The benefits of self-administered questionnaires are that they can be delivered to a group or population and details of the study can be explained, potential participants can then take home the questionnaire and study it in their own time, it is also reported that there is likely to be a greater response rate using this method (Mathers et al., 2007, Aksu, 2009). The advantages of using pre-existing questionnaires are that many are previously validated and tested, they may also potentially have normative data for comparison of results with previous research. Mathers et al.,(2007) acknowledged that a disadvantage to self-administered questionnaires is the potential to have a biased responses from a "captive audience" as they may provide the answers they think the researcher is looking for (Mathers et al., 2007).

4.2 Methods

The questionnaires were distributed in person by the researcher to Heartbeat patients attending their usual exercise classes at the main entre and all satellite centres. Patients were provided with a verbal introduction to the researcher in addition to the purpose of the study along with instructions for completing the questionnaires. Individual packs were made up of participant information sheet confirming verbal information and instructions, and the three questionnaires. Informed consent was provided by returning the completed questionnaires. Returned questionnaires were placed in a secure box in reception of each centre used. The researcher returned each week to collect completed forms, and to interact with patients if they had any questions and to no patients had missed the initial introduction. When saturation point was reached, and all attending patients had received the information a final date was given for any outstanding completed questionnaires to be returned. Four hundred questionnaires were distributed and 254 were returned for analysis.

A total of 3 questionnaires were chosen, to address the research questions outlined (figure 2.1), the first BHF "how healthy is your diet" (appendix 5) was used to investigate patients current eating habits and how/if their diet conformed to government guidelines in place at the time of delivery, the Eatwell Plate (Choices, 2011). The second was the Nutritional Knowledge Questionnaire (NKQ) which was chosen for its ability to investigate patient's knowledge and understanding of nutritional guidelines as and choosing healthy food options (appendix5). It also extracts useful descriptive data such as ethnicity, age range, and education levels so that a profile of current HBNW patients can be compiled (Parmenter and Wardle, 1999). Ordinarily the NKQ is used to investigate the influence of nutritional knowledge on dietary intakes for example Geaney et al., (2015) investigated diet quality on BP measurements, however, in this case it was used solely to investigate patient's knowledge and no dietary information was collected at this time. The third questionnaire was the international physical activity questionnaire (IPAQ) (appendix5), chosen for its reported ability to establish individuals' activity levels outside of the prescribed exercise classes provided by HBNW (Craig et al., 2003).

Three questionnaires were distributed to patients at the end of their usual exercise class, they were informed that completion of the questionnaire was voluntary and only if they wished to be included in the study did they need to complete it and return it for collection the following week. Distribution and collection were continued until saturation in each class was reached, or a response of 254 questionnaires were collected, this took place over a one-month period between May and June 2015.

All completed questionnaires once collected, were taken to the university of central Lancashire where they were stored in a locked filing cabinet in a locked office, once inputted onto a database, data were saved on a password protected computer. Collected data was input into SPSS (IBM, Version 22.0, SPSS, Chicago, IL (Field, 2013)) to generate descriptive data.

4.3 Results

A total of 254 completed questionnaires were returned by 204 males and 47 females. Demographic information included: gender, age, marital status, number of children, employment status, education level and nutrition qualifications. Self-reported anthropometric measures of height, weight and waist circumference were also provided.

Table 4.1 Demographic characteristics, by frequency and percentage.

CHARACTERISTIC	FREQUENCY (NUMBER OF PARTICIPANTS)	PERCENT (%)
MALE	204	81.3
FEMALE	47	18.7
AGE		
45-54	14	5.6
55-64	38	15.1
65-74	123	49
75+	76	30.3
MARITAL STATUS		
SINGLE	11	4.4
MARRIED	198	78.9
LIVING AS MARRIED	6	2.4
SEPARATED	4	1.6
DIVORCED	6	2.4
WIDOW/ER	26	10.4
EMPLOYMENT STATUS		
EMPLOYED	31	12.4

PART TIME	16	6.4
UNEMPLOYED	3	1.2
RETIRED	195	78.3
STUDENT	2	0.8
DISABLED	2	0.8
ETHNIC ORIGIN		
WHITE	247	98.4
INDIAN	3	1.2
ASIAN OTHER	1	0.4
CHILDREN		
NONE	33	13.3
1	34	13.7
2	100	40.2
3	55	22.1
4	19	7.6
4+	8	3.2
CHILDREN (UNDER 18 LIVING AT HOME)		
YES	10	4.0
NO	239	96
HIGHEST LEVEL OF EDUCATION		
PRIMARY	11	4.5
SECONDARY	37	15.1
O LEVEL	31	12.7
A LEVEL	6	2.4
TECHNICAL	49	20.0
DIPLOMA	43	17.6
DEGREE	48	19.6
POST GRAD	20	7.9
HEALTH/NUTRITION QUALIFICATION		
YES	17	6.9
NO	230	90.6
SPECIAL DIET		
YES	23	9.3
NO	223	90.7

A total of 81.3% of participant attending the heartbeat CR programme are male, this is higher than the UK national average of 70% (Rehabilitation, 2015). Over three quarters of participants, (79.3%) are aged 65yrs or over emulating the national UK average of 66yrs. The percentage of married participants is 78.9%, permanent relationship (living as married) 2.4%, widowed 10.4%, and separated 1.6%, compared to NACR figures of 70%, 4%, 11%, and 5% respectfully. Over three quarters of the participants are retired (78.3%) compared to 56% nationally. Traditionally participants attending CR programmes are White British 81%, and Heartbeat has above the national average with 96.7% of its participants at the time of this study were male, white British. It was noted however in the NACR report that regionally this is changing, and more diverse population are now attending CR programmes.

Table 4.2 Patients self-reported anthropometric measurements (mean ± SD).

	Mean	**SD (±)**
Height (m)	1.72	0.83
Weight (kg)	80.16	13.52
BMI (kg/m^2)	27.22	4.12
Waist circumference (cm)	96.04	10.26

The patients mean BMI scores place them in the overweight category (25-29.5kg/m^2). A waist circumference of 96.04cm this places the group into high risk category, WC measurements differ for males and females and when separated the following results were observed: Male (n=191) 96.77±9.61 and Females (n=46) 92.54±12.08 it was shown that Male mean scores remain in the high risk category (94-102cm) and Female mean scores places them in the Very high risk category (>88cm).

4.3.1 BHF Questionnaire results

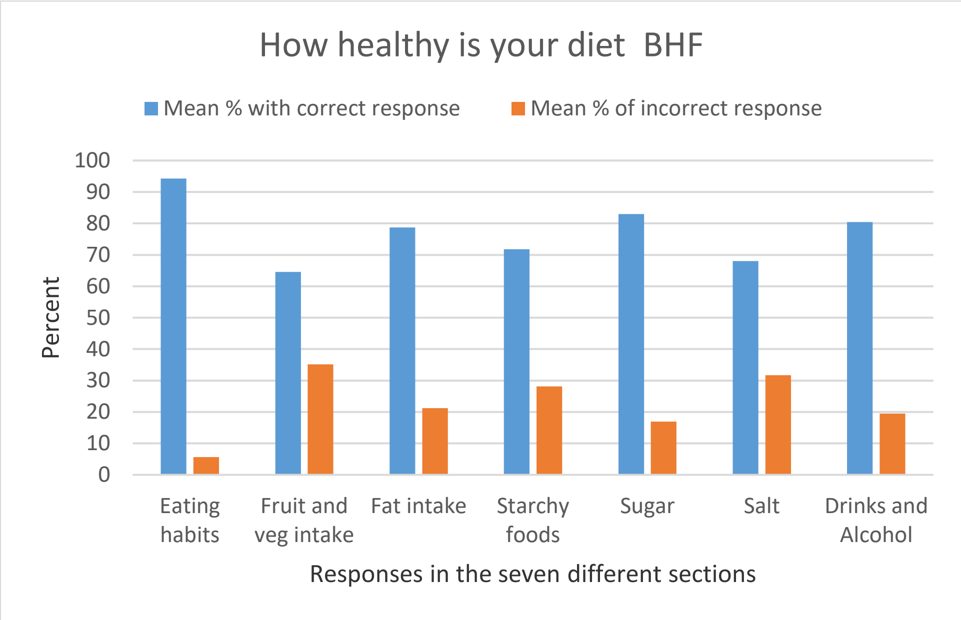


Figure 4.3: The mean scores for each of the 7 food group questions for both correct and incorrect answers expressed as %.

Table 4.3 Summary of responses to each section of the questionnaire

Section	Correct response	Summary
Eating habits	No	An average of 94.3% of the respondents answered the question correctly and do not skip meals on a regular basis. However, 10.8% report to missing lunch more than once per week.
Fruit & veg	Yes	44.6% of participant's report that they meet the daily recommended intake of 5-a-day, whilst 55.4% do not. When asked if they consume a variety of different fruits and vegetables 65.7% and 83.3% respectively, said that they did consume four different varieties each week.
Fat	Yes	84.2% of participants answered yes to choosing low fat products where possible, 87.7% use baking as a preferred method of cooking, 91.3% reported that they remove all visible fat from meat or opt for lean cuts of meat and 77.5% also report that they consume oily fish each week. 53% of participants include nuts and seeds in their weekly diet.

Starchy foods	Yes	When asked if they base main meals around starchy food 75.6% responded with a yes, 84% chose wholemeal bread, 74.4% eat wholegrain cereals without added sugar however only 53.2% include pulses in their diet.
Sugar	No	A total of 91.3% of participants' report that they do not consume sugar coated cereals, or add sugar to cereals, 83.4% do not add sugar to drinks and 95.7% do not consume fizzy drinks on a regular basis, whilst 61.7% report that they do not consume cakes sweets or biscuits at work (during the day).
Salt	No	A total of 63% of participants do not add salt to cooking and 77.2% do not add salt at the table. The total number of participants that responded with No to eating savory snacks and pre-prepared meals was 90.6% and 78.3% respectively, however only 42.1% said they did not consume processed meats.
Drinks and alcohol	Yes	When asked do they drink plenty of fluids at regular intervals each day 87% said they did, with 66.1% stating that they drank a variety of different drinks and 88.2% avoided fizzy drinks. Example of alcoholic units were provided (see questionnaire) and 80.6% responded with yes, to the question do they consume less than the recommended 2-3 units (women) and 3-4 units (men) per day.

The questions required a yes/no response, and a scored questionnaire was supplied by BHF each correct answer was recorded and scores collated providing percentage of correct responses for the group. (see appendix 5 for the questionnaire)

4.3.2 Nutritional knowledge Questionnaire (NKQ)

Table 4.4 Mean and standard deviation participant scores for each of the four sections of the questionnaire, explained in more detail in methods chapter 2.

Questionnaire section *(max score possible)*	***Mean***	***SD (±)***
Section 1 (11)	8.73	1.38
Section 2 (69)	47.24	8.46
Section 3 (10)	7.19	2.16
Section 4 (20)	9.18	2.66
Combined 110	72.08	14.68

A scoring protocol was provided (appendix 6) for each section, maximum scores for each section are shown in brackets.

4.3.3 Section 1. Dietary recommendations

This section carries a maximum score of 11 points the mean score was 8.73(±1.38). The question asked for this section was "do you think health experts recommend that people should eat more, the same amount, or less of these foods? Vegetables, fat, sugar, and salt are counted as separate items and score 1 point each. A total of 64.6% of participants scored 8 or less, 38.2% scored 9, 26.4% scored 10 and just 2.8% scored the maximum of 11 points. 49.6% of participants were not aware of the recommendations to reduce their intake of meat, and 92.5% were not aware of the messages to increase starchy foods in their diet. Participants were aware of how many portions of fruit and vegetables were being recommended with just 13.9% giving an incorrect response, 5 or more portions scored as correct, and 77.8% are aware that saturated fats should be reduced in the diet.

4.3.4 Section 2. Food groups

This section carries a maximum of 69 points. Questions in this section are concerned with food groups and which foods are within the groups, for example "do you think these foods are high or low in added sugar?” the responses are high, low, not sure and one point is awarded for each correct response. The mean score was 47.24 (±8.46) there are many highlighted areas in this section demonstrating areas of limited understanding or confusion. A total of 39% of participants did not know bananas, and tinned fruit juice in natural juice (43.7%) were low in added sugar. When asked questions on which foods were high or low in added sugar, fat, salt, and protein incorrect responses were seen by between 25 and 40% of participants. Low fat spread and polyunsaturated margarine were incorrectly scored as low fat by 83.5% and 66.9% respectively. When asked if foods were low or high in protein 90% knew that chicken was high but around one third of participants gave incorrect responses for baked beans, cheese, fruit, butter, and cream. Participants scored well on most foods in the “are these foods low or high in fibre” section except for cornflakes and bananas with incorrect responses of 51.2% and 37.8%.

There is a clear indication that there is confusion with fat, several questions use the same foods but ask different questions, for example; “polyunsaturated margarine contains less fat than butter” 79.9% answered with agree or not sure., and to “which do you think is higher in calories, butter or margarine” 70.5% of participants scored incorrectly. 46.5% thought brown sugar was a healthy alternative to white sugar and 56.7% thought that whole milk contains more calcium than skimmed milk.

4.3.5 Section 3. Choosing foods

In this section participants are asked which food choice are best and are asked to score on which they think are best rather than what they like or dislike and are given an example. There is a possible maximum score of 10 points in this section, a mean score of 7.19 (±2.16) was recorded. Participants generally scored well when asked questions on which the best choice of low-fat high-fibre meal would be (77.6% correct), which sandwich is healthier (75.2%), best choice to reduce fat (87.8%), which is the healthiest pudding (80.7%), however which was “best choice lower fat option cheese” almost half scored incorrectly (49.6%).

4.3.6 Section 4. Diet and associations with health or disease.

The maximum possible score is 20 for this section and the mean score is 9.18 (±2.66). it is apparent from the mean score that participants scored low in this section, the first five questions ask about the association between diet and disease or health problems, the response choices are; yes, no, not sure which does not score however if they answered yes they are then asked to provide which disease or health problems they think are associated with the particular food/group of foods. An example is “are you aware of any health problems associated with a low intake of fruit and vegetables?” they score one point if they indicate heart disease, cancer, bowel disorders etc. two thirds of participants scored well in this section. Participants were less successful in identifying which foods helped in reducing the risks of certain cancers with incorrect responses given for; eating less sugar 86.6%, less fat 90.2%, 86.2% and less preservatives 94.1%. They scored highly when asked similar questions about heart disease, eating less saturated fat 93.3% correct, 93.7% correct less salt and 92.9% more fruit and vegetables, however eating more fibre and less preservatives scored incorrectly with 95.3% on both questions.96.6% did not know that saturated fat was more likely to raise blood cholesterol than cholesterol in the diet or polyunsaturated fat or answered they were not sure.

The final question in this section was “have you heard of antioxidants?” 99.6% of participants responded with a no with just 2 people not answering the question. However only 102 participants attempted to answer which vitamins they thought were antioxidants and of these over 89% scored incorrectly on all of the following; vitamin A 89.8%, B complex vitamins 91.3%, vitamin C 96.1%, vitamin D 90.1%, vitamin E 97.2% and vitamin K 94.9%.

4.4 International Physical Activity Questionnaire (IPAQ)

Exercise prescription forms one of the key components of all CRP in the UK (Balady 2007). Patients that attend Heartbeat NW attend at least 2 x 1-hour exercise sessions as a part of their CRP, the IPAQ was added to the questionnaire with the aim of assessing how active participants were in their daily lives outside of their CRP.

Exclusion criteria were implemented for the IPAQ and any missing data/refusal of questions resulted in that case being removed from the analysis, outliers in the form of over or under reporting of activities were also removed in accordance with the IPAQ data processing rules.

Table 4.5 IPAQ - Summary of inclusion/exclusion criteria

Exclusions	**Number of participants**
Did not attempt any of the sections	n= 25
Did not answer 1 or more sections	n=194
Did not include number of days in one or more sections	n=2
Did not include number of minutes of activity in one or more sections	n= 8
Total included for analysis	n=25

For the remaining 25 participants, met minutes were calculated by multiplying the MET value of activities (appendix 14) by the number of minutes the activity was performed and by the number of days, eg;

Walking MET value 3.3, multiplied by 30 per day for 5 days.

3.3 x 30 x 5 = 495 met.min.wk-^{1}

Recommended activity levels per week are 30 minutes of moderate to vigorous activity on 5 days of the week or more, therefore the minimum required total amount is 150 minutes. The MET level for moderate is between 3-6 Mets of activity, <500-1000 Met mins per week is the minimum target set by the American College of Sports Medicine (ACSM. 2014) amounting to above required actual minutes of activity.

The IPAQ has four domains for different aspects of daily living; work related activity, active transport (walk and cycle), domestic and garden chores and leisure time activities. Activity levels are calculated in metabolic equivalents or METs. The MET values are defined as the ratio of the work metabolic rate to a standard resting metabolic rate (RMR) of 1.0 $kcal.kg^{-1.} h^{-1}$. One MET is considered the RMR or the energy cost of a person at rest (Howley, 2000;Ainsworth, 2011)The mean scores from each domain were calculated and placed into three categories: walk, vigorous and moderate.

Table 4.6 The mean and standard deviation of met. min. wk^{-1}

Activity	Mean	SD (±).
Walk	732	725
Vigorous	1261	776
Moderate	1067	893

Mean and standard deviation (SD) scores are all presented in $met.min.wk^{-1}$

According to the ACSM (2014) guidelines participants are in the moderate category for all walking activities with a mean of 732 met.min. $wk\text{-}^{1}$, thus meeting the recommended minimum amount of activity per week. The amount of moderate intensity activities calculated at between 3-6 Mets, which covered moderate intensity work related activities such as lifting and carrying, also gardening, digging, and inside chores such as cleaning, cycling as a form of transport was also included in this section as was any leisure activity of a moderate intensity. The participants scored 1067 $met.min.wk\text{-}^{1,}$ this places their moderate activity above the minimum requirements. The amount of reported vigorous activity places the participants above the recommended 30 mins /day most days of the week with a met value of 1261 $met.min.wk\text{-}^{1.}$

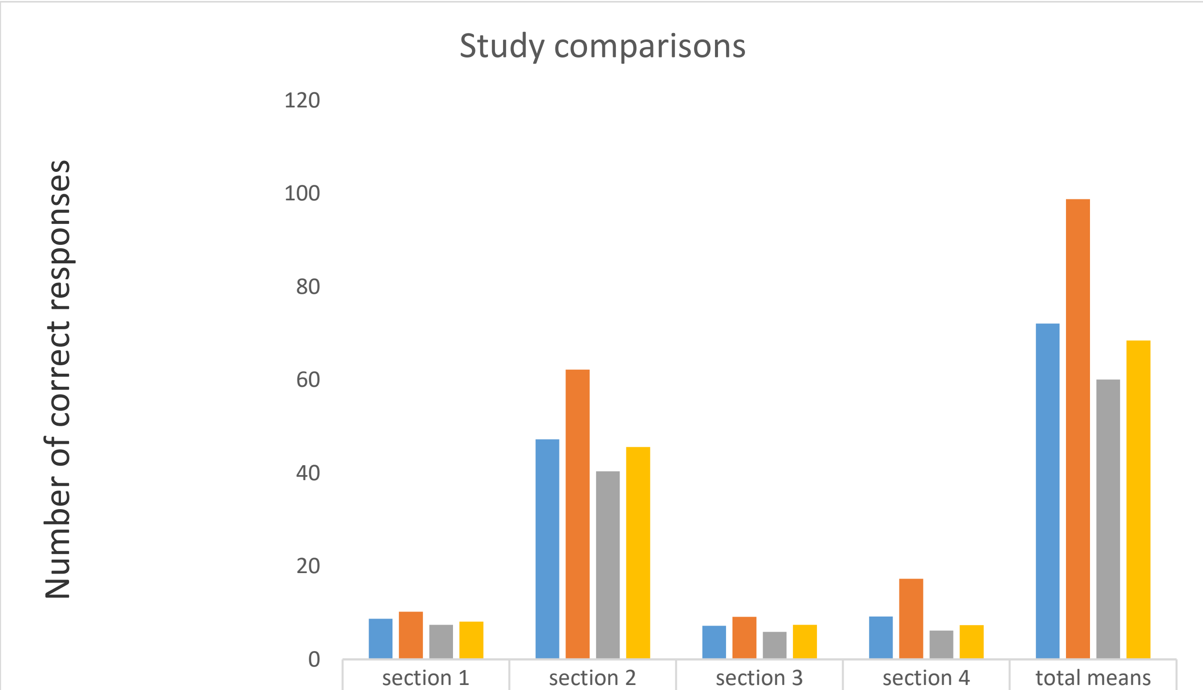
4.5 Discussion

Results from the questionnaires has established that a "typical" Heartbeat NW patient is Male, White British, married, aged >65 and retired. He has a BMI of 27.14kg/m^2 which places him in the overweight category, and he has a waist circumference of 96.7cm placing him in the high-risk category. This profile is typical of CRP patients when compared to other CRP's in the UK (Rehabilitation, 2015).

Evaluation of the questionnaire found that participants report that they have adopted eating patterns in line with current nutritional guidelines, they choose lower fat options when available, bake or boil rather than frying foods, limit the amount of processed foods in the diet and reduce salt, sugar, sugary drinks, biscuits and pastries. Their alcohol intake is reported to be in line with one unit for women and two for men. Only 44.6% reported that they meet the recommended 5-a-day or more of fruit and vegetables and when asked if they are aware of what experts recommend, they should consume each day in the NKQ, 86.1% of participants said they were aware of the recommendation. 75.9% of participants said they base meals around starchy foods like pasta, rice wholegrain foods etc. but when asked if they were aware of the recommendation to increase their intake 92.5% said they were not. Interestingly when the results of this study were compared to the original NKQ in 1999 (Parmenter and Wardle, 2000) the same gaps or misunderstanding in knowledge is still evident, which indicates that the messages are either not being delivered adequately or are not being understood by general populations. Questions relating to the amount of fat and calories in different types of oils, butter and margarine showed that 83.5% of people reporting that they thought polyunsaturated margarine and low-fat margarine were low fat products and that butter contained more calories than margarine. When asked which foods contained high or low amounts of protein approximately one third of participants scored incorrectly or did not know. And foods with added sugar was answered incorrectly by almost half of respondents for example 43.7%

thought that tinned fruit in natural juice was high in added sugar. Questions around nutrition related illness and disease, and antioxidant vitamins were all poorly understood with over 90% of participants leaving this section unanswered.

Heartbeat NW participants' nutritional knowledge and understanding was good when compared to general populations (Parmenter and Wardle. 1999; Alsaffar et. al., 2012). In the present study, the NKQ was used to gain an understanding of the nutritional knowledge of Heartbeat patients. The results demonstrate that compared with populations from previous studies, HBNW participants scored better than general populations in England.



	section 1	section 2	section 3	section 4	total means
Heartbeat	8.73	47.24	7.19	9.18	72.08
Dietetic students	10.2	62.2	9.1	17.3	98.8
computer science students	7.4	40.4	5.9	6.2	60.1
cross-section UK	8.1	45.6	7.4	7.35	68.45

Figure 4.4 A comparison of NKQ results from the Heartbeat participants compared with students and a cross section of UK adults (Parmenter et al., 2000).

Heartbeat participants scored higher than a cross section of UK adults in sections 1,2 &4, better than computer science students in all four categories and less than dietetic students in all categories, with a total mean score of 72.08 compared with 68.45 and 60.1 respectively. This suggests that Heartbeat participants have a good level of understanding when compared to other general populations.

Responses to the IPAQ were disappointing; just 25 participants completed the questionnaire providing limited data for analysis. However, results did suggest that participant's activity levels met current recommendations of 30 minutes of moderate intensity activity on most days of the week. As part of the CRP patients attend at least 2x1 hour exercise sessions per equating to 120 minutes of moderate exercise, therefore a requirement of just 30 minutes is needed to meet the 150 minutes recommended (American College of Sports Medicine, 2013).

Patients that attend a cardiac rehabilitation program have already made a commitment to change and have adopted several measures, including attending exercise sessions, to improve their lifestyle and reduce their risk of further disease progression. Many participants meet, or exceed, the minimum recommended amount of exercise per week due to the two x 1-hour exercise classes they attend as part of their CRP.

4.6 Key points

- Self-reported demographic data describes a typical HBNW patient is male, White British, aged ≥65 years old their anthropometric measurements of BMI and WC place them in the overweight category (27.14kg m^2) and high-risk category (96.7cm) respectively.
- Their current eating habits show they are ready to make changes and bake, grill or poach rather than frying foods, they don't consume large amounts of sugary drinks, or cakes and pastries and trim the fat off meats or purchase lean cuts. Alternatively, only half of the population consume the recommended 5-a-day fruit and vegetables. There is some confusion around foods with added sugar, which foods were high in protein and the

recommendations to reduce meat intake in addition to confusion around low fat products and fats/oils in general these results are similar to previous studies (Parmenter and Wardle, 1999, Wardle et al., 2000, Alsaffar, 2012).

Current activity levels for all CR patients are a minimum of 120 minutes of moderate intensity exercise prescribed as part of the CR programme, and the completed IPAQ questionnaires suggest they remain active outside of these classes and exceed the 150 minutes recommended at the time of this study (World Health Organization, 2010)

4.7 Limitations The questionnaires chosen for this research strand were selected with the specific Heartbeat population in mind. For example, the BHF, although commonly used to assess the eating habits of a workforce, was also appealing for this population as the information is clear and evidence based. Previously HBNW have used BHF materials and there was an assumed familiarity with these materials. The limitation here was that the questionnaire was not validated, and a validation study would be warranted to assess its efficacy for future use and was not carried out here as it is outside of the requirements for this research. The NKQ was a very useful tool and has been used extensively to examine how nutritional knowledge translates into intake (Geaney, 2015; Cooke, 2014; Feren, 2011; Heikkilä, 2018)in a variety of populations.

Chapter 5

Study 3

BARRIERS TO MAKING DIETARY CHANGES IN CARDIAC REHABILITATION PATIENTS

A Focus Group Study

5. Overview of Chapter 5. Study 3

The following chapter provides details of how and where FG sessions were held and explain how the data was collected, transcribed, and interpreted. It will also provide details of how findings from the FG's helped to inform the content of the new education programme.

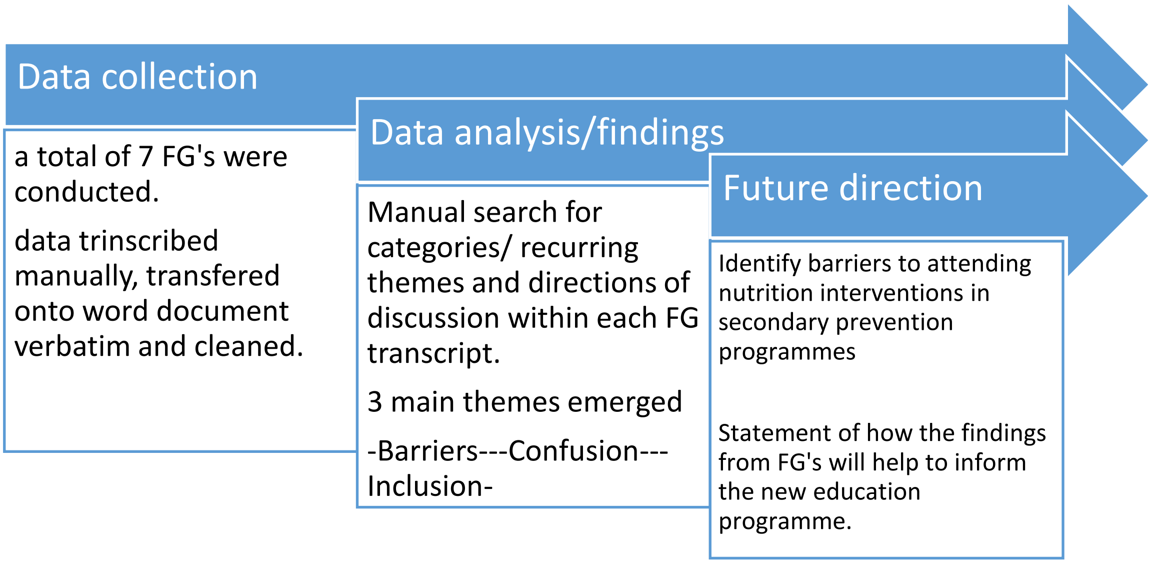


Figure 5.1 shows the sequence of events in the data collection and evaluation focus group sessions with a summary of findings to inform the new education programme.

5.1 Introduction

Many CR patients perceive that dietary change is dependent on "cutting things out" of their diet, rather than increasing their intake of healthier foods or trying new foods (White et al., 2011). In the UK, the profile of individuals' attending CR programmes is predominantly male, white, British with a mean age of 66 years and retired, making up 70% of the CR population (Doherty and Harrison, 2016). Males are far less likely to attend weight loss programmes, and in a recent audit of commercial weight loss programmes involving 1.3 million adults, Stubbs et al., (2015) reported that only 5% were males, however, those that did attend saw greater absolute and percentage weight loss than their female counterparts (Stubbs et al., 2015). In this older population, poor nutrition or food choices prior to diagnosis of CHD may be continued following diagnosis without correct education and support (Lancashire et al., 2002). Men are more likely to see healthy eating as boring and unsatisfying (Sobal, 2005), and regardless of their awareness of healthy eating messages they may be sceptical or unwilling to making changes. In the context of CR, little has been published on patient experiences regarding healthy eating advice following diagnosis, and if this advice translates into diet change. In order to provide meaningful nutrition education (NE) to CR patients, it is necessary to understand what healthy eating means to them, and highlight barriers to attending NE in the future (Ma et al., 2010b). Therefore, this study aims to explore patient's perspectives on healthy eating and identify barriers to making dietary changes.

Focus Groups provide a non-threatening environment for participants to talk openly, potentially generating interesting and varied answers to the point under review, they also provide a useful means of data collection in studies where there is little known on the subject of interest (Stewart and Shamdasani, 2014). This study aims to investigate patient's perspectives on healthy eating and identify barriers to making dietary changes. Focus Groups

(FG) interviews provide a rich and meaningful insight onto participant's perspectives on any number of topics (Duggleby, 2005, Morgan DL, 1998).

5.2 Pilot FG

A set of questions were developed by the researcher to guide the FG discussion, containing 2 simple engagement questions designed to break the ice with the group members, 6 exploratory questions, and an exit question (Stewart et al., 1990, Krueger and Casey, 2002, Stevenson et al., 2007, Isaacs, 2014). A pilot FG (5 male HBNW members) was conducted ahead of general recruitment, enabling the researcher to check the recording equipment worked correctly, identify the level of background noise and foot traffic past the room, assess the suitability of the room (size and comfort), and assess the audibility of the recording following the session. The pilot FG also allowed the researcher to refine the order and content of the questions based on the responses and direction of the discussion. Following the pilot FG, the questions were amended to reflect the flow of conversation, see (Table 5.1) and were used in each of the FG's to provide comparability between the groups (Krueger and Casey, 2014).

Questions

The focus group session followed guidelines from Krueger (Krueger and Casey, 2002) providing a welcome, overview of the topic, outlining the ground rules and setting the first question to break the ice and allow each participant to speak early in the session. Audio recording equipment was placed in the centre of the table at which the participants were seated and switched on at the start of each session.

Table 5.1. The modified questions used for each focus group.

FOCUS GROUP QUESTIONS
Engagement Questions: 3. **What did you have for tea last night?** 4. **Who decides what you eat?**
Exploratory Questions: 8. **What does healthy eating mean to you?** 9. **Do you think that you eat a diet that will reduce your risk of future heart episodes/problems or further progression of your disease?** 10. **How many portions of fruit and vegetables did you consume yesterday?** 11. **What would stop you from attending a nutrition education programme?** 12. **Is there anything that you feel you would like to know about certain foods and your condition** 13. **If someone said, eat like this and your cholesterol/BP/glucose levels would improve, (potentially reducing the need for medication), would you be interested in taking those steps?** 14. **Have you been given nutrition/healthy eating advice in the past? If so, was it helpful? And how long ago?**
Exit Question 2. **Is there anything you would like to add about healthy eating advice that we have not covered here?**

Original questions can be viewed in appendix 11. changes made were minimal and reflected the flow of conversation in the pilot study.

5.3 Methods

Recruitment and advertisement for the study followed previous protocol, in addition to these the dates and times of the FG's were printed and placed on the main reception desk, allowing participants to sign-up to a session that suited them. A maximum of eight places were available at each of the FG sessions (Isaacs, 2014), FG times were either 10am or 2pm allowing participants to attend either before or after their usual exercise sessions. All FG's were conducted between April and July 2017 in the main HBNW centre.

5.4 Data collection and analysis.

Seven FG were conducted, it was thought that the sixth FG reached saturation point, with similar discussion being seen in each group, however one more FG was carried out for confirmation (Green et al., 2007, McKee et al., 2007). Each focus group contained between two and five participants lasting between 45-60 minutes (Stewart et al., 1990) At the start of each FG the researcher welcomed the participants, explained the format of the session, provided details of the researcher's role as the moderator, and as such would not participate in the discussion, other than to keep the dialogue on track. Participants were asked if they had any further questions before the start of the session.

Data was then analysed using Krueger's classic systematic analysis approach (Krueger and Casey, 2014, Krueger and Casey, 2002).

ix) Recordings were listened to without making notes or transcribing,

x) Transcribed using pen and paper, verbatim.

xi) Handwritten transcripts read again

xii) The transcripts were cleaned, whilst being transferred into word document, taking out “er”,” um”, and pauses in the conversation that did not add to the conversation (Stewart and Shamdasani, 2014)

xiii) Transcripts from Each FG were coded.

xiv) Following initial coding, the responses to each question were collected and re coded

xv) Codes gathered into categories

xvi) Emerging themes identified.

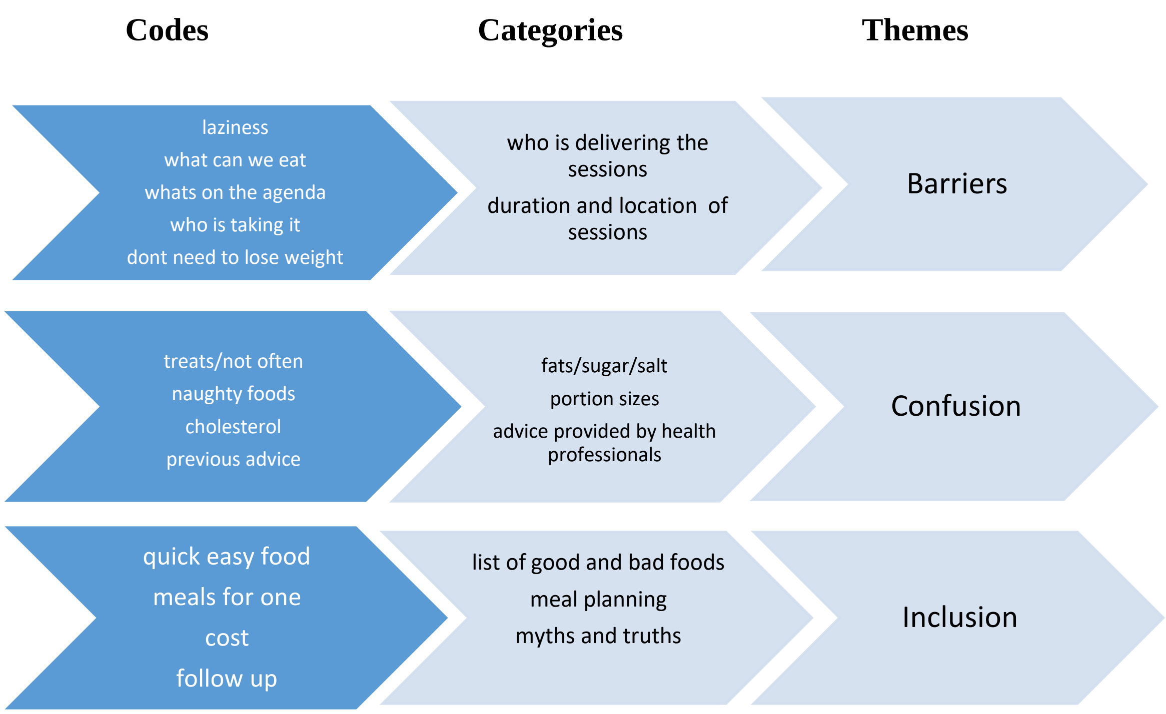


Figure 5.2 Thematic analysis of coding process, from codes to categories and emergent themes. An inductive approach to coding was used and three dominant Themes were identified, i) Barriers, ii) Confusion, iii) Inclusion.

5.5 Results

In total 28 people (20=male (71± 5.9) and 8=female (73±7.3), 100% white British, participated in seven focus groups. Each focus group contained between 2 and 5 participants (Stewart and Shamdasani, 2014).

Table 5.2. Shows a summary of responses grouped together into the three themes that emerged following the extensive coding and re-coding process, these themes were: i) barriers, ii) confusion and iii) inclusion.

BARRIERS	CONFUSION	INCLUSION
• Time • Motivation • Where will it be held? • Will it be fiddly foods? • Is it a diet? Don't want to be left hungry • Going alone and not knowing anyone • Trust – who will be delivering it • Don't need to lose weight so don't need it • Don't like cooking so don't want fancy recipes • Will we have to buy expensive foods	• Which fats are best? • Which foods contain sugars/ hidden sugars and how much sugar is ok? • How is cholesterol affected by the diet, what foods can help? • Are frozen fruit and vegetables ok? • Bananas full of sugar! • Naughty fruit and vegetables? Don't know which to choose • Media saying this is "good" and this is "bad" don't know which to believe	• Meals for one • Quick and easy/simple foods • Inexpensive foods • A list of "good" and "bad" foods • Information on portion sizes • Nutrition for older people • Explain fats/sugar and salt • Provide information on GI of foods • Provide meal plans/diet sheet • Provide a follow up

In the following section, results from the FG sessions are presented using each of the 3 main themes. Participant responses have been used to add context and meaning to various points that arose during the sessions.

5.5.1 Theme 1: barriers (to making healthy food choices and attending nutrition education programmes)

Time. Participants discussed time as a barrier to attending future healthy eating interventions at HBNW; time was discussed in different forms, for example: the time it would take to travel to and from the venue for the sessions

"Like it may be an hour to get there and back then it takes up a lot of time" (1 M5).

Some talked about having transport issues having to catch a bus,

"Yeah, ye I mean im same, but I mean I can't get here unless I come on the bus you know, and it—makes things awkward" (5 F3)

Whist others discussed that the time of day would influence whether they would be willing to travel to attend sessions. Most participants pointed out that the duration of each session and the total duration of the programme (e.g., 6 weeks) would affect their willingness to participate in future programmes, as they had other commitments that may interfere with attendance

"Yeah if it was for a set amount of time then yeah I would be(interested) --, I would come to it but if it was ongoing, sorry but you just get a bit fed up don't you?" (2 F5).

2 out of 7 groups commented that if it was "added on" to their regular exercise time it may be possible to attend. Time was also used by a few participants in the context of having time to purchase and prepare healthy foods when compared to using pre-prepared or fast foods. There was a perception that eating healthy took time and commitment.

Motivation. Lack of motivation may lead to disinterest in taking on extra commitments, one participant reported that laziness was a factor and he may find it difficult to come back out (from home) for a separate session.

"*Laziness that's all, if I hadn't come here this afternoon, I'd be in my chair asleep" (4 M3).*

Being motivated to prepare foods from scratch was not always easy as some participants lived alone and found it more challenging to cook "proper" meals just for themselves. A few participants said they did not like to cook so if it were "fussy foods" then they would not want to try them "*I can't be bothered with thinking oh I will make this myself or I will make myself that because it's too much trouble. I just want basic ingredients and I'll eat them every day until I get a bit tired of something and I'll change that "(4 M3).*

At least one person in each group commented that they did not see the need to change their diet, as they were not overweight

"Well, I don't, I will be quite honest with you I don't really feel that I need to go on a strict dietary regime I think that I eat reasonably sensibly and have done all my life". (5 M1)

There appeared to be a perception that overweight, and obesity were directly related to poorer health, and there was no need to make dietary change if they were "normal weight". This also ties in with the fact that many participants saw healthy eating as "eating like rabbits", cutting out foods that you like

"I think it is possible to cut things out altogether, I mean well I used to eat quite a bit of cheese but now I don't eat any at all now –a few years ago I used to have crisps and things like that but I just don't buy anything like that at all nowadays" (6 M1)

and "going on a strict diet". Therefore, their perception of being healthy was reflected in whether they thought they needed to lose weight or not.

Cost. Many participants reported that they had tried diets in the past and they used ingredients that were only required in small amounts, and never used again, this posed a problem for those on a tight budget (pension) and they would not want to waste money on complicated recipes that required many expensive ingredients. There is an assumption that a nutrition education programme would be like commercial diet/slimming clubs and may contain recipes requiring expensive ingredients and time commitment to prepare healthy meals.

5.5.2 Other barriers.

One female participant said she may have concerns about attending alone, feeling anxious if she were to attend alone and fear of not knowing other people in the sessions. Whilst another female participant had her adult Son living with her and he was not supportive when it came to healthy-eating and that he preferred to eat pie and chips rather than vegetables or salad, so family support is an important point for some.

The final point that was made in several of the groups was who would be providing any nutrition information in a new intervention. They wanted to know if it would be someone who wanted to sell a product or get them to sign up to something.

"I think I'd like to know who was taking it, and whether in fact I had confidence in that person, and they weren't selling something" (2 M1)

5.5.3 Theme 2. Confusion

All seven groups reported that media messages added to their confusion on which foods they should eat and not eat, stating confusion around; the different types of Fat, the sugar hidden in foods, the amount of salt that is recommended, the role of diet in reducing cholesterol, and reading nutrition labels on foods. Five out of seven groups were confused about portion sizes and how to achieve the 5 portions of fruit and vegetables per day that are currently recommended. Additionally, the information that they had received from health professional, including GP's, consultants and dietitians had added to the confusion in many cases. Participants voiced their opinions on what constituted a healthy diet and foods that are reported to have conflicting messages, demonstrating the level of confusion felt within the groups, here are some examples;

"Healthy eating for me is --, confusing because there are so many people doing research on whether cheese is good for you or not good for you. Some say it's bad some eat it and I get confused. There are three areas for me one is salt, one is fat and the other one is sugars. And I'm afraid in all the research that is being done at the moment they all have different versions of diet and one comes and then the other as long as you have in the back of your mind not too much sugar not too much fat and salt, I don't know about salt.(2 M1)

"And like what was it, 10 years ago you ate 2 eggs, and you were guna be dead by weekend and now they are good for you" (7 M4)

"They (manufacturers) have now started this traffic light system where you can see red, yellow or green that seems to confuse me more than help me, because it can show probably less than 5% fat, but it will be showing in the red, so it doesn't seem to add up somehow" (1.M5)

Many participants reported having no nutritional help or guidance following diagnosis or medical intervention. Some remembered having very limited contact with a dietician, for example, a one-hour session in a series of lifestyle modification classes. A few said that the information they were given by their medical team directly following surgery was limited or unhelpful as this next insert demonstrates;

"When I had my operation the surgeon said to me afterwards, if it tastes good then don't eat it, you can't have it, that's what he said, if it tastes good you can't…, my wife said what do I feed him on? (4. M2)

"Just coming back to the banana that raises an issue because we keep getting contradictory advice. When I was, I mean when I had my bypass 10 years ago, when I was coming out they said you've got to eat a banana every day 'cause it's, I think its potassium or magnesium that's

needed so you know they give you bananas because it's got that in it. Now you shouldn't eat them because they're full of sugar, so you know it's a bit of a dilemma". (6 M1)

Others had attended some form of nutrition education and this appears to have added to their confusion in some cases. Participants discussed what they had been told from health professionals, one female participant said:

"That's a naughty fruit (banana), your Satsuma's are naughty, your grapes are naughty, on the list they gave me, any melon is quite good for you and blueberries, raspberries, they are on the good list, anything expensive"(4 F2)

Whilst a male, recently diagnosed with type II diabetes, had attended a DESMOND (diabetes education and self-management for ongoing and newly diagnosed) course and recalled some information he had been given:

"Do you realise how much sugar is in a jacket potato? About 16 cubes, that's what they told me when I went to that DESMOND. They had all these things laid out, and how much sugar is in stuff, and in a bowl of sugar puffs and what you think when you only put like a few in. All day all she did was bombard you all this and that and what sugar was in--." (1 M2)

Two female participants were discussing buying foods in the sale section in the supermarket; one had bought chicken Kiev, stating that she knew she shouldn't really eat these too often, the following comment was made, and one of the male participants added to the conversation:

"Why are you not supposed to have chicken Kiev?" (7 F3)

"Well because there's butter and all sorts of stuff in it, its" (7 M5)

"But garlic butter, isn't it (garlic) good for you?" (7 F3)

5.5.4 Theme 3. Inclusion

Participants discussed a variety of options that they felt would benefit them, to be included in any future nutrition education offered as part of their current rehabilitation programme. Some participants referred to the negative aspects of current advice telling them what they should reduce or cut out of their diet altogether and focus on what they can and should be eating. These two extracts convey the feelings of several participants:

"All I want is a thing that tells me what I ought to eat, what I can eat sometimes and what I should never eat" (4 M3)

"You could do like dos and don'ts and maybe's, because that's the hardest thing, because when you go shopping you can say to yourself, well that is perhaps a once-a-week treat, these are what I can definitely have but those I shouldn't" (4 F4)

They also wanted practical ways to facilitate adherence to guidelines and make improvements to their diet. Some participants correctly identified a portion size and provided examples (80g, one apple) whilst others expressed their confusion:

*"*The thing that I can never get my head round is what is a portion? *Like you say with your main meal, you have peas or carrots or whatever, how much do you put on as a portion?" (1 M1)*

Another area for inclusion was providing some nutrition science behind current recommendations, in particular fats, salt, and sugar

"I would be interested in the science of nutrition and what foods do for you – I think knowledge of that would help us, it doesn't have to be in depth science, but at least understanding it" (3 M3)

As well as:

"Something that's varied, not something that's boring something that fills you up. I can look at those cakes and not eat them because its morning. Every morning I have a bowl of porridge with honey and milk and that fills me up, but I go to an art group on Wednesday afternoons and I clear the plate of biscuits ha-ha-ha so yes something that won't make me feel hungry or you know, make me feel miserable" (3 M2)

Another participant stated:

"We don't want don'ts we want Do's" (1 M4)

5.6 Discussion

Across all seven focus groups, patients demonstrated an understanding of current nutritional guidelines, however, they discussed issues and concerns that they have when putting these recommendations into daily practice, for example balancing reduced fat, reduced sugar and salt and if a product is low fat it may contain more sugar. When asked what healthy eating meant to them, there was a range of responses including eating less fat, reducing sugar, reducing salt, and including more fruit and vegetables, demonstrating knowledge of current guidelines. In contrast, others though it meant cutting out foods they liked, eating like rabbits and feeling hungry, these responses echo those of Macdiarmid, et al (2013) who noted that some patients associated healthy eating with feelings of hunger and feeling anxious about being hungry when adopting a healthy diet (Macdiarmid et al., 2013). Some patients described not being as knowledgeable as they should be when it came to implementing change and discussed confusion around current recommendations for heart health, which is Similar to findings by Booth et al (2013) in which newly diagnosed diabetic patients attended FG's. They identified key themes which included barriers to making dietary changes, confusion with portions sizes, and knowing what to eat. In the present FG's patients also shared these concerns but also expressed confusion about how to incorporate the recommendations for fat, salt, and sugar into their daily meals. These areas of confusion confer with early findings in chapter 4 with the questions regarding fat content of foods, which foods were highest in added sugar and added salt. Consequently, the new education programme should consider ways of overcoming these barriers, patients offered solutions and said they would like to have clear guidance on low cost, easy to prepare, simple foods that can clarify how to reduce intake of salt, sugar and saturated fats.

People who lived alone reported that this had impacted on their diet, widowed females for example may have reduced motivation to cook whilst men, who were not responsible for preparing meals previously, may have limited cooking skills and may rely on more pre-prepared foods or consume simple meals. External factors such as skill level (in this case to purchase individual ingredients and having the skills to prepare meals), resources (availability of foods, available funds), and environmental conditions (available time, motivation and family support) all influence dietary habits (Goodwin et al., 2012). Many patients saw healthy eating as "cutting foods out" of the diet that they deemed to be unhealthy rather than adding healthier foods into the diet which is consistent with previous findings by White et al (2011) who conducted FG's with CR patients who reported that if they thought their diet had a direct impact on their CHD they would make changes, they also uncovered similar barriers such as time, willingness to make changes and knowing what they should eat. Whereas Lacroix et al (2017) found that avoidance of less healthy foods was not as important as the addition of healthy foods into the diet for secondary prevention of CV events (White et al., 2011, Lacroix et al., 2017).

The quality and quantity of nutrition advice following diagnosis of CHD, or following surgical intervention was similar in all groups with little or no guidance provided, and the advice that they did recall was unhelpful or unsupportive in most cases. Worryingly, the guidance provided by health professionals, dieticians, and medical consultants all seem to have added to the confusion in these patients. There is strong evidence in support of the Med diet (MED diet) for primary prevention (De Lorgeril and Salen, 2006, Delgado-Lista et al., 2016), and secondary prevention of CHD (Bisogni et al., 2012, Fix and Bokhour, 2012) . Nevertheless, the results of this research show that there are serious disparities in the translation from these recommendations to the shopping trolley and onto the plates of cardiac patients. Their experiences of nutritional advice do not appear to provide the necessary education to promote behaviour change. Perhaps it is not the information provided to the patients; rather the delivery of that information, that needs serious modification, the negative connotations of nutrition advice here warrant further investigation.

Evidence shows that education programmes that concentrate on several modifiable risk factors together, can improve patient's knowledge and facilitate behavioural change in areas such as; medication adherence, smoking cessation and making positive dietary changes (Booth et al., 2013, Truman and Elliott, 2019). Poor nutritional choices can increase the risks in those diagnosed with CHD, equally, adherence to correct dietary recommendations can positively influence or even reverse heart disease (Lacroix et al., 2017). Therefore, it would seem logical that those diagnosed with CHD would make the necessary changes to induce positive outcomes for their future health. Unfortunately making dietary change is complex with no one size fits all solution, and as highlighted in this study, there are many barriers to making change.

Patients in this study made several recommendations for future nutrition education within their CR programme, these included meals for one, simple meals using inexpensive foods, a list of "good" and "bad" foods as well as information on portion sizes and clear explanation of which fats they should use and how to reduce sugar and salt. In addition to this, they also felt it would be beneficial to have regular follow up sessions, so any problems can be addressed. The overriding message extracted from this study is that patients want to be told what they can and should eat rather than what they should not, "*we don't want don'ts, we want do's*" (1MS)

It is imperative that challenges that patients face are understood and to provide meaningful nutrition education programmes in future (Goodwin et al., 2016). Patients in this study have demonstrated they are motivated and are receptive to information provided by health professionals to improve their quality of life and reduce further progression of their disease. Patients also suggest that current healthy eating messages are confusing and worryingly many have experienced unhelpful and misguided information from professionals tasked with providing this vital information, this included dietitians who were reported to focus on what not to eat. It is evident that a more positive approach to providing dietary information is required, concentrating on a whole diet approach rather than vilifying single nutrients. If lessons are to be learned from this research it is possible that bespoke nutrition education programmes can be provided for CR patients and revolutionise the way in which we deliver the healthy eating message to facilitate positive, long term changes.

5.7 Key points

Mixed messages in the media and from healthcare professionals adds to the confusion patients feel surrounding healthy eating. Patients are generally interested in making changes to improve their health if they feel the changes directly apply to them. Barriers to attending nutrition education in the future should be addressed to facilitate change in this older, predominantly male population. Patients reported that they are always told what they should not eat but feel they are not provided with enough information on what they should eat and have previously had negative experiences with healthy eating programmes as they are primarily weight loss focussed or conjure images of “being hungry” and “eating like rabbits”.

There is a need for an evidence-based nutrition education programme, one that clarifies currentthinking on nutrition for heart health. In addition to explaining current guidelines on portion sizes and making simple changes to the diet, this would provide positive re-enforcement for making heart healthy changes, not simply for weight loss.

5.8 implications for new education programme

The new education programme will focus on what foods shold be included in the diet with a rationale for the recommendations. Information on portion sizes will also be included along with details on how to reduce the main three recommendations: fat, Sugar and Salt. The new education programme will not be prescriptive in its approach, rahter it will act as a guide to making informed choices, supported with contemporary research to facilitate long term change in eating behaviours.

5.9 Recap

The BACPR provide core standards on which secondary prevention programmes are based (Cowie et al., 2019, Jones et al., 2012) and there is evidence from NACR figures that many aspects of CR are successful including an increase in physical activity levels, reduction in smoking, improved quality of life as assessed by hospital anxiety and depression scale (HADS) but BMI scores were less successful (Bethell et al., 2008a). This was reportedly due to the complicated nature of BMI change, with several key mechanisms such as, exercise, diet, social status and depression affecting individual changes (Krueger and Casey, 2014, Foundation, 2018). It was also acknowledged that when trying to stop smoking many individuals will gain weight over a period of time adding to the burden of excess weight and increased risk form CHD and mortality (Aubin et al., 2012, Snaterse et al., 2018) . De Melo Ghisi et al., (2014) reviewed education in CR and found that many studies were poorly reported and the full extent of behaviour change advice was limited, and the precise mechanisms for change were difficult to identify because of the poor explanations of research measures and outcomes (de Melo Ghisi et al., 2014). The original biggest loser was delivered “in -house” and not for research purposes and it is thought this was common, hence the limited evidence in the public domain from individual CR programmes. There is a clear need for research into the efficacy of nutrition interventions in CR and for better reporting methods to provide a strong framework in the exploration of best practice.

Chapter 6

Study 4, randomised control trial of the new education programme "Healthy Heart Happy You".

6.Overview of previous chapters

This chapter brings together the main findings from chapters 3,4 and 5 which were in effect the health needs assessment elements of the research (Gupta, 2011) The pragmatic approach taken in this research enabled each of the research strands to take shape and evolve to form the basis for the final research strand the RCT (Creswell, 2003). Below are the main points from each chapter, how these points will be incorporated in the new education programme are shown in italics.

Chapter 3 provided an evaluation of The Biggest loser, its efficacy and use in a future education programme. Findings indicated that significant positive changes were made to the WC and BMI measurements of patients, particularly those with higher baseline measurements, therefore at greater risk from future coronary events. It was also identified that there was a lack of dietary analysis due to the intervention being delivered “in house” which is commonplace in CR, this leads to unknown best practice protocols and highlights the need for more rigorous experimental design, delivery and evaluation in future research.

Chapter 4 questionnaires, using the BHF questionnaire CR patents reported that they made healthy food choices overall, reducing saturated fat, reducing salt, sugar, and processed foods. The NKQ was used to establish patient’s knowledge on a range of healthy eating messages, food choices and how poor diet may affect certain healthy conditions. Each section of the questionnaire focused on different elements of health eating including making the healthiest choices between high/low fat or added salt/sugar in foods, also the associations between poor nutrition and different diseases such as bowel disease, some cancers and heart disease. Results from the NKQ showed patients had a good level of understanding when compared to general UK population, however there were still several areas of confusion around making healthiest food choices, distinguishing best choice between different high fat, sugar, and salt in a variety of foods. The final questionnaire was the IPQA which demonstrated that activity levels outside of the structured 120 minutes of exercise delivered by Heartbeat CR they remained active and exceeded current guidelines of 150 minutes of moderate exercise each week. Patients reported to have a healthy diet (BHF) however when questioned about which foods were healthier choices, how diet affects disease and how to reduce fat, sugar and salt (NKQ) they were unclear in many areas, providing direction of emphasis for the new education programme.

Chapter 5 focus groups, based on the findings from chapters 3 and 4, questions were designed to further understand how patients perceive healthy eating, their stage of readiness to attend a nutrition education programme and make dietary changes. Interestingly three main themes were identified **Barriers** around attending education programmes and how to make better choices, **confusion** around messages received from GP medical consultants, other professionals and in the media, and what they thought should be **included** in the new education programme. Addressing each of the themes in the new education programme:

Barriers – meals should be simple, affordable, not weight loss based. Not a “diet”

Confusion -provide clear, evidence-based nutrition education specifically for heart health,

Inclusion - an emphasis on the positive, what should be included in the diet with rationale and positive re-enforcement

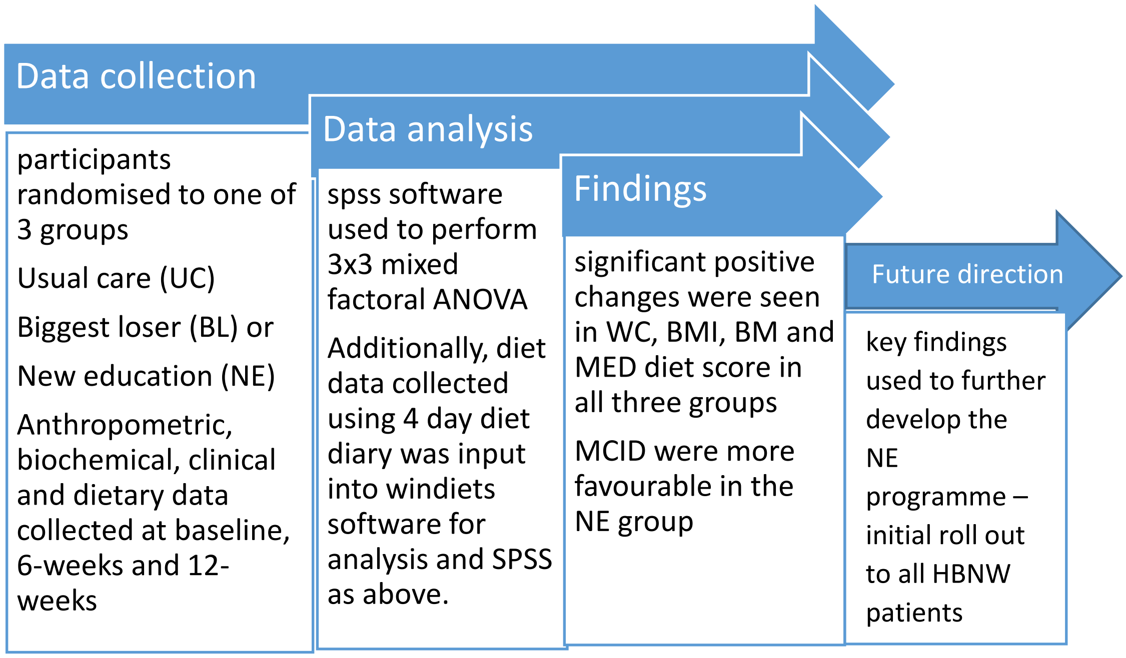


Figure 6.1 Shows the sequence of events in the data collection and evaluation of the RCT with summary of findings to further develop the Education programme for HBNW patients.

Randomised Control Trial

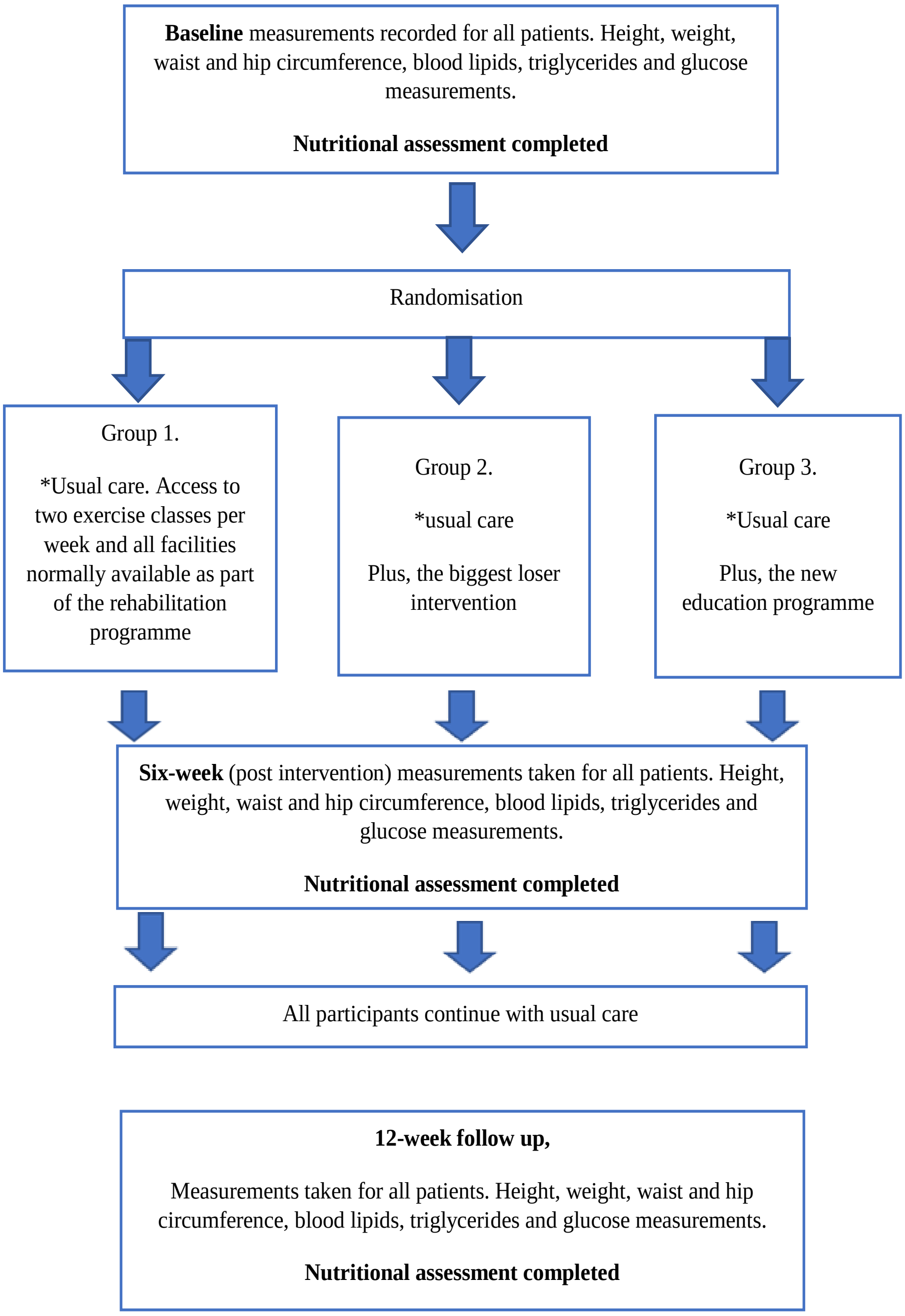


Figure 6.2 *shows the structure of the randomised control trial (RCT), patients were recruited and randomly assigned to one of three groups. Measurements and assessments were conducted at baseline, 6 weeks, and 12-weeks.*

6.1 Introduction

The dearth of published research on nutrition interventions specifically within CR settings (secondary prevention of CHD) has been alluded to in previous chapters (1,3 4). There is however, strong evidence for the diet type for example the Med diet (Estruch et al., 2016; Delgado-Lista et al., 2016) or the DASH diet (Sacks et al., 2001; Bathrellou et al., 2019) in individuals at high risk of CHD. More recently Butler et al, (2020) for the BACPR, has provided dietary recommendations like the present study which place the emphasis on a whole diet approach rather than individual nutrients. key messages may be reaching individuals, particularly following a major life altering event such as MI and people are more likely to make changes (White et al., 2011). However, for many, the messages are unclear and inconsistent and can be very confusing (Ma et al., 2010; Mayer et al., 2014). It is well recognised that what works for some people may not work for others this “one size fits all” approach is unlikely to have long term success and a more holistic approach may be the key to sustainable changes (Popkin, 2011).

Despite the abundance of nutritional recommendations this research has revealed that patients are still unsure about what changes would be most beneficial to them and reduce their risk of further progression of CHD. In chapter 3 it was evident that a supported nutrition intervention provided significant changes to WC, and BMI, however, nutritional intake was not recorded so dietary change could not be confirmed. Chapter 4 established that patients in general are aware of key recommendations to reduce saturated fats, processed foods, salt, and sugar, but had confusion around the type of fat they should consume. Patients also expressed confusion concerning how to meet targets for salt, sugar and what a portion size was. Chapter 5 enabled a deeper understanding of the experiences of patients through their journey from heart episode to rehabilitation. This provided interesting accounts of the limited nutritional education and support. This is an important finding as it highlights the gap between what should be provided and what is provided. No matter how well researched and how large the body of evidence to support certain eating patterns if the population most at risk is not being supported to make the changes then the desired outcome is unlikely to me met.

This RCT aims to test a new education programme, against the previous intervention The Biggest Loser, and the usual care provided as part of HBNW rehabilitation programme (figure 6.2).

6.2 Methods

All patients used in this study were in phase IV cardiac rehabilitation. A total of 64 patients (n=45 male (70.3%) and (n=19 females (29.7%) agreed to participate in this study. Patients were aged between 45-82 years (mean 68.6±8.5 years), mean height of 1.68 ±0.93m, baseline mass of 85.9±20.8kg ranging from 49.8-163.20 kg, and mean baseline BMI of 30.19 ±7.28kg/m2. Randomisation was performed using a computer-generated program (Saghaei, 2004) each participant self-selected the date and time of their preferred first data collection appointment further adding to the randomisation process, on arrival they were allocated a number assigning them to one of the three groups. The number of patients in each group were: usual care (UC) 20, biggest loser (BL) 22 and new education (NE) 22.

Patients in the two intervention groups attended one of the sessions each week for six-weeks in addition to their usual exercise classes, whilst those in the control group continued to attend their usual exercise classes. The biggest loser programme was delivered using the same protocol as previously described in chapter 3 and the same EP delivered each session. The Healthy Heart Happy You programme consisted of an interactive lecture each week, where patients were encouraged to ask questions and form discussions at any time, they were also provided with handouts of the slides in addition to recipes and useful information relevant to the weekly topic, additional materials were supplied by BHF and the lecture materials compiled by the researcher.

6.2.1 Data collection

All data collection and nutrition education sessions took place at the main centre PNE. Upon arrival participants were given the opportunity to re-read the participant information sheet (appendix 4) and ask questions, once satisfied they provided written informed consent to participate in the study (appendix 8).

6.2.2 Anthropometric measures; (patients were advised to wear loose clothing, height and weight measurements taken without shoes). Discussed in more detail in chapter 2.

Height: recorded in cm using a portable stadiometer (SECA 217, Birmingham, United Kingdom), **Weight**: measured in kg, using mechanical personal scale (SECA 760, Birmingham, United Kingdom), **BMI** calculated using weight (kg) divided by height m². Hip and Waist measurements taken using standard fabric tape measure, Hip- tape placed around the widest part of the hips and buttocks, and waist measurement taken 2cm below the navel (IDASS, Cornwall, United Kingdom).

6.2.3 Biochemical Measures

The middle finger on the participant's non-dominant hand was chosen to extract blood samples, the ~~index~~ middle finger was prepared with an alcohol wipe, safety lancets were used to pierce the skin (Unstick 3, Owens and Mumford, Oxfordshire, United Kingdom). The first droplet of blood was wiped with a cotton swab to avoid contamination with the cleaning solution and to remove any tissue fluid. Droplets of blood were transferred onto separate reagent strips for each of the variables measured; Glucose, Triglycerides and total cholesterol, the PRIMA multi-care system (PRIMA LAB SA, Balerna, Switzerland) was used to measure non-fasting blood levels. All waste materials were disposed of in the appropriate receptacle (blood and sharps bins) and taken back to university of central Lancashire for disposal.

6.2.4 Clinical measures

Blood pressure; was taken on the non-dominant arm using Electronic sphygmomanometer (OMRON, M3 LED) following manufacturers recommended protocol. No other clinical measures were required for this study.

6.2.5 Dietary measures

Each patient was allocated a 30-minute appointment to complete the above measurements and provide them with detailed instructions on completing the Med diet score tool (appendix 1) (Martinez-Gonzalez et al., 2004, Martínez-González et al., 2012) and a four-day diet diary (appendix 12), which they were to complete at home and return the following week. All data were entered to Excel spreadsheets and transferred onto SPSS for analysis where a 3x3 mixed factorial ANOVA was performed. Results are presented with baseline, 6-weeks and 12-week follow up for all groups and dependent variables will be compared to normative data where applicable. Results section contains; BM, BMI, waist, hip/waist ratio, BP, Triglycerides, Cholesterol, Glucose, Med diet score, Total energy, Carbohydrates, free sugar, Fibre, Protein, Fat, Saturated, Monounsaturated, Polyunsaturated, B-Vitamins, Vitamins A, C, D, E Calcium, Sodium and Salt, selenium and zinc.

6.3 Results

Following baseline data collection all participant information and measurements were input onto excel computer programme ahead of transfer into SPSS version 22 for statistical analysis.

Data was analysed using a 3x3 mixed factorial ANOVA (Field, 2013) Significance was set at $p = \leq 0.05$, tests of normality were performed and significant findings were correlated with baseline and change. All data were stored in accordance with GDPR guidelines for data protection. All paper copies were stored in a locked filing cabinet in a locked office in Darwin building University of central Lancashire and only available to the researcher (Bhaimia, 2018).

All significant findings are presented in the following figures, non-significant measures are presented in tables.

Body Mass ** Figure 6.3 shows there was no significant main effect for Group ($F_{(2, 50)} = 0.20$, $P > 0.05$, $P\eta^2 = 0.008$), however, there was a significant main effect for Time ($F_{(2, 100)} = 7.30$, $P < 0.05$, $P\eta^2 = 0.013$) Post-hoc pairwise comparisons show that body mass reduced significantly from Baseline to 6-weeks (P=0.02) and from Baseline to 12 weeks (P=0.03) in all three groups. There was no significant interaction between Group X Time ($F_{(4, 100)} = 1.20$, $P > 0.05$, $P\eta^2 = 0.04$

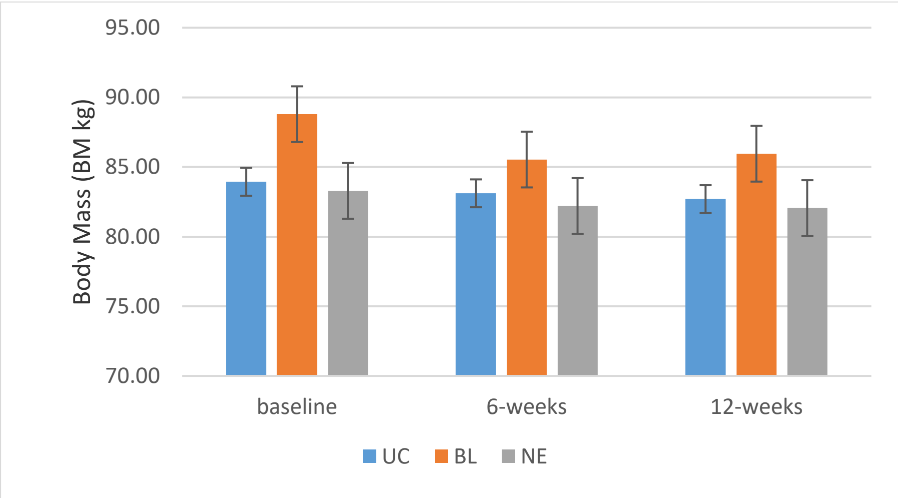


Figure 6.3 Body Mass** (Mean ± SD) at each time point for each group.

BMI ** Figure 6.4 Shows there was no significant main effect for Group ($F_{(2, 50)} = 0.48$, $P > 0.05$, $P\eta^2 = 0.02$). However, there was a significant main effect for Time ($F_{(2, 100)} = 7.88$, $P < 0.05$, $P\eta^2 = 0.14$). Post-hoc pairwise comparisons showed that BMI decreased significantly from baseline to 6-weeks (P=0.02) and between baseline and 12-weeks (P=0.02). There was no interaction between Group X Time ($F_{(4, 100)} = 1.07$, $P > 0.05$, $P\eta^2 = 0.04$).

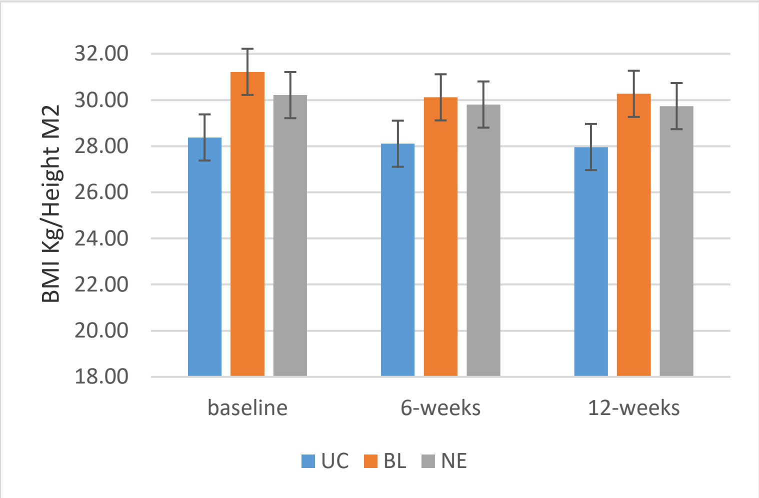


Figure 6.4 BMI** (Mean ± SD) at each time point for each group.

WC Figure 6.5** Shows there was no significant main effect for Group ($F_{(2, 50)} = 0.10$, $P > 0.05$, $P\eta^2 = 0.004$), however there was a significant main effect for Time ($F_{(2, 100)} = 5.74$, $P < 0.05$, $P\eta^2 = 0.10$) Post-hoc pairwise comparisons showed that waist circumference significantly reduced from Baseline to 6-weeks (P=0.01) but not at 12-weeks (P= 0.09). There was no significant interaction between Group X Time ($F_{(4, 100)} = 1.01$, $P >0.05$, $P\eta^2 = 0.10$).

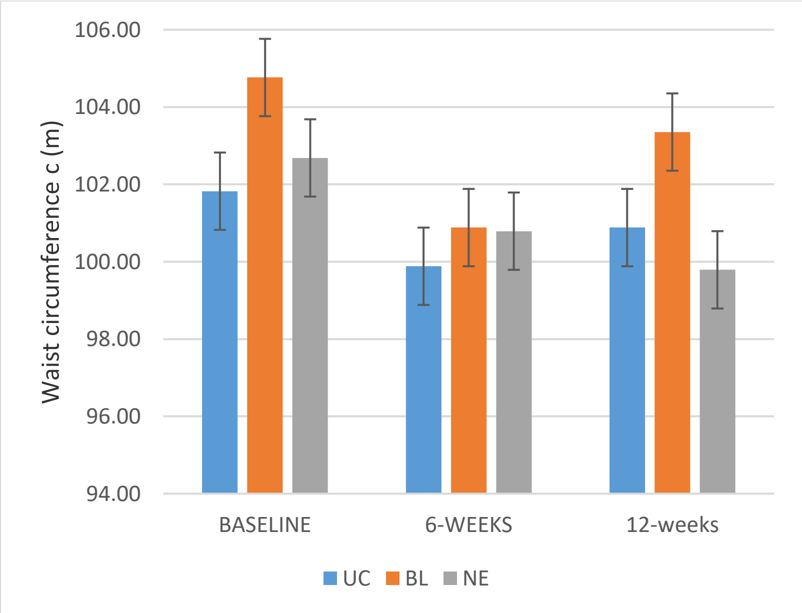


Figure 6.5 WC** (Mean ± SD) at each time point for each group.

The Med diet score figure 6.6** showed there was a significant main effect for Group ($F_{(2, 34)} = 4.25$, $P < 0.05$, $P\eta^2 = 0.20$) Post-hoc pairwise comparisons showed that there was a significant increase in the Med Diet scores in the NE group compared to the UC group (P=0.02) but no significant difference seen between the Biggest loser group and the New education group (P=0.15) or between usual care and biggest loser (p=1.00).There was also a significant main effect found for Time ($F_{(2, 68)} = 12.41$, $P < 0.05$, $P\eta^2 = 0.001$). Post-hoc pairwise comparisons showed that there was a significant increase in the Med Diet scores from baseline to 6 weeks (P=0.001) and from baseline to 12 weeks (P=0.001). There was no significant Time x Group interaction ($F^{(4, 68)} = 1.48$, $P > 0.05$, $P\eta^2 = 0.08$).

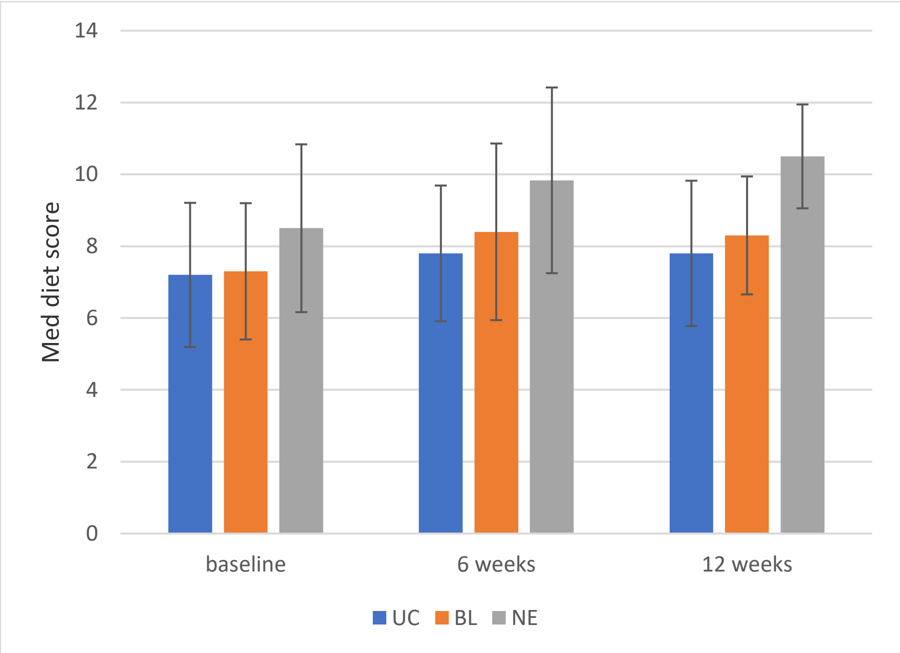


Figure 6.6 ** Med diet score **(Mean ± SD) at each time point for each group.

Calcium figure 6.7 showed no significant main effect for Group ($F_{(2, 33)}$ =0.10, P > 0.05, Pη^2 =0.006), however there was a significant main effect for Time ($F_{(2, 66)}$ = 7.34, P < 0.05, Pη^2 0.18) Post-hoc pairwise comparisons showed that Calcium intakes significantly reduced from Baseline to 6-weeks (P=0.007) and from baseline to 12-weeks (P= 0.02). There was no significant interaction between Group X Time ($F_{(4, 66)}$ = 1.33, P >0.05, Pη^2 = 0.07).

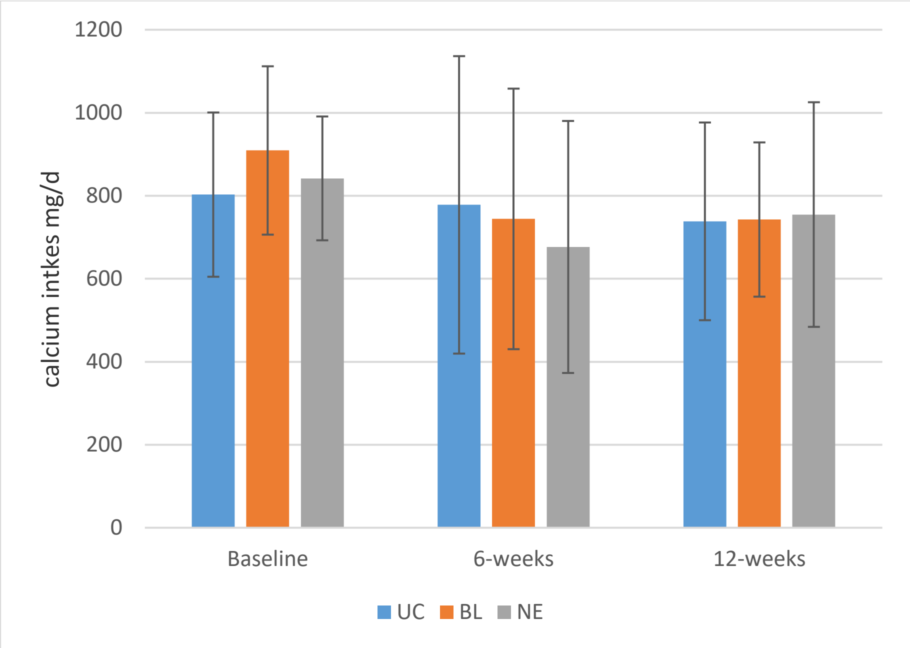


Figure 6.7 ** Calcium intake (Mean ± SD) at each time point for each group.

The following non-statistical results are presented in the following tables:

Table 6.1 shows the mean and SD for non-significant clinical results, with spss output data below.

	UC						BL						NE					
	Baseline		**6-weeks**		**12-weeks**		**Baseline**		**6-weeks**		**12-weeks**		**Baseline**		**6-weeks**		**12-weeks**	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Diastolic Blood Pressure (mmHg)	**73.94**	**10.52**	**72.23**	**7.8**	**72.11**	**11.7**	**76.29**	**10.45**	**72.64**	**10.78**	**77**	**11.72**	**73.94**	**11.58**	**71.26**	**11.4**	**71.84**	**13.41**
Systolic Blood Pressure (mmHg)	**130.7**	**12.01**	**128.11**	**19.02**	**126.35**	**15.58**	**132.7**	**12.01**	**123.05**	**18.99**	**134.58**	**23.91**	**135.42**	**20.03**	**131.63**	**27.42**	**126.26**	**18.97**
Resting Heart Rate (bpm)	**72**	**11.71**	**67.17**	**11.56**	**68.76**	**11.71**	**63.52**	**7.29**	**68.11**	**9.52**	**63.05**	**9.02**	**69**	**11.99**	**67.63**	**13.7**	**68.47**	**12.21**

Systolic blood pressure (SBP) showed no significant main effect for Group ($F_{(2, 50)} = 0.12$, $P > 0.05$, $P\eta^2 = 0.01$) or Time ($F_{(2, 100)} = 2.02$, $P > 0.05$, $P\eta^2 = 0.04$). There was also no significant Time x Group interaction ($F_{(4, 100)} = 1.83$, $P > 0.05$, $P\eta^2 = 0.07$). Although there were no significant changes over time or between groups there were however changes from baseline to 12-weeks, **Diastolic blood pressure** (DBP) showed no significant main effect for Group ($F_{(2, 50)} = 0.51$, $P > 0.05$, $P\eta^2 = 0.02$) or Time ($F_{(2, 100)} = 1.78$, $P > 0.05$, $P\eta^2 = 0.04$). There was also no significant Time x Group interaction ($F_{(4, 100)} = 0.48$, $P > 0.05$, $P\eta^2 = 0.02$).

Table 6.2 provides the mean and SD for non-significant biochemical measures with spss outputs below.

	UC						BL						NE					
	Baseline		**6-weeks**		**12-weeks**		**Baseline**		**6-weeks**		**12-weeks**		**Baseline**		**6-weeks**		**12-weeks**	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Total cholesterol (mmol/L)	**4.19**	**0.76**	**4.47**	**0.71**	**4.49**	**0.61**	**4.20**	**0.98**	**4.36**	**1.54**	**4.19**	**1.08**	**4.46**	**0.73**	**4.76**	**1.37**	**4.59**	**0.46**
Glucose (mmol/L)	**7.32**	**2.90**	**6.91**	**2.40**	**6.71**	**2.37**	**7.67**	**2.11**	**7.37**	**2.79**	**7.30**	**1.91**	**6.80**	**1.73**	**7.60**	**3.59**	**7.10**	**2.39**
Triglyceride (mm/L)	**1.54**	**1.07**	**1.36**	**0.58**	**1.51**	**1.1**	**1.96**	**1.28**	**1.85**	**1.22**	**1.87**	**0.96**	**1.72**	**0.76**	**2.22**	**0.87**	**1.84**	**0.76**

Glucose measurements showed no significant main effects for Group ($F_{(2, 50)} = 0.21$, $P > 0.05$, $P\eta^2 = 0.01$) or Time ($F_{(2, 100)} = 0.39$, $P > 0.05$, $P\eta^2 = 0.01$). There was also no significant Time x Group interaction ($F_{(4, 100)} = 0.81$, $P > 0.05$, $P\eta^2 = 0.03$).**Total cholesterol** showed no significant main effects for Group ($F_{(2, 47)} = 0.75$, $P > 0.05$, $P\eta^2$ 0.03) or Time ($F_{(2.94)} = 2.35$, $p > 0.05$, $P\eta^2 = 0.05$). There was also no significant Time x Group interaction ($F_{(4, 94)} = 2.35$, $P > 0.05$, $P\eta^2 = 0.02$.). Finally, **Triglycerides** showed no significant main effect for Group ($F (2, 46) = 1.61$, $P > 0.05$, $P\eta^2 = 0.07$) or Time ($F (2, 92) = 0.17$, $P > 0.05$, $P\eta^2 = 0.004$). There was also no significant Time x Group interaction ($F (4, 92) = 1.20$, $P > 0.05$, $P\eta^2 = 0.05$).

Table 6.3 provides non-significant anthropometric measures with spss outputs below.

	UC						BL						NE					
	Baseline		6-weeks		12-weeks		Baseline		6-weeks		12-weeks		Baseline		6-weeks		12-weeks	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Hip Circumference (cm)	**106.4**	**8.97**	**106.23**	**10.37**	**105.94**	**8.74**	**109.1**	**16.96**	**107**	**16.65**	**106.76**	**15.27**	**109.84**	**17.87**	**106.78**	**17.72**	**106.26**	**16.32**
Waist Hip Ratio	**0.95**	**0.57**	**0.94**	**0.63**	**0.95**	**0.05**	**0.96**	**0.08**	**0.94**	**0.84**	**0.97**	**0.1**	**0.93**	**0.08**	**0.94**	**0.73**	**0.93**	**0.08**

There was no significant main effect for Group on WHR ($F_{(2, 50)} = 0.52$, $P > 0.05$, $P\eta^2 = 0.02$), or Time ($F_{(2, 100)} = 1.55$, $P > 0.05$, $P\ \eta^2 = 0.03$). There was also no significant Time x Group interaction ($F_{(4, 100)} = 1.68$, $P > 0.05$, $P\eta^2 = 0.03$).

Table 6.4 provided non-significant B- Vitamin and folate measures with spss outputs below.

	UC						BL						NE					
	Baseline		6-weeks		12-weeks		Baseline		6-weeks		12-weeks		Baseline		6-weeks		12-weeks	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Vitamin B12 (ug)	**4.57**	**1.66**	**7.82**	**7.78**	**4.53**	**1.57**	**4.2**	**2.28**	**4.23**	**3.17**	**4.07**	**2.38**	**5.11**	**2.13**	**5.09**	**2.34**	**4.3**	**2.23**
Vitamin B6 (mg)	**1.58**	**0.26**	**1.74**	**0.55**	**1.53**	**0.47**	**1.83**	**0.75**	**1.74**	**0.95**	**1.58**	**0.38**	**1.48**	**0.45**	**1.38**	**0.39**	**1.39**	**0.31**
Folate (ug)	**242.5**	**64.1**	**238.3**	**94.26**	**233**	**85.71**	**256.5**	**147**	**225.3**	**111.2**	**228.1**	**88.98**	**229.5**	**78.26**	**226.6**	**43.24**	**222.9**	**32.2**

Results for **Vitamin B6** was also shown to have no significant main effect for Group ($F_{(2, 33)} = 1.94$, $P > 0.05$, $P\eta^2 = 0.10$) or Time ($F_{(2, 66)} = 0.91$, $P > 0.05$, $P\eta^2 = 0.03$). There was also no significant Time x Group interaction ($F_{(4, 66)} = 0.45$, $P > 0.05$, $P\eta^2 = 0.03$). **Folate** was similar with no significant main effect for Group ($F_{(2, 33)} = 0.10$, $P > 0.05$, $P\eta^2 = 0.01$) or Time ($F_{(2, 66)} = 0.61$, $P > 0.05$, $P\eta^2 = 0.02$). There was also no significant Time x Group interaction ($F_{(4, 66)} = 0.20$, $P > 0.05$, $P\eta^2 = 0.01$). and finally, **Vitamin B12** showed no significant main effect for Group ($F_{(2, 33)} = 1.39$, $P > 0.05$, $P\eta^2 = 0.08$) or Time ($F_{(2, 66)} = 1.69$, $P > 0.05$, $P\eta^2 = 0.05$). There was also no significant Time x Group interaction ($F_{(4, 66)} = 1.20$, $P > 0.05$, $P\eta^2 = 0.07$).

Table 6.5 the non-significant vitamin measures with spss outputs below.

	UC						BL						NE					
	Baseline		6-weeks		12-weeks		Baseline		6-weeks		12-weeks		Baseline		6-weeks		12-weeks	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Vitamin A (ug)	**574.4**	**256**	**1052**	**1727**	**529.8**	**206.9**	**501.5**	**172.8**	**521.6**	**236.9**	**529.8**	**206.9**	**501.7**	**268.3**	**567.2**	**332**	**497.8**	**259.5**
Vitamin C (mg)	**88.13**	**73.19**	**77.6**	**37.97**	**68.38**	**40.62**	**76.82**	**57.94**	**80.81**	**54.35**	**85.63**	**38.7**	**91.4**	**68.48**	**86.35**	**19**	**98.97**	**41.48**
Vitamin D (ug)	**2.98**	**1.76**	**4.19**	**2.78**	**2.73**	**2.01**	**2.89**	**2.15**	**2.8**	**2.92**	**2.5**	**1.27**	**3.92**	**2.71**	**3.27**	**2.97**	**2.79**	**2.91**
Vitamin E (mg)	**6.27**	**2.05**	**7.24**	**2.58**	**7.07**	**3.08**	**7.24**	**3.65**	**8.82**	**4.5**	**7.07**	**2.93**	**7.1**	**3**	**7.56**	**3.37**	**7.22**	**2.24**
Thiamine (mg)	**1.51**	**0.35**	**1.64**	**0.52**	**1.48**	**0.52**	**1.78**	**0.81**	**1.58**	**0.79**	**1.5**	**0.58**	**1.59**	**0.55**	**1.36**	**0.42**	**1.45**	**0.3**
Riboflavin (mg)	**1.86**	**0.61**	**1.85**	**0.75**	**1.74**	**0.58**	**1.92**	**0.92**	**1.74**	**1.03**	**1.58**	**0.83**	**1.63**	**0.47**	**1.39**	**0.37**	**1.51**	**0.42**
Selenium (ug)	**58.79**	**20.92**	**52.07**	**19.27**	**48.28**	**18.2**	**44.7**	**13.52**	**45.5**	**29.79**	**43.3**	**13.65**	**54.17**	**14.31**	**55.5**	**19.36**	**47.41**	**22.99**
Zinc (mg)	**8.78**	**0.98**	**8.05**	**2.24**	**8.2**	**2.48**	**8.48**	**2.12**	**8.28**	**2.31**	**7.82**	**2.17**	**8.54**	**2.68**	**8.25**	**3.13**	**7.6**	**1.74**

Vitamin A showed no significant main effect for Group ($F_{(2, 33)}$ = 0.89, P > 0.05, Pη^2 =0.05) or Time ($F_{(2, 66)}$ = 1.03, P > 0.05, Pη^2 = 0.03) There was also no significant Time x Group interaction ($F_{(4, 66)}$ = 0.79, P >0.05, Pη^2= 0.05). **Vitamin C** showed no significant main effect for Group ($F_{(2, 33)}$ = 0.43, P > 0.05, Pη^2 =0.03) or Time ($F_{(2, 66)}$ = 0.10, P > 0.05, Pη^2 = 0.003). There was also no significant Time x Group interaction ($F_{(4, 66)}$ = 0.64, P >0.05, Pη^2 = 0.04). **Vitamin D** showed there was no significant main effect for Group ($F_{(2, 33)}$ = 0.40, P > 0.05, Pη^2 =0.02) or Time ($F_{(2, 66)}$ = 1.22, P > 0.05, Pη^2 = 0.04). There was also no significant Time x Group interaction ($F_{(4, 66)}$ = 0.71, P >0.05, Pη^2 = 0.04). Intakes of **Vitamin E** showed there was no significant main effect for Group ($F_{(2, 33)}$ = 0.60, P > 0.05, Pη^2 =0.03) or Time ($F_{(2, 66)}$ = 0.59, P > 0.02, Pη^2 = 0.003). There was also no significant Time x Group interaction ($F_{(4, 66)}$ = 0.99, P >0.05, Pη^2 = 0.06) Results for **Thiamine** found that there was no significant main effect for Group ($F_{(2, 33)}$ = 0.36, P > 0.05, Pη^2 =0.02) or Time ($F_{(2, 66)}$ = 1.07, P > 0.05, Pη^2 = 0.03). There was also no significant Time x Group interaction ($F_{(4, 66)}$ = 0.71, P >0.05, Pη^2 = 0.04). **Riboflavin** showed that there was no significant main effect for Group ($F_{(2, 33)}$ = 1.15, P > 0.05, Pη^2 =0.06) or Time ($F_{(2, 66)}$ = 1.23, P > 0.05, Pη^2 = 0.04). There was also no significant Time x Group interaction ($F_{(4, 66)}$ = 0.36, P >0.05, Pη^2 = 0.02). **Selenium** also showed that there was no significant main effect for Group ($F_{(2, 33)}$ = 1.19, P > 0.05, Pη^2 =0.07) or Time ($F_{(2, 66)}$ = 1.37, P > 0.05, Pη^2 = 0.04). There was also no significant Time x Group interaction ($F_{(4, 66)}$ = 0.37, P >0.05, Pη^2 = 0.02). Intakes of **Sodium** showed there was no significant main effect for Group ($F_{(2, 33)}$ = 1.20, P > 0.05, Pη^2 =0.07) or Time ($F_{(2, 66)}$ = 1.35, P > 0.05, Pη^2 = 0.04). There was also no significant Time x Group interaction ($F_{(4, 66)}$ = 1.18, P >0.05, Pη^2 = 0.07). Finally, **Zinc** intakes showed there was no significant main effect for Group ($F_{(2, 33)}$ = 0.97, P > 0.05, Pη^2 =0.06) or Time ($F_{(2, 66)}$ = 0.98, P > 0.05, Pη^2 = 0.03). There was also no significant Time x Group interaction ($F_{(4, 66)}$ = 1.02, P >0.05, Pη^2 = 0.06).

Table 6.6 the non-specific total energy and macronutrient measurements with spss outputs below.

	UC						BL						NE					
	Baseline		**6-weeks**		**12-weeks**		**Baseline**		**6-weeks**		**12-weeks**		**Baseline**		**6-weeks**		**12-weeks**	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Total Energy (Kcal)	**1769**	**395.6**	**1718.4**	**379.5**	**1703.4**	**530.4**	**1829**	**424.3**	**1759.5**	**687.8**	**1603.1**	**465.6**	**1559.6**	**413.3**	**1362.8**	**285.2**	**1506.1**	**407.8**
Charbohydrate (Cho)(g)	**213.4**	**59.9**	**197.67**	**65.59**	**194.01**	**65.13**	**218.8**	**65.54**	**204.71**	**108**	**195.66**	**93.89**	**176.65**	**51.44**	**142.89**	**57.48**	**178.95**	**63.94**
Cho % total daily intake	**45.53**	**7.01**	**44.45**	**4.9**	**43**	**9**	**45.53**	**8.83**	**43.2**	**8.48**	**43.99**	**9.02**	**42.73**	**6.96**	**43.2**	**8.48**	**44.66**	**8.38**
Total Sugars (g)	**97.08**	**41.65**	**87.93**	**38.69**	**85.08**	**35.71**	**93.67**	**39.5**	**86.7**	**34.44**	**90.36**	**44.31**	**72.74**	**20.35**	**66.26**	**19.59**	**73.53**	**23.71**
Total Sugar % daily intake	**20.45**	**6.64**	**19.03**	**6.26**	**18.78**	**4.91**	**19.15**	**6**	**19.02**	**5.6**	**20.02**	**4.57**	**17.74**	**2.8**	**17.91**	**3.42**	**18.88**	**5.89**
Dietary Fibre (g)	**19.07**	**5.37**	**18.78**	**5.75**	**17.4**	**6.97**	**16.57**	**6.62**	**16.89**	**8.62**	**17.53**	**5.74**	**15.86**	**5.47**	**16.78**	**4.65**	**17.21**	**3.9**
Starch (g)	**113.7**	**35.64**	**100.47**	**34.98**	**95.69**	**30.42**	**120.2**	**33.58**	**108.93**	**79.56**	**87.1**	**43.76**	**96.69**	**30.64**	**79.19**	**28.67**	**92.33**	**36.29**
Total Starch % daily intake	**24.42**	**5.36**	**22.15**	**6.37**	**21.32**	**3.24**	**25.06**	**5.17**	**22.17**	**7.75**	**20.34**	**7.47**	**23.45**	**5.05**	**21.7**	**6.73**	**22.89**	**4.43**
Non-Starch Polysacchirides (g)	**16.18**	**5.87**	**14.36**	**5.52**	**13.69**	**5.18**	**12.83**	**7.09**	**13.15**	**5.56**	**12.12**	**2.76**	**12.05**	**3.52**	**12.46**	**4.44**	**12.69**	**3.42**
Protein (g)	**78.44**	**13.6**	**76.3**	**14.76**	**81.03**	**20.71**	**76.42**	**16.62**	**72.25**	**14.89**	**112.13**	**29.45**	**76.3**	**19.52**	**75.94**	**19.75**	**75.85**	**20.6**
Total Protein % daily intake	**18.3**	**3.34**	**18.14**	**3.38**	**19.85**	**4.22**	**16.9**	**2.23**	**17.52**	**3.09**	**26.92**	**27.15**	**20.22**	**5.33**	**17.52**	**3.09**	**20.6**	**4.7**
Fat (g)	**67.61**	**23.29**	**65.27**	**15.16**	**66.62**	**29.03**	**64.86**	**29.88**	**65.69**	**27.17**	**56.45**	**19.02**	**57.75**	**20.25**	**52.91**	**13.98**	**57.29**	**17.86**
Total Fat % daily intake	**32.94**	**5.7**	**33.32**	**3.73**	**33.42**	**6.77**	**29.92**	**8.8**	**33.05**	**6.77**	**30.17**	**6.88**	**31.91**	**4.75**	**33.28**	**4.37**	**33.03**	**5.74**
Saturated fatty Acids (SFA) (g)	**21.55**	**5.59**	**22.65**	**6.19**	**25.17**	**14.46**	**24.59**	**10.88**	**22.53**	**8.94**	**18.99**	**7.41**	**19.46**	**7.66**	**16.77**	**3.81**	**19.11**	**7.33**
Total SFA % daily intake	**10.71**	**2.1**	**11.59**	**2.36**	**12.54**	**4.18**	**11.31**	**3.39**	**11.42**	**3.19**	**9.95**	**2.1**	**10.7**	**2.2**	**10.63**	**1.57**	**10.74**	**2.44**
Monounsaturated FA (g)	**26.05**	**11.5**	**22.26**	**7**	**22.05**	**9.34**	**22.9**	**11.65**	**23.73**	**13.02**	**19.39**	**7.53**	**21.46**	**8.68**	**19.29**	**6.05**	**20.04**	**6.5**
Total Mono % daily intake	**12.5**	**3.38**	**11.3**	**2.47**	**11.1**	**2.44**	**10.42**	**3.87**	**11.6**	**3.71**	**10.56**	**3.7**	**11.85**	**3.09**	**12.15**	**2.68**	**11.71**	**3.61**
Polyunsaturated (PUFA) (g)	**11.48**	**6.3**	**10.17**	**3.37**	**9.69**	**4.77**	**8.98**	**4.6**	**10.82**	**4.81**	**9.39**	**3.1**	**9.84**	**4.07**	**9.89**	**3.62**	**9.4**	**2.88**
Total PUFA % daily intake	**5.34**	**2.03**	**5.15**	**1.72**	**4.75**	**1.64**	**4**	**1.44**	**5.57**	**2.02**	**5.16**	**1.55**	**5.44**	**2.02**	**6.32**	**2.06**	**5.59**	**1.65**
Sodium Na (mg)	**1719**	**675.6**	**1728.2**	**505**	**1748.5**	**517.1**	**1987**	**431.9**	**1559**	**515.5**	**7096**	**17893**	**1677.3**	**566.8**	**1568.3**	**474.3**	**1681.5**	**707.4**

Total energy intakes showed no significant main effect for Group ($F_{(2, 33)} = 1.86$, $P > 0.05$, $P\eta^2 = 0.10$) or Time ($F_{(2, 66)} = 1.53$, $P > 0.05$, $P\eta^2 = 0.04$). There was also no significant Time x Group Interaction ($F_{(4, 66)} = 0.75$, $P > 0.05$, $P\eta^2 = 0.04$). **Carbohydrate (CHO)** intakes showed no significant main effect for Group ($F_{(2, 33)} = 1.79$, $P > 0.05$, $P\eta^2 = 0.10$) or Time ($F_{(2, 66)} = 1.51$, $P > 0.05$, $P\eta^2 = 0.04$). There was also no significant Time x Group interaction ($F_{(4, 66)} = 0.67$, $P > 0.05$, $P\eta^2 = 0.04$). Dietary fibre intakes showed no significant main effect for Group ($F_{(2, 33)} = 0.51$, $P > 0.05$, $P\eta^2 = 0.10$) or Time ($F_{(2, 66)} = 0.05$, $P > 0.05$, $P\eta^2 = 0.001$). There was also no significant Time x Group interaction ($F_{(4, 66)} = 0.05$, $P > 0.05$, $P\eta^2 = 0.03$). **Protein,** showed that there was no significant main effect for Group ($F_{(2, 33)} = 0.57$, $P > 0.05$, $P\eta^2 = 0.03$) or Time ($F_{(2, 66)} = 2.03$, $P > 0.05$, $P\eta^2 = 0.06$). There was also no significant Time x Group interaction ($F_{(4, 66)} = 1.42$, $P > 0.05$, $P\eta^2 = 0.08$). Intakes of **total Fat**

6.4 Discussion

The new education programme named “Healthy Heart Happy You” was designed to incorporate not only current nutritional guidelines of the Eatwell Guide (Buttriss, 2016a) and Med diet (Mozaffarian and Ludwig, 2010, Dernini et al., 2018), but also to meet the needs of a specific CR population. The findings of study 1 (Chapter 3) showed that the biggest loser was successful in reducing risk factors of BMI, WC and BM, study 2 (Chapter 4) provided key indicators of current diet quality and understanding of current guidelines, in addition to highlighting areas of confusion around fats, sugar, portion sizes and the role of antioxidants in the diet, and study 3 (Chapter 5) provided valuable insights into patients views on healthy eating, areas of confusion, what barriers they faced when contemplating change and what they would like to be included in future education programmes. Like earlier findings from White et al., (2011) some patients have made dietary changes following diagnosis and are keen to improve their diet if they feel it will improve their risk factor profile as part of their CR (White et al., 2011). The following sections will discuss the relevant findings in each domain of nutrition assessment.

6.4.1 Anthropometric measures

BM showed no significant main effect for group but there was a significant main effect for time from baseline to 6-weeks (P=0.02) and baseline to 12-weeks (P=0.02).This was seen in all three groups and is not totally unexpected as when asked to complete a diet diary many individuals will change their dietary habits omitting less healthy foods, also they may have increased awareness of food intakes and modify their diet potentially reducing overall energy intake (Ortega et al., 2015). The mean reductions in BM for each group were UC -1.25kg, BL -2.84kg and NE -1.23kg over the 12-week period. One patient in each group met the minimal clinical important difference (MCID) for weight loss of >5%, UC (5.8%), BL (6.52%) and NE

(5.23%). Intentional weight loss has been shown to elicit positive changes in risk factors in the obese with established CHD (Pack et al., 2014). with BL group seeing the greatest reductions however this group had the highest baseline BM at 88.8±24.5kg compared with UC 84±8.7kg and NE 83.2±25.8kg. Weight loss was not a main outcome of the interventions but should be recommended for those who are at increased risk associated with overweight and obesity (≥25kg/m^2), weight loss alone has been shown to reduce CHD risk in those who are overweight or obese (Singh et al., 1992).

Healthy BMI range is between 18.5 kg/m^2 -24.9 kg/m^2 mean scores for each group show that patients are in the overweight or obese category both at baseline and at 12-weeks therefore continued reduction in BMI is recommended. Many patients are still at increased risk and for each 5kg/m^2 above 25kg/m^2 overall mortality was reported to be increased by 30% and CV mortality by 40% (Calle et al., 1999, Collaboration, 2009). Increased BMI has been consistently linked to increased risk of other NCD such as type II diabetes, hypertension and hypercholesterolemia (Tonstad et al., 2009). The NDNS statistics report states that in the UK the mean BMI score was 27.4kg/m^2 and mean score for HBNW patients in this study was 29.60kg/m^2 indicating that both the mean UK and HBNW scores place them in the overweight category (Bates et al., 2019). Many patients initially attend as obese and are likely to see an increase in weight over time (Lavie et al., 2009), therefore monitoring of high risk individuals is warranted. The NACR reported that approximately one third (33%) of CR patients initially attend with a BMI of >30kg/m^2 (Doherty and Harrison, 2017).

Average WC measurements in NDNS for the UK population was 97.4cm, compared to 100cm in the HBNW study population. Whilst there was no significant main effect for time or between groups the NE programme saw a -2.89cm reduction in mean WC compared with UC group (-1.47cm) and BL group (-1.41cm). Burke et al (2013) found that a 2.11cm decrease in WC improved risk factor profile (Burke et al., 2013) the NE programme showed greater improved health outcomes when compared to UC or BL.

The mean WHR places patients from all groups in the medium (0.95 or below) to high risk (0.96-1.0) categories, WHR remained the same from baseline to 12-weeks, UC (0.95), BL (0.97), NE (0.93). this placed UC and NE groups in the medium risk category and BL in the high-risk category. An increase in WHR is associated with greater risk of CHD and type II diabetes, it is recommended that WHR needs to be used in conjunction with other measures such as BMI and WC for a greater accuracy of risk prediction (Chan et al., 2003, Circumference and Ratio, 2008, De Koning et al., 2007, Organization, 2011) and all three of these measures have been used in the present study. Abdominal adiposity is a major concern for health care providers due to its associations with impaired glucose metabolism, hypertension and hypercholesterolemia, and a 1-SD increased WHR also increased risks of MI (Emdin et al., 2017).

6.4.2 Biochemical measures

Diabetes UK Recommend a fasted glucose levels of ≤.6mmol/L and a non-fasting glucose level of ≤7.8mmol/L (Dyson et al., 2011), patients in this study were tested in and non-fasted state due to the logistics of testing throughout the course of the day, it is reported that almost 25% of CR patients have type II diabetes (Foundation, 2018). Overall, each of the three groups saw a mean reduction of UC -0.64mmol/L, BL-0.37mmol/L and NE 0.70mmol/L. In 2018 Diabetes UK supported the use of the Med diet pattern, rather than focusing on individual nutrients such as carbohydrates and saturated fat, should be adopted and tailored to individual needs to reduce or even reverse type II diabetes (Dyson et al., 2018).

Target ranges of Total cholesterol are: <5.0mmol/L or <4.0mmol/L for those at high risk LDL-C < 2.0mm/L (Society et al., 2005, Board, 2014, Piepoli et al., 2014), all three groups have mean values between 4.0 and 4.5mmol/L suggesting an optimum total cholesterol level. Almost

32% of patients attending CR have some form of elevated lipid levels and will be medicated (Foundation, 2017). Medication has not been addressed in the present study however, it is plausible that some patients will be medicated to control lipid levels, this could account for satisfactory baseline and end results here. Increases on long term mortality risk has been seen with elevated triglyceride levels in patients with CHD (Klempfner et al., 2016), normal fasted blood levels are <1.7mmol/L and non-fasted levels are <2.3mmol/L (Medicine, 2013). As patients were in a non-fasted state at each timepoint, the mean triglyceride levels are in the normal range for each of the three groups UC 1.54mmol/L, BL 1.90mmol/L and NE 1.84mmol/L.

6.4.3 Clinical measures

Many of the patients attended testing following their exercise sessions resulting in elevated BP measurements in some individuals, the normal measurement for systolic blood pressure is <120mmHg. Just under 50% of CR patients nationally have a co-morbidity of hypertension and this needs to be addressed through nutrition education and exercise intervention (Doherty and Harrison, 2018). Although there were no significant changes over time or group interactions there were however changes from baseline to 12-weeks, there was a reduction in SBP in the UC group (-4mmHg), and new education group (-9mmHg) whereas the BL group saw an increase of +2mmHg, and for many decades Stamler and colleagues have suggested that small reductions in SBP can have positive consequences for CHD and stroke risk. They propose that a 2mmHg decrease in SBP decreased mortality from CHD by 4%, stroke by 6% and all-cause mortality by 3% and a 5mmHg reduction would cause 9% reduction in CHD a 14% reduction from stroke and 7% from all-cause mortality therefore suggesting that reductions seen in the UC and NE groups are meaningful and provide positive patient outcomes when compared to the BL. Similarly, DBP readings were within normal parameters of <80mmHg, at all three timepoints and for all groups and a mean change was seen UC-2mmHg, NE -2mmHg and BL +1mmHg. A diet lower in sodium is recommended to reduce the risk from hypertension in the future, and this can be achieved by following either the DASH diet or Med diet (Estruch et al., 2013, Martinez-Gonzalez et al., 2004, Harnden et al., 2010, Nadeau, 2019). It is however, advisable to monitor BP levels to ensure they are in an optimum range (Bertoia et al., 2012). Vidal-Petiot et al., (2016) conducted a review of patients selected from the CLARIFY registry (which contained patients from 45 countries) in BP control measures and found a J-shaped curve relevant to low BP (<120/70mmHg (Vidal-Petiot et al., 2016) therefore if dietary measures can positively influence BP then a reduction in medication may be warranted. Figure 9.6 shows the reported risks with elevated and lower BP parameters.

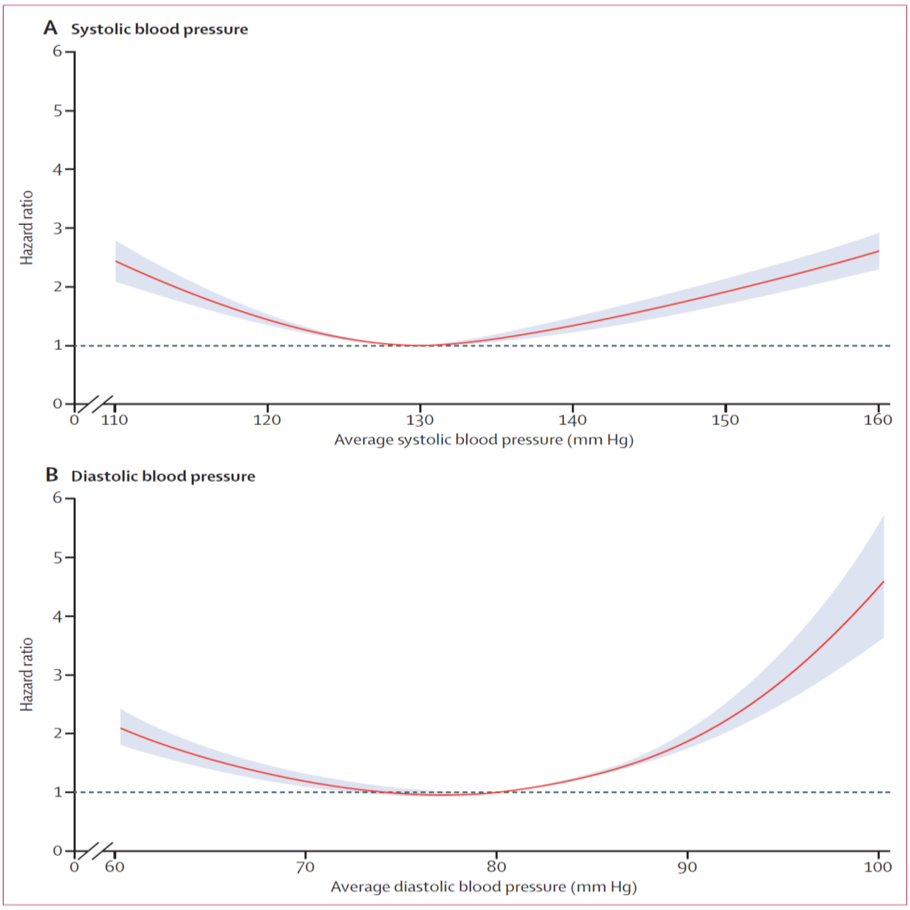


Figure 6.8 the J-shaped curve was found in BP measurements at the lowest and highest levels and levels at either end of the spectrum were said to be independent risk factors of mortality from CHD (Vidal-Petiot et al., 2016).

6.4.4 Dietary measures

The Med diet score significantly increased in all three groups over the 12-week period with the two intervention groups showing the greatest increases, UC (+0.6points), BL (+1 point) and NE (+2points) these findings are encouraging as continued adherence to the Med diet has been shown to reduce morbidity and mortality (Sofi et al., 2014). It was reported that a 2-point increase in Med score elicited an 8% reduction in overall mortality and a 10% reduction in CVD (Sofi et al., 2008, Sofi et al., 2014), and the NE group achieved the required 2-point increase over the intervention period. Data from the 4-day diet diary provide further insight into diet quality, total energy intakes for over 65year olds is between 1,900kcals-2,350kcals for women and men respectfully and according to SACN data reported intakes in all three groups were below the lowest recommended intake (mean intakes between 1560kcals-1769kcals) (Nutrition, 2012). This is not unusual as there are many barriers or external influences that play a role in the food choices and energy intakes of many older people, for example they may decrease their energy intake due to decreased appetite and restricting foods to those they deem to be healthy and this could potentially reduce total nutrient intake (Shlisky et al., 2017, White et al., 2011). Motivation to prepare foods or lack of cooking skills, changes in dental health or loss of taste can all influence energy intakes. Circumstances at home/family support (living alone), having limited funds or access to supermarket to purchase foods are all potential factors in food choices and dietary intake (Roininen et al., 2004, Corfe, 2018, Bloom et al., 2017). An Opinium study conducted in 2018 in the UK found that almost 25% of people surveyed reported feeling healthy foods were unaffordable, particularly meat and fish, around 17% found fruit and vegetables were too expensive and 12% said the distance to a supermarket that provided affordable healthy foods was a barrier to including them in their diet (Corfe, 2018). This is an important point and warrants further investigation however in the context of the energy intake for the duration of this study it is encouraging to see that energy intake did not reduce significantly over the intervention period and as we have seen from the Med diet score the quality of the diet has significantly improved. Results from the 4-day diet diary will shed light on the remaining macro and micronutrient content of the diet to help assess the overall quality of the diet in terms of nutrient intakes.

6.4.5 Macronutrient intake

Dietary reference value for CHO are 50% of total energy intake across all three groups CHO intakes are lower than recommended amounts with a mean intake of 43.98%, however it is the quality of CHO consumed that is most important, increased intakes of whole grain cereal and other wholegrain foods in addition to fruit, vegetable and legumes which are predominantly low glycaemic foods, (meaning that they slow down gastric emptying and reduce the rate of absorption of glucose reducing rate of insulin production) resulting in slower glucose and fat absorption which may help with feeling of satiety and fullness (Riccardi et al., 2004, McKeown et al., 2009). Public Health England (PHE) definition for free sugars is " all monosaccharides and disaccharides added to foods by the manufacturer, cook, or consumer, plus naturally present in honey, syrups and unsweetened fruit juices" cited in Buttriss (2016) (Buttriss, 2016b). UK adults currently consume 12.1% which is over twice the recommended amount of consuming no more than 30g/d (5%) of free sugars per day (Buttriss, 2016a) however, this target is thought to be challenging so the WHO recommend 5% but no more than 10% of total intakes (Gibson et al., 2017). All three groups reduced their intake of free sugars over the duration of the study, and mean intakes for UC group remained above the recommended intake but showed a mean reduction of 2.78g/d (from 40.86g/d to 38.08g/d), BL reduced mean intake by 15.09g/day (from 42.95 to 27.86g/d) and the NE reduced by 9.15g/day (from 30.81 to 21.66g/d), the two intervention groups improved more than the UC group with the BL having the largest reduction which is encouraging as they had the highest baseline intakes. Both intervention groups are now within the recommended intakes of 30g/d. Dietary Fibre intakes showed no significant reductions over time or between the groups, adults should aim to consume 30g of fibre daily (Buttriss, 2015), all three groups at all three timepoints are lower than half of recommended intakes, and at 12-weeks were UC 13.69g/d, BL 12.12g/d and NE 12. 69g/d, which is not surprising as this is in line with current intakes in the UK population which is approximately 18g/d (adults aged >65yrs) (Buttriss, 2015). High fibre cereals such as oats containing around 3.8g/serving of β glucan helps reduce the insulin response in addition to lowering total cholesterol levels (El Khoury et al., 2011) other high fibre cereals may be fortified with vitamins increasing intakes in addition to the natural fibre improving gut health (Lafiandra et al., 2014).

Total fat in takes should be no more than 35% daily energy intake, all three groups were within these parameters UC 33.23%, BL 31.04% and NE 32.74, and there were no significant differences between the groups or over time. Saturated fat intakes for UC were 11.68% BL 10.89% and NE 10.69%; there were no significant differences between the three groups and intakes are within the RNI of no more than 11% of total fat for BL and NE and fractionally over in the UC group, Polyunsaturated fatty acids were UC 5.08%. BL 4.91% and NE 5.78%, monounsaturated fats were UC 11.63%, BL 10.86%, and NE 11.90%. These intakes are comparable to UK population intakes of; 12.1% Saturated fats 12% monounsaturated and 6% polyunsaturated fatty acids (Forouhi et al., 2018). There is strong evidence that the type of fat consumed is more important than total fat intakes, and that trans and processed fats should be eliminated, polyunsaturated fatty acids should replace saturated fat, rather than replacing with carbohydrates when attempting to improve quality of the diet (Levy and Tedstone, 2017). More research is still needed on the long term use and health outcomes of plant oils, and of differing diets such as high fat-low carbohydrate and it is important not to vilify single nutrients and to focus on dietary patterns (Levy and Tedstone, 2017, Bhupathiraju and Tucker, 2011a) and a recent report from SACN stated that there is still a long way to go with long term RCT to ascertain best practice and in the meantime continue to support current recommended intakes (Forouhi et al., 2018).

There were no significant differences for protein between the groups or over the intervention period, intakes for UC was 18.84%, BL 17.37% and NE 21.01% Protein requirements for general populations is between 10-20% of total energy intake or 0.75g/kg/BM – 1.2g/kg/BM (Volpi et al., 2012), but in recent years it has been suggested that this should be increased to between 1.2g-1.5g/kg/bw/d for older adults to compensate for the reduced ability for muscle protein synthesis and to reduce risks of sarcopenia (Clegg and Williams, 2018). It was suggested that older adults may not consume adequate protein due to a number of previously discussed factors including oral health, diminished taste and lower total energy intake, and although the total energy intake is low, findings from this study suggest patient’s intakes are approximately 80g/d (0.88g/kg/BM) which is similar to UK intakes of around 88g for males and 64g for females, approximately 16% total intake (Bates et al., 2019). Protein intakes could be increased if total energy intakes were increased to the recommended amounts, also individual protein requirements should be considered, such as BM, age, activity level and gender.

6.4.6 Micronutrients

There was no significant main effect for group or time for intakes of Vitamins A, C, D and E, however results show that mean intakes for vitamin A were UC 718.62 μg/day, BL 523.97 μg/day and NE 522.06 μg/day compared to RNI of 600 μg/day females and 700 μg/day for males meaning that only the UC group met RNI, and these intakes are typical in the UK with around 29% of the population not meeting the RNI (ter Borg et al., 2015). There are two dietary sources of Vitamin A, there is preformed vitamin A found in animal sources such meat, fish and dairy products, and provitamin A which is converted into vitamin A from plant foods including dark green leafy vegetables, tomatoes and tomato products, fruit and orange and yellow vegetables, both types are important for maintaining the integrity of epithelial cell, normal vision, and it's a role in immune function (Castiglione et al., 2018, Levine, 2018), as an antioxidant vitamin it also helps to in the reduction of oxidative stress and free radical formation reducing the formation of atherosclerosis (Gatenby et al., 2015).

Vitamin C intakes were more than double the RNI of 40mg/d with UC consuming 78.03mg/d, BL 81.08mg/d and NE 92.24mg/d, but this should not be of major concern as intakes in excess of 300mg/d have reported mild symptoms such as stomach cramps, nausea and gastric disturbances but this was from supplementation rather than dietary sources (Grosso et al., 2013, Supplements, 2018). Vitamin C (L-ascorbic acid) is involved in wound healing, protein metabolism, improves the absorption of non-heme iron, may be able to regenerate vitamin E and other antioxidants, is thought to reduce risk from CHD and some cancers by reducing oxidative stress and has an important role in immune functioning (Levine, 2018). The RNI for Vitamin E (alpha-tocopherol) is 15mg/d and all groups were below recommended intakes, with BL consuming just 7.71mg/d and NE with 7.29mg/d, the UC group had the highest intake but still only 9.02mg/d. Vitamin E helps to protect cellular and intracellular membranes from damage caused by lipoprotein and polyunsaturated fatty acids (PUFA), PUFA can be either pro or anti-oxidant in nature, an increased intake of PUFA requires increased intakes of vitamin E, and this relationship and concentrations of each in the diet can determine how susceptible the cell is to free radical damage (Banks, 2017). In contrast vitamin D intakes, which were less than half of the recommended intake of 10 μg/day with UC consuming just 3.3 μg/day, BL 2.73 μg/day and NE 3.3 μg/day, and these low levels are consistent with current UK dietary intakes of 3.3 μg/day and currently there are calls to support a 10μg/d supplement for most people.1 in 5 UK adults are reportedly deficient or under the optimum levels it is important to address this situation through nutrition education and raising awareness of how to achieve a greater intake. Vitamin D is important for bone health and the regulation of calcium metabolism and absorption and there is much recent research investigating vitamin D's role in reducing BP and its anti-inflammatory influence (O'Connor et al., 2018). Additionally, the relationship between reduced vitamin D and the increased risks of CHD, hypertension and sudden cardiac death continues to attract attention, however Judd et al.,(2008) reported that there are very few long term published studies to provide conclusive evidence to support these claims, which and has since been supported by more recent studies from Kopecky et al., 2016 and Wang et al., (2017) (Judd and Tangpricha, 2008, Wang et al., 2017, Kopecky et al., 2016). Calcium intakes showed a significant reduction over the intervention period in all three groups, however they remained just above current RNI with UC consuming 772.99mg/d, BL 797.19mg/d and NE 757.69mg/d, this is in line with current UK intakes which are said to be satisfactory (Francis, 2008), when adequate intakes of calcium in combination with vitamin D (which regulates calcium uptake) is said to increase longevity in older adults as well as reducing the risk from falls and fractures (Aspray, 2017) calcium absorption decreases with age so a good dietary intake of calcium is recommended. Additionally, there has been some interest in the inverse relationship between BMI and calcium intake, however not all research agrees and is ongoing (Rodríguez-Rodríguez et al., 2010).

In older populations the intake of B vitamins in particular vitamin $B_{6,}$ B_{12} and folate are important for their role in homocysteine metabolism, increased homocysteine levels are linked to increased incidence of CVD and decline in cognitive function (Clarke et al., 2014, Fratoni and Brandi, 2015). There were no significant time or group interactions for: vitamin $B_{6,}$ $B_{12,}$ folate, Thiamin, and riboflavin and intakes in all B vitamins were above the RNI for all three groups, older populations may have increased requirements, and those who may be taking metformin for type II diabetes can have reduced availability of B_{12} so this increased intake is ideal (Phillips, 2003). B vitamins are essential for catabolic and anabolic metabolism, for aerobic respiration and cellular energy production in addition to regulating homocysteine levels (Castro-Quezada et al., 2014) and a deficiency in any one will have a negative impact on health.

The health implications for sodium intakes have been widely discussed in nutrition research and recommendations to incorporate the DASH diet and the DASH-sodium diet eating patterns are advocated for those at greater risk from high sodium intakes(Soltani et al., 2016, Sacks et al., 1999, Sacks et al., 2001, Shirani et al., 2013, Svetkey et al., 2004). The AHA recommend <1,500mg/d with <5% from salt (Whelton et al., 2012), a high sodium intake is reported to increase risks from hypertension and stroke, although the DASH diet doesn't directly recommend a reduction in sodium, it helps to lower intakes through the choice of whole fresh foods and the DASH-sodium collaborative research group suggest that reduced sodium intakes along with the DASH diet pattern will reduce overall salt intake and reduce BP and stroke risk (Svetkey et al., 2004). There were no significant differences in sodium or salt intakes between the groups and no change over time, all three groups had a higher intake of UC 1,532mg/d, BL1,697mg/d and NE 1,642mg/d, salt intakes of UC 4.48g/d, BL 4.59g/d and NE 4.16g/d, so total sodium intakes could be lowered to less than the 1,500mg/d set by the AHA, since reducing intakes to 1,000mg/d has been shown to elicit greater reduction (Bathrellou et al., 2019).

Intakes of selenium were under RNI of 75 μg /d for males and 60 μg /d for females, with UC consuming 53.04μg/d, BL 44.50 μg/d and NE 53.35 μg/d. Selenium is a trace mineral and plays a vital role along with other antioxidants in the fight against oxidative stress, there are many different selenoproteins, approximately 25 in humans, that are involved in reducing the harmful effects of ROS (Tinggi, 2008). Furman et al., (2004) theorised that selenoenzymes and selenoproteins played a role in reducing the incidence of CHD by decreasing the manufacture of oxidised LDL-C and recommended taking supplements to enhance this process when dietary intakes are low(Furman et al., 2004) Conversely, other researchers report that identification of the actual mechanisms are still to be identified and supplementation should be prescribed with care (Rayman, 2019), it appears that a balanced and varied diet (for example Med or DASH diet) would provide the necessary antioxidants to reduce oxidative stress and lessen the burden of CHD and many other NCD. Zinc intakes showed no significant main effect for time or a time group interaction, intakes between the three groups were slightly lower than the RNI with UC consuming 8.34mg/d, BL 8.19mg/d and NE 8.13mg/d the RNI is 9.5mg/d for males and 7mg/d for females. Zinc is important in biological processes such as wound healing, protein synthesis and immune function, and is necessary for DNA synthesis and cellular processes (Cunnane, 2018), red meat and poultry are the most consumed sources of zinc but seafood such as oysters and crab contain greater amounts of available zinc. Beans, nuts and wholegrains are also good sources however the wholegrains can bind to zinc reducing its bioavailability (Saunders et al., 2013).

6.4.7 Key points

Results from the RCT has revealed that all three groups saw a significant reduction in BM, BMI and WC in addition to MCID in these measures, and there were also significant improvements in free sugar intake, MCID was noted for SBP and DBP which translates into tangible real life meaning for patients. Total energy intakes for HBNW patients were lower than RNI and like general populations for PUFA, Fibre, vitamins A, D and E and selenium and zinc intakes and need further investigation to monitor changes for these nutrients.

The NEP did see some small but important changes above those of the BL and UC groups. WC reduced by 1.47cm in the UC group, 1.41cm in the BL group but the NE exceeded the MCID of 2.11cm with a reduction of 2.89cm (Burke et al., 2013). SBP also saw positive results, UC saw a 4mmHg reduction, BL increased by 2mmHg and NE reduced by 9mmHg. This is an important finding as a 2mmHg reduction in SBP was shown to decrease incidence of CHD by 4%, stroke by 6% and all-cause mortality by 3%. A 5mmHg decrease would cause a 9% decrease in CHD, 14% decrease in stroke and 7% decrease in all-cause mortality. The BL met the lower target, but the NE exceeded the higher target (Stamler et al., . The Med diet score sheet scores improved in all three groups with UC increased by 0.6 points, the BL by 1 point and the NE by 2points. The 2-point increase is shown to provide an 8% reduction in all- cause mortality and a 10% reduction in CVD (Sofi et al., 2008, 2014)

HBNW patients were recruited to participte in a RCT, as part of the trial it is evident that all patients modified their diet either intentionally or due to being part of a research study where they were required to complete 4-day diet diaries and provide anthropometric and biochemical measurements at each timepoint.

Statistically significant reductions were seen in BM, BMI, WC, in all three groups, some areas for improvement were identified for intakes of PUFA, Fibre, vitamins A,D E and for selenium and zinc.

Chapter 7

Final Discussion

7.0 Introduction

This research aimed to investigate the efficacy of current nutrition education in a CR programme followed by the design and implementation of a new education programme. The hypothesis was that a new nutrition education programme would elicit beneficial changes in BM, BMI, WHR in addition to improved diet and biochemical outcome measures more effectively than the previous intervention (biggest loser) and usual care (exercise only). To design a suitable nutrition education, programme several questions needed to be answered:

1) How effective was the current intervention in reducing risk factors relating to CHD which are WC, BMI, and BM, and how well attended is the intervention?

2) What were the current eating habits of Heartbeat patients and how much do they understand about healthy eating?

3) What are the barriers to attending nutrition education programmes and making dietary changes?

Studies 1,2 and 3 helped to inform a New Education Programme (NE) which was then delivered using a RCT to answer the final question:
ion programme in reducing RF for CHD when compared to standard education or usual care?

4) How effective is a new nutrition education programme in reducing RF for CHD when compared to standard education or usual care?

The following sections will review the key findings from each of the research studies to explain how the NE was developed and then discuss the outcomes of the NE programme.

Study 1 (Chapter 3) showed significant positive changes in risk factors of BMI, WC and BM from baseline to 6-weeks, and more importantly these changes had real impact for the participants as they met the MICD which improves their risk factor profile and if continued could reduce overall mortality. Unfortunately, there was no evidence to indicate what dietary changes had been made, for example if they had removed unhealthy energy dense foods without replacement with nutrient dense foods. The positive results indicate that with support (weekly meetings) patients were able to make favourable changes in body composition. These changes could potentially lead to improved glucose sensitivity, as a reduction in visceral fat reduces dyslipidaemia, lowers BP, improves insulin sensitivity, (Andreou et al., 2011, Clark, 2015). Therefore, further research is warranted and outcome measures should be extended to include: diet diary, blood pressure and biochemical measures (Sanguankeo et al., 2017).

Study 2 (Chapter 4) provided self-reported data which described a typical HBNW patient as; Male, White British, aged ≥65 years old with a WC (96.7cm), and BMI (27.14kg/m^2) which places them in the high risk and overweight categories respectively which is similar to other CR patients in the UK according to NACR figures (Doherty and Harrison, 2017). The questionnaires chosen for this study were designed to provide details of current eating patterns with the BHF "how healthy is your diet" questionnaire, which indicated that only 44.6% of patients met their 5-a-day F&V target, they chose low fat products where possible (84.2%), and removed visible fat from foods (91.3%), with 75% stating that they consumed oily fish each week and just over half of them also included nuts and seeds in their diet. Many patients were aware of the recommendations to reduce salt, 63% do not add salt to cooking, and 77.2% do not add extra salt at the table. Only 42% said they did not eat processed meats. The "Nutritional Knowledge Questionnaire" was chosen to establish what patients understood about healthy eating messages from professionals and the media, in addition to their ability to link health and dietary intake. Results showed that their knowledge was slightly higher than UK population but not as high as nutrition students, which is to be expected. This questionnaire highlighted some areas of confusion about what is meant by a "low-fat option" of food, and they also thought that polyunsaturated margarine and lower fat margarine were low-fat products. In addition to this, their responses highlighted areas of confusion around sugar (some thought that a banana was high in added sugar), portion sizes and the role of antioxidants in the diet.

Study 3 (Chapter 5) provided valuable insights into patients views on healthy eating, areas of confusion, some of the barriers they faced when contemplating change and what they would like to see included in future education programmes. In agreement with earlier findings from White et al., (2011) some patients have made dietary changes following diagnosis and are keen to improve their diet if they feel it will improve their risk factor profile as part of their CR (White et al., 2011). Evidence from the focus groups suggested that mixed messages from the media and from health professionals had added to their confusion, and they provided insights into how they perceive healthy eating, with negative phrases such as "boring", "eating like rabbits", "feeling hungry", and "cutting out foods they enjoy" therefore identifying some important barriers to attending nutrition education programmes in the future. It is easy to see from the comments that negative experiences in the past will impact on engaging with education programmes in the future. Of those patients who remembered being provided with nutrition education they remember the focus being on what should be cut from the diet or reduced such as, reduce salt, sugar fat and alcohol with little emphasis on what should be included. Patients reported that this had led to them having a restricted diet for most of the time but this was hard to sustain causing them to abandon their "diet" and consuming more foods they considered "bad" and returning to previously unhealthy eating patterns. These results are like those of Meyer et al., (2014) who conducted interviews with CR patients regarding barriers to following nutritional guidelines provided by healthcare professionals. Patients cited there being too many sources of information which made it difficult to make decisions about food choices, and there was a lot of contradictory information both from medical professionals and external sources such as the media leading to many individuals not engaging in education programmes and making their own choices rather than following the seemingly incoherent advice of others (Meyer et al., 2014). CR is male dominated with over 70% of patients nationally taking part, and it is important to recognise that males may have different views on healthy eating and “diet” compared to females (Ma et al., 2010b) . Males are far less likely to attend weight loss programmes. In an audit of commercial weight loss programmes involving 1.3 million adults, Stubbs et al (2015) reported that only 5% were males, however, those that did attend saw greater absolute and percentage weight loss than their female counterparts (Stubbs et al., 2015). This suggests that the way in which education is marketed will have an impact on uptake, and as seen from the low uptake of the initial biggest loser intervention (which was advertised as a weight loss programme) that a more pro-active and positive approach may increase interest and participation. During the FG sessions when asked if they would be interested in a nutrition education programme many answered with a no, however when this question was re-framed and asked would you like to improve your heart health and reduce risks would you be interested, the overwhelming response was yes therefore adding support for a more positive approach to nutrition education in the future. In this older population, poor nutrition or food choices prior to diagnosis of CHD may be continued following diagnosis without correct education and support (Lancashire et al., 2002). Men are more likely to see healthy eating as boring and unsatisfying and regardless of their awareness of healthy eating messages they may be sceptical or unwilling to making changes (Sobal, 2005, Nielsen et al., 2017). In the context of CR, little has been published on patient experiences regarding healthy eating advice following diagnosis, and whether it translates into diet change (Ma et al., 2010a). To provide meaningful NE to CR patients, it is necessary to understand what healthy eating means to them and highlight barriers to attending NE in the future (Stubbs et al., 2015). Clearly a more positive approach to providing dietary information is required, concentrating on a whole diet approach rather than vilifying single nutrients (Bhupathiraju and Tucker, 2011a), this sentiment was carried forward in the development of the NE programme.

Study 4 (chapter 6) demonstrated that participating in an intervention can provide the motivation for patients to reassess their current diet and make changes, it is not uncommon for people when completing diet diaries and feeling that they are being “assessed” to make changes regardless of the instructions to maintain regular eating patterns (Ortega et al., 2015). It was not surprising therefore, that all three resulted in a significant reduction in BM, BMI, and WC. The inclusion of all 5 domains of nutritional assessment; anthropometric, biochemical, clinical, dietary and environmental, has provided valuable information and although from a statistical viewpoint there were no significant differences in many of the outcome measures there were important positive changes of clinical significance. For example, the NE group had greater reductions in SBP (-9mmHg) than UC (-4mmHg) and BL (+2mmHg) where a 2mmHg decrease in SBP can decrease mortality from CHD by 4%, stroke by 6% and all-cause mortality by 3% and a 5mmHg reduction can result in a 9% reduction in CHD a 14% reduction from stroke and 7% from all-cause mortality. This suggests that the reductions seen in the UC and NE groups are meaningful and provide positive patient outcomes when compared to the BL. Similarly, DBP changes were also encouraging for UC with -2mmHg, NE -2mmHg, where the BL group had a marginal increase of +1mmHg. Diet quality in terms of increased adherence to the Med diet had improved in all three groups with a 0.9-point increase seen in the UC group, a 1-point increase in the BL group and a 2-point increased seen in the NE group. A 2-point increase in Med score elicited an 8% reduction in overall mortality and a 10% reduction in CVD (Sofi et al., 2008, Sofi et al., 2014). The NE group achieved the required 2-point increase over the intervention period. If we take the reductions in overall mortality risk from blood pressure and med diet scores the NE has seen the greatest improvements when compared to the UC and BL groups. However, in all other dietary measures, including total energy, macronutrient and micronutrient intakes, there were no statistically or clinically significant differences between the three groups. Nutritional analysis revealed that HBNW dietary intakes were similar to UK populations according to NDNS figures (Bates et al., 2015) and results from the present study highlighted that total fibre intake was consistent with UK populations at approximately half of the recommended 30g/d, whereas PUFA intakes were just above 5% of total fat intake and recommendations to reduce saturated fat and replace with PUFA for heart health do not appear to be translating into practice (current UK intakes are SFA 11%, PUFA 5% and MUFA 11.5% of total fat intake). Vitamin E intakes were around half of the RNI (15mg/d), which is consistent with UK figures and Vitamin D intakes again are consistent with UK populations at 3.3μg/d, B vitamins were above RNI whilst selenium and zinc intakes were slightly above the LRNI which is not ideal and needs to be addressed.

The findings of this study show that participating in the RCT had positive outcomes in WC, BM, and BMI measurements regardless of which group patients were assigned to. This could be in part because the act of completing diet diaries and attending the re-assessment sessions at three separate timepoints could have influenced dietary intakes. Whilst there were no statistical differences in the outcome measures between the three programmes the NE programme resulted in greater clinically significant changes in some key outcome measures when compared to UC or BL, these were: WC, WHR, Glucose levels, SBP and DBP and Med diet score, all of which have positively influenced the risk factor profile of individuals in that group. The BL group saw a greater reduction in free sugar intake and BM compared to the other two groups, and the UC group had higher intakes of fibre, vitamins A and E although these were still below the RNI. These results are positive, and it should be noted that this NE programme provided education only, not a prescriptive diet plan. Individuals in the NE group were free to make their own food choices according to their own preferences. Patients in this group were provided with the tools for constructing a heart healthy diet, opening their minds to the role that diet plays in heart health is the first step in facilitating behaviour change over time.

The rationale behind not prescribing a diet was to ensure the NE programme could be delivered by exercise professionals in the future, a programme that does not overstep their professional boundaries was of the upmost importance. Therefore, by using the Med diet and Eatwell guide as the basis of the education programme and demonstrating, through evidence-based research, the potential benefits of adopting such eating patterns then these boundaries are not crossed. Each week patients in the NE group were given a weekly challenge to incorporate different elements of the eating patterns over the six-week period rather than trying to change completely at the beginning of the programme.

7.2 Strengths of this research

The strengths of this research were that it addressed the requirements of a specific CR population through a need's assessment approach, discovering what had previously been done in terms of nutritional education, assessing the diet quality and nutritional knowledge of patients and listening to their views and concerns and barriers to adopting healthy eating practices. The information then helped to inform the new education programme, patients that volunteered to take part in each of the studies provided a good representation of the HBNW population and had a similar profile in terms of gender, age, BM, BMI and are similar to other CR in the UK (Foundation, 2018, Cowie et al., 2019) suggesting that positive outcomes of this programme could be generalisable to a wider CR population. The RCT provided positive outcomes in terms of the health status of individuals from each of the three groups with significant improvements in anthropometric measures, for BP in UC and NE, reductions in free sugars in all groups but more so in the BL group and greater adherence to the Med diet eating pattern, with the NE group seeing the greatest improvement. The final strength was that the intervention highlighted areas of less than satisfactory intakes in some vital nutrients that are consistent with UK population figures (Doherty and Harrison, 2017), and need to be addressed in any future education programmes, for example fibre intakes are around half of the current guidelines to consume 30g/d (Buttriss, 2015)the importance of increased fibre intakes on heart health in addition to gut health and reduced risks from some cancers should be included need to be emphasised.

7.3 Limitations and implications for future research

Data from each research study was analysed as a group, a gender difference was not considered, and this could have potentially had a bearing on the results reported (Holdcroft, 2007). This was a conscious decision as there is little evidence that gender split in the context of this research would have yielded further information on the parameters tested here. For example, Springer et al., (2012) discussed the disparity of gender balance in research but acknowledges that factoring for all males and females is complex and may even lead to misclassification or incorrect data being recorded. Put simply it is the accumulation of abdominal fat rather than the gender that is the risk factor. The cut points set out by WHO (2011) were enough to classify patients. Identifying biological mechanisms that would rationalise gender differences were beyond the scope of the present research however it would be interesting to follow this up in future research and potential re-visiting of data.

The duration of the intervention (12-weeks) is relatively short timeframe when considering dietary, anthropometric, and biochemical changes. Many people will engage in good practice whist they are being monitored but some will inevitably slip back into their previous eating patterns over time so regular follow up would be recommended to produce long term behaviour change. The limited statistically significant results may cast doubt on the efficacy of the NE programme when compared to UC or BL, however the clinically meaningful results seen in some measures in the NE programme need to be investigated further. Another potential limiting factor was that the intervention groups were not provided with a specific diet plan, this was the intent of the researcher to enable patients to be presented with rationale behind specific heart healthy recommendations with the Med diet and Eatwell guide along with supporting research being used to explain the guidelines advocated. The use of self-reported measures to establish eating habits via questionnaires and diet diaries are subjective and rely on the motivations of individuals who are completing them. They may withhold information either intentionally or not, and this can place uncertainty on the quality of information gathered. Patients are likely to change their eating patterns simply because they are part of a research study, which was evident in this case with anecdotal evidence suggesting that patients from each of the groups had a raised awareness of their current diet quality when completing the diet diaries and therefore had made changes.

7.4 Implications for practice

Throughout this research many patients have reacted positively to the prospect of continued support to make the changes necessary to reduce overall and CVD mortality. This research has ignited an interest in nutritional behaviours to influence heart health, so much so that results from this research are informing the next phase of nutrition education and the “Happy heart healthy you” programme has been adopted by HBNW in a collaborative effort with the researcher to continue to provide a comprehensive CR programme

This research has provided evidence that the NE programme had a positive influence in clinical outcomes for a range of modifiable risk factors including WC, BM, BMI, Med diet score, and BP resulting from dietary education alone. Some patients who participated in the study have clearly improved their risk factor profile and the risk from further progression of metabolic disorders and co-morbidities for CHD progression. It is therefore important that the positive aspects of the study are continued to maintain the progress made.

7.5 Gaps in current research

Chapter one and five identified gaps in the provision of nutrition education for cardiac rehabilitation patients, with limited access to appropriately trained staff to provide the necessary education programmes being one major problem. Dietary modifications in addition to increased activity are required to facilitate change in high risk individuals, much of the research presently focuses on primary prevention (pre-diagnosis) in high-risk populations. However, limited evidence is available in secondary prevention, it is apparent that further investigation is warranted within a cardiac rehabilitation setting.

7.6 Unique contribution to research

Contribution 1. – delivery and staff

The aim of the research was to develop an education programme that can be delivered by exercise professionals in the future. For this to come to fruition the education programme needs to

- remain within the professional boundaries of exercise professionals (Barnes et al., 2017, McKean et al., 2019,
- follow a simple format
- be time efficient (both for the instructor and the patients).

The intervention was delivered over a 6-week period, similar to Butscher et, al., (2016) who initially started with 24 nutrition sessions, however following patient feedback this was reduced to 6 sessions (all delivered by a registered dietitian nutritionist (RDN) as this was considered more achievable for patients and RDN. As previously discussed, only 50% of CR programmes employ a dietitian, therefore it would make financial and practical sense to deliver nutrition education at point of contact utilising resources and personnel already available.

Contribution 2. Recommendations v intake

During this research it was apparent that the dietary guidelines and recommendations from health and medical professionals were either lacking altogether or confused and contradictory. This is the first study to involve patients in the development of a nutrition education programme to provide simple and achievable diet advice. Utilising research to dispel myths and provide evidence-based information on what patients should consume for heart health rather than what they should avoid. This level of comprehensive education, delivered as part of the CR programme is unique to HBNW and UCLan, and together it is hoped that patients will have an improved risk factor profile and quality of life following CR. Further development of materials and resources used in this study will provide the EP with detailed guidelines needed to deliver the NE programme working within their professional boundaries and level of expertise (Barnes et al., 2017, McKean et al., 2019).

Contribution 3

7.7 Future direction

Designing a nutrition education programme is challenging and ever evolving. The culmination of this research was the design and delivery of the new education programme. It is evident from the results that there are responders and non-responders to the intervention. Follow up of the non-responders would be necessary to identify reasons for this, potentially they would benefit from a more personalised approach to facilitate positive changes. Based on the findings of the RCT the “Healthy Heart Happy You” nutrition chapter 6 education programme will be refined and offered to all patients attending HBNW as a standard part of their cardiac rehabilitation programme.

Reference List

AASHEIM, E. T., HOFSØ, D., HJELMESÆTH, J., BIRKELAND, K. I. & BØHMER, T. 2008. Vitamin status in morbidly obese patients: a cross-sectional study. *The American journal of clinical nutrition,* 87**,** 362-369.

ABDELHAMID, A. S., MARTIN, N., BRIDGES, C., BRAINARD, J. S., WANG, X., BROWN, T. J., HANSON, S., JIMOH, O. F., AJABNOOR, S. M. & DEANE, K. H. 2018. Polyunsaturated fatty acids for the primary and secondary prevention of cardiovascular disease. *Cochrane Database of Systematic Reviews*.

AHMED, S., FRANEY, C., MCDEVITT, H., SOMERVILLE, L., BUTLER, S., GALLOWAY, P., REYNOLDS, L., SHAIKH, M. & WALLACE, A. 2011. Recent trends and clinical features of childhood vitamin D deficiency presenting to a children's hospital in Glasgow. *Archives of disease in childhood,* 96**,** 694-696.

AKSU, H. H. 2009. Questionnaries and interviews in educational researches. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*.

ALBERTI, K. 2009. International Diabetes Federation Task Force on Epidemiology and Prevention; Hational Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; International Association for the Study of Obesity: Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation,* 120**,** 1640-1645.

ALISSA, E. M. & FERNS, G. A. 2017. Dietary fruits and vegetables and cardiovascular diseases risk. *Critical reviews in food science and nutrition,* 57**,** 1950-1962.

ALSAFFAR, A. A. 2012. Validation of a general nutrition knowledge questionnaire in a Turkish student sample. *Public health nutrition,* 15**,** 2074-2085.

ANDERSON, L., OLDRIDGE, N., THOMPSON, D. R., ZWISLER, A.-D., REES, K., MARTIN, N. & TAYLOR, R. S. 2016. Exercise-based cardiac rehabilitation for coronary heart disease: Cochrane systematic review and meta-analysis. *Journal of the American College of Cardiology,* 67**,** 1-12.

ANDREOU, E., PHILIPPOU, C. & PAPANDREOU, D. 2011. Effects of an intervention and maintenance weight loss diet with and without exercise on anthropometric indices in overweight and obese healthy women. *Ann Nutr Metab,* 59**,** 187-92.

APPEL, L. J., MOORE, T. J., OBARZANEK, E., VOLLMER, W. M., SVETKEY, L. P., SACKS, F. M., BRAY, G. A., VOGT, T. M., CUTLER, J. A. & WINDHAUSER, M. M. 1997. A clinical trial of the effects of dietary patterns on blood pressure. *New England journal of medicine,* 336**,** 1117-1124.

APPLETON, K. 2016. Barriers to and facilitators of the consumption of animal-based protein-rich foods in older adults. *Nutrients,* 8**,** 187.

ASHLEY, E. A. & NIEBAUER, J. 2004. Coronary artery disease. *Cardiology Explained.* Remedica.

ASPRAY, T. J. 2017. Calcium: Basic Nutritional Aspects. *Molecular, Genetic, and Nutritional Aspects of Major and Trace Minerals.* Elsevier.

ATKINS, S., HOLLAND, S., CROSSLEY, D., TAYLOR, P. J. & SINCLAIR, J. 2017. Assessment of the effectiveness of a phase IV cardiac rehabilitation programme. *The Lancet,* 389**,** S23.

AUBIN, H. J., FARLEY, A., LYCETT, D., LAHMEK, P. & AVEYARD, P. 2012. Weight gain in smokers after quitting cigarettes: meta-analysis. *BMJ,* 345**,** e4439.

BACPR, E. C. M. 2012. RAMIT presents an outdated version of cardiac rehabilitation. *Heart (British Cardiac Society),* 98**,** 672; author reply 673.

BADRICK, E., SPERRIN, M., BUCHAN, I. E. & RENEHAN, A. G. 2017. Obesity paradox and mortality in adults with and without incident type 2 diabetes: a matched population-level cohort study. *BMJ Open Diabetes Research and Care,* 5**,** e000369.

BAKER, A. H. & WARDLE, J. 2003. Sex differences in fruit and vegetable intake in older adults. *Appetite,* 40**,** 269-275.

BALADY, G. J., WILLIAMS, M. A., ADES, P. A., BITTNER, V., COMOSS, P., FOODY, J. A., FRANKLIN, B., SANDERSON, B. & SOUTHARD, D. 2007. Core components of cardiac rehabilitation/secondary prevention programs: 2007 update: a scientific statement from the American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee, the Council on Clinical Cardiology; the Councils on Cardiovascular Nursing, Epidemiology and Prevention, and Nutrition, Physical Activity, and Metabolism; and the American Association of Cardiovascular and Pulmonary Rehabilitation. *J Cardiopulm Rehabil Prev,* 27**,** 121-9.

BANACK, H. & STOKES, A. 2017. The 'obesity paradox'may not be a paradox at all. Nature Publishing Group.

BANKS, M. A. 2017. VITAMIN E AND POLYUNSATURATED FATS: ANTIOXIDANT AND PRO-OXIDANT RELATIONSHIP. *Oxidants, Antioxidants And Free Radicals***,** 23.

BARNES, K., BALL, L. & DESBROW, B. 2017. An International Comparison of Nutrition Education Standards, Occupational Standards and Scopes of Practice for Personal Trainers. *International journal of sport nutrition and exercise metabolism,* 27**,** 507-519.

BARTRAM, B. 2019. Using questionnaires. *Practical Research Methods in Education: An Early Researcher's Critical Guide***,** 1.

BATES, B., COLLINS, D., COX, L., NICHOLSON, S., PAGE, P., ROBERTS, C., STEER, T. & SWAN, G. 2019. National Diet and Nutrition Survey, Years 1 to 9 of the Rolling Programme (2008/2009–2016/2017): Time Trend and Income Analyses. *Public Health England: London, UK*.

BATES, B., PRENTICE, A., BATES, C., PAGE, P., STEER, T., COX, L., NICHOLSON, S. & SWAN, G. 2015. National Diet and Nutrition Survey Rolling Programme (NDNS RP). Supplementary report: blood folate results for the UK as a whole, Scotland, Northern Ireland (years 1 to 4 combined) and Wales (years 2 to 5 combined). *National Diet and Nutrition Survey Rolling Programme (NDNS RP). Supplementary report: blood folate results for the UK as a whole, Scotland, Northern Ireland (years 1 to 4 combined) and Wales (years 2 to 5 combined).*

BATHRELLOU, E., KONTOGIANNI, M. D., CHRYSANTHOPOULOU, E., GEORGOUSOPOULOU, E., CHRYSOHOOU, C., PITSAVOS, C. & PANAGIOTAKOS, D. 2019. Adherence to a DASH-style diet and cardiovascular disease risk: The 10-year follow-up of the ATTICA study. *Nutrition and health,* 25**,** 225-230.

BERTOIA, M. L., WARING, M. E., GUPTA, P. S., ROBERTS, M. B. & EATON, C. B. 2012. Implications of new hypertension guidelines in the United States. *Hypertension,* 60**,** 639-644.

BETHELL, H., DALAL, H. & LEWIN, R. 2008a. Cardiac rehabilitation: worth it? *Heart*.

BETHELL, H., LEWIN, R. & DALAL, H. 2009. Cardiac rehabilitation in the United Kingdom. *Heart,* 95**,** 271-275.

BETHELL, H. J. N., LEWIN, R. J. P. & DALAL, H. M. 2008b. Cardiac rehabilitation. *British Journal of General Practice,* 58**,** 677.

BHAIMIA, S. 2018. The General Data Protection Regulation: the next generation of EU data protection. *Legal Information Management,* 18**,** 21-28.

BHATNAGAR, P., WICKRAMASINGHE, K., WILKINS, E. & TOWNSEND, N. 2016. Trends in the epidemiology of cardiovascular disease in the UK. *Heart,* 102**,** 1945-1952.

BHATTI, J. S., BHATTI, G. K. & REDDY, P. H. 2017. Mitochondrial dysfunction and oxidative stress in metabolic disorders—A step towards mitochondria based therapeutic strategies. *Biochimica et Biophysica Acta (BBA)-Molecular Basis of Disease,* 1863**,** 1066-1077.

BHUPATHIRAJU, S. N. & TUCKER, K. L. 2011a. Coronary heart disease prevention: Nutrients, foods, and dietary patterns. *Clinica Chimica Acta,* 412**,** 1493-1514.

BHUPATHIRAJU, S. N. & TUCKER, K. L. 2011b. Greater variety in fruit and vegetable intake is associated with lower inflammation in Puerto Rican adults. *Am J Clin Nutr,* 93**,** 37-46.

BINGHAM, S. A., GILL, C., WELCH, A., DAY, K., CASSIDY, A., KHAW, K., SNEYD, M., KEY, T., ROE, L. & DAY, N. 1994. Comparison of dietary assessment methods in nutritional epidemiology:

weighed records v. 24 h recalls, food-frequency questionnaires and estimated-diet records. *British Journal of Nutrition,* 72**,** 619-643.

BINKOSKI, A. E., KRIS-ETHERTON, P. M., WILSON, T. A., MOUNTAIN, M. L. & NICOLOSI, R. J. 2005. Balance of unsaturated fatty acids is important to a cholesterol-lowering diet: comparison of mid-oleic sunflower oil and olive oil on cardiovascular disease risk factors. *Journal of the American Dietetic Association,* 105**,** 1080-1086.

BINTI OTHMAN, F., BIN JAN MOHAMED, H. J., SIRAJUDEEN, K. & RAJAB, N. F. 2017. The influence of selenium status on body composition, oxidative DNA damage and total antioxidant capacity in newly diagnosed type 2 diabetes mellitus: A case-control study. *Journal of Trace Elements in Medicine and Biology,* 43**,** 106-112.

BIRO, G., HULSHOF, K., OVESEN, L. & CRUZ, J. A. 2002. Selection of methodology to assess food intake. *European journal of clinical nutrition,* 56**,** S25.

BISOGNI, C. A., JASTRAN, M., SELIGSON, M. & THOMPSON, A. 2012. How people interpret healthy eating: contributions of qualitative research. *J Nutr Educ Behav,* 44**,** 282-301.

BLAUM, C., BRUNNER, F. J., KRÖGER, F., BRAETZ, J., LORENZ, T., GOßLING, A., OJEDA, F., KOESTER, L., KARAKAS, M. & ZELLER, T. 2019. Modifiable lifestyle risk factors and C-reactive protein in patients with coronary artery disease: Implications for an anti-inflammatory treatment target population. *European journal of preventive cardiology***,** 2047487319885458.

BLOOM, I., EDWARDS, M., JAMESON, K. A., SYDDALL, H. E., DENNISON, E., GALE, C. R., BAIRD, J., COOPER, C., AIHIE SAYER, A. & ROBINSON, S. 2017. Influences on diet quality in older age: the importance of social factors. *Age Ageing,* 46**,** 277-283.

BOARD, J. B. S. 2014. Joint British Societies' consensus recommendations for the prevention of cardiovascular disease (JBS3). *Heart,* 100**,** ii1-ii67.

BONACCIO, M., DI CASTELNUOVO, A., BONANNI, A., COSTANZO, S., DE LUCIA, F., POUNIS, G., ZITO, F., DONATI, M. B., DE GAETANO, G. & IACOVIELLO, L. 2013a. Adherence to a Mediterranean diet is associated with a better health-related quality of life: a possible role of high dietary antioxidant content. *BMJ open,* 3**,** e003003.

BONACCIO, M., DI CASTELNUOVO, A., COSTANZO, S., DE LUCIA, F., OLIVIERI, M., DONATI, M. B., DE GAETANO, G., IACOVIELLO, L., BONANNI, A. & INVESTIGATORS, M.-S. P. 2013b. Nutrition knowledge is associated with higher adherence to Mediterranean diet and lower prevalence of obesity. Results from the Moli-sani study. *Appetite,* 68**,** 139-146.

BONACCIO, M., DONATI, M., IACOVIELLO, L. & DE GAETANO, G. 2016. Socioeconomic determinants of the adherence to the Mediterranean diet at a time of economic crisis: the experience of the MOLI-SANI study. *Agriculture and agricultural science procedia,* 8**,** 741-747.

BOOTH, A. O., LOWIS, C., DEAN, M., HUNTER, S. J. & MCKINLEY, M. C. 2013. Diet and physical activity in the self-management of type 2 diabetes: barriers and facilitators identified by patients and health professionals. *Prim Health Care Res Dev,* 14**,** 293-306.

BOS, M., DE VRIES, J., FESKENS, E., VAN DIJK, S., HOELEN, D., SIEBELINK, E., HEIJLIGENBERG, R. & DE GROOT, L. 2010. Effect of a high monounsaturated fatty acids diet and a Mediterranean diet on serum lipids and insulin sensitivity in adults with mild abdominal obesity. *Nutrition, Metabolism and Cardiovascular Diseases,* 20**,** 591-598.

BOYNTON, P. M. & GREENHALGH, T. 2004. Selecting, designing, and developing your questionnaire. *Bmj,* 328**,** 1312-1315.

BPHIL, J. H. B. E. 2012. NICE and the Quality and Outcomes Framework (QOF) 2009–2011. *Quality in Primary Care,* 20**,** 47-55.

BRANDES, R. P., FLEMING, I. & BUSSE, R. 2005. Endothelial aging. *Cardiovascular research,* 66**,** 286-294.

BREMER, A. A. & JIALAL, I. 2013. Adipose tissue dysfunction in nascent metabolic syndrome. *Journal of obesity,* 2013.

BRUSTAD, M., SKEIE, G., BRAATEN, T., SLIMANI, N. & LUND, E. 2003. Comparison of telephone vs face-to-face interviews in the assessment of dietary intake by the 24 h recall EPIC SOFT program—the Norwegian calibration study. *European journal of clinical nutrition,* 57**,** 107.

BURKE, L., LEE, A. H., JANCEY, J., XIANG, L., KERR, D. A., HOWAT, P. A., HILLS, A. P. & ANDERSON, A. S. 2013. Physical activity and nutrition behavioural outcomes of a home-based intervention program for seniors: a randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity,* 10**,** 14.

BUTTRISS, J. 2015. Fibre–Need to increase intake according to new recommendations. *Nutrition bulletin,* 40**,** 291-295.

BUTTRISS, J. 2016a. The Eatwell guide refreshed. *Nutrition Bulletin,* 41**,** 135-141.

BUTTRISS, J. 2016b. Sugars–part of a bigger picture? *Nutrition bulletin,* 41**,** 78-86.

CALLE, E. E., THUN, M. J., PETRELLI, J. M., RODRIGUEZ, C. & HEATH JR, C. W. 1999. Body-mass index and mortality in a prospective cohort of US adults. *New England Journal of Medicine,* 341**,** 1097-1105.

CASEY, P. H., GOOLSBY, S. L., LENSING, S. Y., PERLOFF, B. P. & BOGLE, M. L. 1999. The use of telephone interview methodology to obtain 24-hour dietary recalls. *Journal of the American Dietetic Association,* 99**,** 1406-1411.

CASTIGLIONE, D., PLATANIA, A., CONTI, A., FALLA, M., D'URSO, M. & MARRANZANO, M. 2018. Dietary micronutrient and mineral intake in the mediterranean healthy eating, ageing, and lifestyle (MEAL) study. *Antioxidants,* 7**,** 79.

CASTRO-QUEZADA, I., ROMÁN-VIÑAS, B. & SERRA-MAJEM, L. 2014. The Mediterranean diet and nutritional adequacy: a review. *Nutrients,* 6**,** 231-248.

CERHAN, J. R., MOORE, S. C., JACOBS, E. J., KITAHARA, C. M., ROSENBERG, P. S., ADAMI, H.-O., EBBERT, J. O., ENGLISH, D. R., GAPSTUR, S. M. & GILES, G. G. A pooled analysis of waist circumference and mortality in 650,000 adults. Mayo Clinic Proceedings, 2014. Elsevier, 335-345.

CHAN, D., WATTS, G. F., BARRETT, P. & BURKE, V. 2003. Waist circumference, waist-to-hip ratio and body mass index as predictors of adipose tissue compartments in men. *Qjm,* 96**,** 441-447.

CHANG, V. W., LANGA, K. M., WEIR, D. & IWASHYNA, T. J. 2017. The obesity paradox and incident cardiovascular disease: A population-based study. *PloS one,* 12**,** e0188636.

CHOI, S.-H., SVIRIDOV, D. & MILLER, Y. I. 2017. Oxidized cholesteryl esters and inflammation. *Biochimica et Biophysica Acta (BBA)-Molecular and Cell Biology of Lipids,* 1862**,** 393-397.

CHOICES, N. 2011. The eatwell plate. *Internet http://www. nhs. uk/Livewell/Goodfood/Pages/eatwell-plate. aspx (accessed 10th December 2012)*.

CHUA, T. & LIPKIN, D. P. 1993. Cardiac rehabilitation. *BMJ: British Medical Journal,* 306**,** 731.

CHUNG, E., MO, H., WANG, S., ZU, Y., ELFAKHANI, M., RIOS, S. R., CHYU, M.-C., YANG, R.-S. & SHEN, C.-L. 2018. Potential roles of vitamin E in age-related changes in skeletal muscle health. *Nutrition Research,* 49**,** 23-36.

CIRCUMFERENCE, W. W. & RATIO, W.-H. 2008. report of a WHO expert consultation. *Geneva: WHO***,** 8-11.

CLARK, J. E. 2015. Diet, exercise or diet with exercise: comparing the effectiveness of treatment options for weight-loss and changes in fitness for adults (18-65 years old) who are overfat, or obese; systematic review and meta-analysis. *J Diabetes Metab Disord,* 14**,** 31.

CLARKE, R., BENNETT, D., PARISH, S., LEWINGTON, S., SKEAFF, M., EUSSEN, S. J., LEWERIN, C., STOTT, D. J., ARMITAGE, J., HANKEY, G. J., LONN, E., SPENCE, J. D., GALAN, P., DE GROOT, L. C., HALSEY, J., DANGOUR, A. D., COLLINS, R., GRODSTEIN, F. & COLLABORATION, O. B. O. T. B.-V. T. T. 2014. Effects of homocysteine lowering with B vitamins on cognitive aging: meta-analysis of 11 trials with cognitive data on 22,000 individuals. *The American Journal of Clinical Nutrition,* 100**,** 657-666.

CLEGG, M. E. & WILLIAMS, E. A. 2018. Optimizing nutrition in older people. *Maturitas,* 112**,** 34-38.

COLLABORATION, H. S. 2002. Homocysteine and risk of ischemic heart disease and stroke: a meta-analysis. *Jama,* 288**,** 2015-2022.

COLLABORATION, P. S. 2009. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. *The Lancet,* 373**,** 1083-1096.

CONSORT, B. T. J. A. I. M. 2010. CONSORT 2010 statement: updated guidelines for reporting parallel group randomized trials. 152.

CORFE, S. 2018. What are the barriers to eating healthily in the UK. *Social Market Foundation. Retrieved from: http://www. smf. co. uk/publications/barriers-eating-healthily-uk*.

COSTANZO, D. G. 2006. ACSM Certification: the evolution of the exercise professional. *ACSM's Health & Fitness Journal,* 10**,** 38-39.

COWIE, A., BUCKLEY, J., DOHERTY, P., FURZE, G., HAYWARD, J., HINTON, S., JONES, J., SPECK, L., DALAL, H., MILLS, J., BRITISH ASSOCIATION FOR CARDIOVASCULAR, P. & REHABILITATION 2019. Standards and core components for cardiovascular disease prevention and rehabilitation. *Heart*.

CRAIG, C. L., MARSHALL, A. L., SJÖSTRÖM, M., BAUMAN, A. E., BOOTH, M. L., AINSWORTH, B. E., PRATT, M., EKELUND, U., YNGVE, A. & SALLIS, J. F. 2003. International physical activity questionnaire: 12-country reliability and validity. *Medicine & science in sports & exercise,* 35**,** 1381-1395.

CRESWELL, J. W. & CLARK, V. L. P. 2017. *Designing and conducting mixed methods research*, Sage publications.

CRESWELL, J. W., PLANO CLARK, V. L., GUTMANN, M. L. & HANSON, W. E. 2003. Advanced mixed methods research designs. *Handbook of mixed methods in social and behavioral research,* 209**,** 240.

CUNNANE, S. C. 2018. *Zinc Clinical and Biochemical Significance*, CRC press.

DALAL, H. M., DOHERTY, P. & TAYLOR, R. S. 2015. Cardiac rehabilitation. *Bmj,* 351**,** h5000.

DALAL, H. M., ZAWADA, A., JOLLY, K., MOXHAM, T. & TAYLOR, R. S. 2010. Home based versus centre based cardiac rehabilitation: Cochrane systematic review and meta-analysis. *Bmj,* 340**,** b5631.

DASU, M. R. & JIALAL, I. 2010. Free fatty acids in the presence of high glucose amplify monocyte inflammation via Toll-like receptors. *American journal of physiology-endocrinology and metabolism,* 300**,** E145-E154.

DAUCHET, L., AMOUYEL, P., HERCBERG, S. & DALLONGEVILLE, J. 2006. Fruit and vegetable consumption and risk of coronary heart disease: a meta-analysis of cohort studies. *The Journal of nutrition,* 136**,** 2588-2593.

DAVIES, J. H. & SHAW, N. J. 2010. Preventable but no strategy: vitamin D deficiency in the UK.

DAY, N. E., MCKEOWN, N., WONG, M.-Y., WELCH, A. & BINGHAM, S. 2001. Epidemiological assessment of diet: a comparison of a 7-day diary with a food frequency questionnaire using urinary markers of nitrogen, potassium and sodium. *International journal of epidemiology,* 30**,** 309-317.

DE CATERINA, R., LIBBY, P., PENG, H.-B., THANNICKAL, V. J., RAJAVASHISTH, T., GIMBRONE, M. A., SHIN, W. S. & LIAO, J. K. 1995. Nitric oxide decreases cytokine-induced endothelial activation. Nitric oxide selectively reduces endothelial expression of adhesion molecules and proinflammatory cytokines. *The Journal of clinical investigation,* 96**,** 60-68.

DE KONING, L., MERCHANT, A. T., POGUE, J. & ANAND, S. S. 2007. Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies. *European heart journal,* 28**,** 850-856.

DE LORGERIL, M., SALEN, P., MARTIN, J.-L., MONJAUD, I., DELAYE, J. & MAMELLE, N. 1999. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. *Circulation,* 99**,** 779-785.

DE LORGERIL, M. & SALEN, P. J. P. H. N. 2006. The Mediterranean-style diet for the prevention of cardiovascular diseases. 9**,** 118-123.

DE MELO GHISI, G. L. 2015. Development of an Educational Curriculum for Cardiac Rehabilitation Patients and their Families. *Journal of Clinical & Experimental Cardiology,* 06.

DE MELO GHISI, G. L., ABDALLAH, F., GRACE, S. L., THOMAS, S. & OH, P. 2014. A systematic review of patient education in cardiac patients: Do they increase knowledge and promote health behavior change?

DELGADO-LISTA, J., PEREZ-MARTINEZ, P., GARCIA-RIOS, A., ALCALA-DIAZ, J. F., PEREZ-CABALLERO, A. I., GOMEZ-DELGADO, F., FUENTES, F., QUINTANA-NAVARRO, G., LOPEZ-SEGURA, F., ORTIZ-MORALES, A. M., DELGADO-CASADO, N., YUBERO-SERRANO, E. M., CAMARGO, A., MARIN, C., RODRIGUEZ-CANTALEJO, F., GOMEZ-LUNA, P., ORDOVAS, J. M., LOPEZ-MIRANDA, J. & PEREZ-JIMENEZ, F. 2016. CORonary Diet Intervention with Olive oil and cardiovascular PREVention study (the CORDIOPREV study): Rationale, methods, and baseline characteristics: A clinical trial comparing the efficacy of a Mediterranean diet rich in olive oil versus a low-fat diet on cardiovascular disease in coronary patients. *Am Heart J,* 177**,** 42-50.

DEN OUDSTEN, B. L., ZIJLSTRA, W. P. & DE VRIES, J. 2013. The minimal clinical important difference in the World Health Organization Quality of Life instrument—100. *Supportive Care in Cancer,* 21**,** 1295-1301.

DENNEHY, C. & TSOUROUNIS, C. 2010. A review of select vitamins and minerals used by postmenopausal women. *Maturitas,* 66**,** 370-380.

DERNINI, S., LAIRON, D., BERRY, E. M., BRUNORI, G., CAPONE, R., DONINI, L. M., IANNETTA, M., MATTIONI, D., PISCOPO, S. & SERRA-MAJEM, L. 2018. 19 The Med Diet 4.0 Framework: a Multidimensional Driver for Revitalizing the Mediterranean Diet as a Sustainable Diet Model. *Sustainable Diets: Linking Nutrition and Food Systems***,** 187.

DESPRES, J.-P., MOORJANI, S., LUPIEN, P. J., TREMBLAY, A., NADEAU, A. & BOUCHARD, C. 1990. Regional distribution of body fat, plasma lipoproteins, and cardiovascular disease. *Arteriosclerosis: An Official Journal of the American Heart Association, Inc.,* 10**,** 497-511.

DOHERTY, P., HARRISON, A. S., KNAPTON, M. & DALE, V. 2015. Observational study of the relationship between volume and outcomes using data from the National Audit of Cardiac Rehabilitation. *Open Heart,* 2**,** e000304.

DOHERTY, P. J. & HARRISON, A. S. 2016. The National Audit of Cardiac Rehabilitation: Annual Statistical Report 2016.

DOHERTY, P. J. & HARRISON, A. S. 2017. The National Audit of Cardiac Rehabilitation: Annual Statistical Report 2017.

DOHERTY, P. J. & HARRISON, A. S. 2018. The national audit of cardiac rehabilitation: Quality and outcomes report 2018.

DONNELLY, J. E., HONAS, J. J., SMITH, B. K., MAYO, M. S., GIBSON, C. A., SULLIVAN, D. K., LEE, J., HERRMANN, S. D., LAMBOURNE, K. & WASHBURN, R. A. 2013. Aerobic exercise alone results in clinically significant weight loss for men and women: midwest exercise trial 2. *Obesity,* 21**,** E219-E228.

DOYLE, B., FITZSIMONS, D., MCKEOWN, P. & MCALOON, T. 2012. Understanding dietary decision-making in patients attending a secondary prevention clinic following myocardial infarction. *J Clin Nurs,* 21**,** 32-41.

DREWNOWSKI, A., REHM, C. D., MAILLOT, M., MENDOZA, A. & MONSIVAIS, P. 2015. The feasibility of meeting the WHO guidelines for sodium and potassium: a cross-national comparison study. *BMJ open,* 5**,** e006625.

DUGGLEBY, W. 2005. What about focus group interaction data? *Qual Health Res,* 15**,** 832-40.

DYSON, P., KELLY, T., DEAKIN, T., DUNCAN, A., FROST, G., HARRISON, Z., KHATRI, D., KUNKA, D., MCARDLE, P. & MELLOR, D. 2011. Diabetes UK evidence-based nutrition guidelines for the prevention and management of diabetes. *Diabetic Medicine,* 28**,** 1282-1288.

DYSON, P., TWENEFOUR, D., BREEN, C., DUNCAN, A., ELVIN, E., GOFF, L., HILL, A., KALSI, P., MARSLAND, N. & MCARDLE, P. 2018. Diabetes UK evidence-based nutrition guidelines for the prevention and management of diabetes. *Diabetic medicine,* 35**,** 541-547.

EL KHOURY, D., CUDA, C., LUHOVYY, B. & ANDERSON, G. 2011. Beta glucan: health benefits in obesity and metabolic syndrome. *Journal of nutrition and metabolism,* 2012.

EMDIN, C. A., KHERA, A. V., NATARAJAN, P., KLARIN, D., ZEKAVAT, S. M., HSIAO, A. J. & KATHIRESAN, S. 2017. Genetic association of waist-to-hip ratio with cardiometabolic traits, type 2 diabetes, and coronary heart disease. *Jama,* 317**,** 626-634.

ESCOBAR, E. 2002. Hypertension and coronary heart disease. *Journal of human hypertension,* 16**,** S61-S63.

ESPOSITO, K., MAIORINO, M. I., BELLASTELLA, G., CHIODINI, P., PANAGIOTAKOS, D. & GIUGLIANO, D. 2015. A journey into a Mediterranean diet and type 2 diabetes: a systematic review with meta-analyses. *BMJ open,* 5**,** e008222.

ESTRUCH, R., MARTÍNEZ-GONZÁLEZ, M. A., CORELLA, D., SALAS-SALVADÓ, J., FITÓ, M., CHIVA-BLANCH, G., FIOL, M., GÓMEZ-GRACIA, E., ARÓS, F., LAPETRA, J., SERRA-MAJEM, L., PINTÓ, X., BUIL-COSIALES, P., SORLÍ, J. V., MUÑOZ, M. A., BASORA-GALLISÁ, J., LAMUELA-RAVENTÓS, R. M., SERRA-MIR, M. & ROS, E. 2016. Effect of a high-fat Mediterranean diet on bodyweight and waist circumference: a prespecified secondary outcomes analysis of the PREDIMED randomised controlled trial. *The Lancet Diabetes & Endocrinology,* 4**,** 666-676.

ESTRUCH, R., ROS, E., SALAS-SALVADÓ, J., COVAS, M.-I., CORELLA, D., ARÓS, F., GÓMEZ-GRACIA, E., RUIZ-GUTIÉRREZ, V., FIOL, M., LAPETRA, J., LAMUELA-RAVENTOS, R. M., SERRA-MAJEM, L., PINTÓ, X., BASORA, J., MUÑOZ, M. A., SORLÍ, J. V., MARTÍNEZ, J. A., FITÓ, M., GEA, A., HERNÁN, M. A. & MARTÍNEZ-GONZÁLEZ, M. A. 2018. Primary Prevention of Cardiovascular Disease with a Mediterranean Diet Supplemented with Extra-Virgin Olive Oil or Nuts. *New England Journal of Medicine,* 378**,** e34.

ESTRUCH, R., ROS, E., SALAS-SALVADÓ, J., COVAS, M.-I., CORELLA, D., ARÓS, F., GÓMEZ-GRACIA, E., RUIZ-GUTIÉRREZ, V., FIOL, M., LAPETRA, J., LAMUELA-RAVENTOS, R. M., SERRA-MAJEM, L., PINTÓ, X., BASORA, J., MUÑOZ, M. A., SORLÍ, J. V., MARTÍNEZ, J. A. & MARTÍNEZ-GONZÁLEZ, M. A. 2013. Primary Prevention of Cardiovascular Disease with a Mediterranean Diet. *New England Journal of Medicine,* 368**,** 1279-1290.

FÉLIX-REDONDO, F. J., GRAU, M. & FERNÁNDEZ-BERGÉS, D. 2013. Cholesterol and cardiovascular disease in the elderly. Facts and gaps. *Aging and disease,* 4**,** 154.

FIELD, A. 2013. *Discovering statistics using IBM SPSS statistics*, sage.

FITZGERALD, S. P. & BEAN, N. G. 2010. An analysis of the interactions between individual comorbidities and their treatments—implications for guidelines and polypharmacy. *Journal of the American Medical Directors Association,* 11**,** 475-484.

FIX, G. M. & BOKHOUR, B. G. 2012. Understanding the context of patient experiences in order to explore adherence to secondary prevention guidelines after heart surgery. *Chronic Illn,* 8**,** 265-77.

FLETCHER, G., ADES, P., KLIGFIELD, P., ARENA, R., BALADY, G., BITTNER, V., COKE, L., FLEG, J., FORMAN, D. & GERBER, T. 2013. on behalf of the American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee of the Council on Clinical Cardiology, Council on Nutrition, Physical Activity and Metabolism, Council on Cardiovascular and Stroke Nursing, and Council on Epidemiology and Prevention. Exercise standards for testing and training: a scientific statement from the American Heart Association. *Circulation,* 128**,** 873-934.

FLETCHER, G. F., BALADY, G., BLAIR, S. N., BLUMENTHAL, J., CASPERSEN, C., CHAITMAN, B., EPSTEIN, S., FROELICHER, E. S. S., FROELICHER, V. F. & PINA, I. L. 1996. Statement on exercise: benefits and recommendations for physical activity programs for all Americans: a statement for health professionals by the Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology, American Heart Association. *Circulation,* 94**,** 857-862.

FOROUHI, N. G., KRAUSS, R. M., TAUBES, G. & WILLETT, W. 2018. Dietary fat and cardiometabolic health: evidence, controversies, and consensus for guidance. *Bmj,* 361**,** k2139.

FOUNDATION, B. H. 2017. BHF CVD statistics compendium 2017. BHF London.

FOUNDATION, B. H. 2018. National Audit of Cardiac Rehabilitation (NACR) Quality and Outcomes Report 2018.

FOX, C. S., MASSARO, J. M., HOFFMANN, U., POU, K. M., MAUROVICH-HORVAT, P., LIU, C.-Y., VASAN, R. S., MURABITO, J. M., MEIGS, J. B. & CUPPLES, L. A. 2007. Abdominal visceral and subcutaneous adipose tissue compartments: association with metabolic risk factors in the Framingham Heart Study. *Circulation,* 116**,** 39-48.

FRANCIS, R. 2008. What do we currently know about nutrition and bone health in relation to United Kingdom public health policy with particular reference to calcium and vitamin D? *British Journal of Nutrition,* 99**,** 155-159.

FRATONI, V. & BRANDI, M. 2015. B vitamins, homocysteine and bone health. *Nutrients,* 7**,** 2176-2192.

FSA 2007. The eatwell plate.

FURMAN, C., RUNDLÖF, A.-K., LARIGAUDERIE, G., JAYE, M., BRICCA, G., COPIN, C., KANDOUSSI, A., FRUCHART, J.-C., ARNÉR, E. & ROUIS, M. 2004. Thioredoxin reductase 1 is upregulated in atherosclerotic plaques: specific induction of the promoter in human macrophages by oxidized low-density lipoproteins. *Free Radical Biology and Medicine,* 37**,** 71-85.

FURUKAWA, S., FUJITA, T., SHIMABUKURO, M., IWAKI, M., YAMADA, Y., NAKAJIMA, Y., NAKAYAMA, O., MAKISHIMA, M., MATSUDA, M. & SHIMOMURA, I. 2017. Increased oxidative stress in obesity and its impact on metabolic syndrome. *The Journal of clinical investigation,* 114**,** 1752-1761.

GATENBY, K., WHEATCROFT, S. & KEARNEY, M. 2015. The Heart and Blood Vessels. *Clinical Nutrition***,** 300-326.

GHISI, G. L. D. M., MAHAJAN, A., DA SILVA CHAVES, G. S., ROUSE, V., BRUM, M., AJWANI, F., AULTMAN, C., RICUPERO, M., OH, P. & COLELLA, T. J. 2019. Validation of a self-administered version of the Mediterranean diet scale (MDS) for cardiac rehabilitation patients in Canada. *International journal of food sciences and nutrition,* 70**,** 202-211.

GIBSON, S., ASHWELL, M., ARTHUR, J., BAGLEY, L., LENNOX, A., ROGERS, P. J. & STANNER, S. 2017. What can the food and drink industry do to help achieve the 5% free sugars goal? *Perspectives in public health,* 137**,** 237-247.

GIDDING, S. S., ANN CHAMPAGNE, M., DE FERRANTI, S. D., DEFESCHE, J., ITO, M. K., KNOWLES, J. W., MCCRINDLE, B., RAAL, F., RADER, D. & SANTOS, R. D. 2015. The agenda for familial hypercholesterolemia: a scientific statement from the American Heart Association. *Circulation,* 132**,** 2167-2192.

GNAGNARELLA, P., DRAGÀ, D., MISOTTI, A., SIERI, S., SPAGGIARI, L., CASSANO, E., BALDINI, F., SOLDATI, L. & MAISONNEUVE, P. 2018. Validation of a short questionnaire to record adherence to the Mediterranean diet: An Italian experience. *Nutrition, Metabolism and Cardiovascular Diseases,* 28**,** 1140-1147.

GOLDSTEIN, J. L. 1974. Familial hypercholesterolemia.

GÓMEZ-AMBROSI, J., SILVA, C., GALOFRÉ, J. C., ESCALADA, J., SANTOS, S., GIL, M. J., VALENTÍ, V., ROTELLAR, F., RAMÍREZ, B. & SALVADOR, J. 2011. Body adiposity and type 2 diabetes: increased risk with a high body fat percentage even having a normal BMI. *Obesity,* 19**,** 1439-1444.

GOODWIN, C. L., FORMAN, E. M., HERBERT, J. D., BUTRYN, M. L. & LEDLEY, G. S. 2012. A pilot study examining the initial effectiveness of a brief acceptance-based behavior therapy for modifying diet and physical activity among cardiac patients. *Behav Modif,* 36**,** 199-217.

GOODWIN, L., OSTUZZI, G., KHAN, N., HOTOPF, M. H. & MOSS-MORRIS, R. J. P. O. 2016. Can we identify the active ingredients of behaviour change interventions for coronary heart disease patients? A systematic review and meta-analysis. 11**,** e0153271.

GOUGH, B. & CONNER, M. T. 2006. Barriers to healthy eating amongst men: a qualitative analysis. *Social science & medicine,* 62**,** 387-395.

GREEN, J., WILLIS, K., HUGHES, E., SMALL, R., WELCH, N., GIBBS, L. & DALY, J. 2007. Generating best evidence from qualitative research: the role of data analysis. *Aust N Z J Public Health,* 31**,** 545-50.

GROSSO, G., BEI, R., MISTRETTA, A., MARVENTANO, S., CALABRESE, G., MASUELLI, L., GIGANTI, M. G., MODESTI, A., GALVANO, F. & GAZZOLO, D. J. F. B. 2013. Effects of vitamin C on health: a review of evidence. 18, 1017-29.

GRUNDY, S. M. 2016. Metabolic syndrome update. *Trends Cardiovasc Med,* 26**,** 364-73.

HAGSTRÖMER, M., OJA, P. & SJÖSTRÖM, M. 2006. The International Physical Activity Questionnaire (IPAQ): a study of concurrent and construct validity. *Public health nutrition,* 9**,** 755-762.

HANKEY, C., LESLIE, W., CURRALL, J., MATTHEWS, D., LEAN, M. J. J. O. H. N. & DIETETICS 2002. Weight change after myocardial infarction: statistical perspectives for future study. 15**,** 439-444.

HARNDEN, K., FRAYN, K. & HODSON, L. 2010. Dietary Approaches to Stop Hypertension (DASH) diet: applicability and acceptability to a UK population. *Journal of human nutrition and dietetics,* 23**,** 3-10.

HARRIS, W. S., MILLER, M., TIGHE, A. P., DAVIDSON, M. H. & SCHAEFER, E. J. 2008. Omega-3 fatty acids and coronary heart disease risk: clinical and mechanistic perspectives. *Atherosclerosis,* 197**,** 12-24.

HASKELL, M. J. 2012. The challenge to reach nutritional adequacy for vitamin A: β-carotene bioavailability and conversion—evidence in humans. *The American journal of clinical nutrition,* 96**,** 1193S-1203S.

HEALTH, G. B. D. O. 2004. *Choosing health: making healthy choices easier*, The Stationery Office.

HELLERSTEIN, H. K. 1968. Exercise therapy in coronary disease. *Bulletin of the New York Academy of Medicine,* 44**,** 1028.

HENNEIN, R., LIU, C., MCKEOWN, N. M., HOFFMANN, U., LONG, M. T., LEVY, D. & MA, J. 2019. Increased Diet Quality is Associated with Long-Term Reduction of Abdominal and Pericardial Fat. *Obesity,* 27**,** 670-677.

HENRIKSEN, E. J., DIAMOND-STANIC, M. K. & MARCHIONNE, E. M. 2011. Oxidative stress and the etiology of insulin resistance and type 2 diabetes. *Free Radical Biology and Medicine,* 51**,** 993-999.

HERAN, B. S., CHEN, J. M., EBRAHIM, S., MOXHAM, T., OLDRIDGE, N., REES, K., THOMPSON, D. R. & TAYLOR, R. S. 2011a. Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane database of systematic reviews*.

HERAN, B. S., CHEN, J. M. H., EBRAHIM, S., MOXHAM, T., OLDRIDGE, N., REES, K., THOMPSON, D. R. & TAYLOR, R. S. 2011b. Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database of Systematic Reviews*.

HERRERA, M. D., MINGORANCE, C., RODRÍGUEZ-RODRÍGUEZ, R. & DE SOTOMAYOR, M. A. 2010. Endothelial dysfunction and aging: an update. *Ageing research reviews,* 9**,** 142-152.

HICKSON, M. & SMITH, S. 2018. *Advanced Nutrition and Dietetics in Nutrition Support,* Newark, UNITED KINGDOM, John Wiley & Sons, Incorporated.

HIGDON, J. V. & FREI, B. 2003. Obesity and oxidative stress: a direct link to CVD? : Am Heart Assoc.

HOBBS, F. 2002. The National Service Framework for Coronary Heart Disease. *British journal of cardiology,* 9.

HOUSTON, D., DING, J., LEE, J., GARCIA, M., KANAYA, A., TYLAVSKY, F., NEWMAN, A., VISSER, M. & KRITCHEVSKY, S. 2011. Dietary fat and cholesterol and risk of cardiovascular disease in older adults: the Health ABC Study. *Nutrition, Metabolism and Cardiovascular Diseases,* 21**,** 430-437.

HU, F. B. & WILLETT, W. C. 2002. Optimal diets for prevention of coronary heart disease. *Jama,* 288**,** 2569-2578.

HUBERT, H. B., FEINLEIB, M., MCNAMARA, P. M. & CASTELLI, W. P. 1983. Obesity as an independent risk factor for cardiovascular disease: a 26-year follow-up of participants in the Framingham Heart Study. *Circulation,* 67**,** 968-977.

HUGHES, G., BENNETT, K. M. & HETHERINGTON, M. M. 2004. Old and alone: barriers to healthy eating in older men living on their own. *Appetite,* 43**,** 269-276.

ISAACS, A. 2014. An overview of qualitative research methodology for public health researchers. *International Journal of Medicine and Public Health,* 4.

JAESCHKE, R., SINGER, J. & GUYATT, G. H. 1989. Measurement of health status: ascertaining the minimal clinically important difference. *Controlled clinical trials,* 10**,** 407-415.

JONES, J., BUCKLEY, J. P., FURZE, G., DOHERTY, P., SPECK, L., CONNOLLY, S. & HINTON, S. 2012. The BACPR standards and core components for cardiovascular prevention and rehabilitation 2012. British Association for Cardiovascular Prevention and Rehabilitation.

JONES, N. R., TONG, T. Y. & MONSIVAIS, P. 2018. Meeting UK dietary recommendations is associated with higher estimated consumer food costs: An analysis using the National Diet and Nutrition Survey and consumer expenditure data, 2008–2012. *Public health nutrition,* 21**,** 948-956.

JUDD, S. & TANGPRICHA, V. 2008. Vitamin D deficiency and risk for cardiovascular disease. *Circulation,* 117**,** 503.

KANNEL, W. B., WILSON, P. W., NAM, B.-H. & D'AGOSTINO, R. B. 2002. Risk stratification of obesity as a coronary risk factor. *The American journal of cardiology,* 90**,** 697-701.

KATZ, A. M. & KATZ, P. B. 1962. Disease of the heart in the works of Hippocrates. *Heart,* 24**,** 257-264.

KELLY, R. B. 2010. Diet and exercise in the management of hyperlipidemia. *American family physician,* 81**,** 1097-1102.

KLEMPFNER, R., EREZ, A., SAGIT, B.-Z., GOLDENBERG, I., FISMAN, E., KOPEL, E., SHLOMO, N., ISRAEL, A. & TENENBAUM, A. 2016. Elevated triglyceride level is independently associated with increased all-cause mortality in patients with established coronary heart disease: twenty-two–year follow-up of the bezafibrate infarction prevention study and registry. *Circulation: Cardiovascular Quality and Outcomes,* 9**,** 100-108.

KOPECKY, S. L., BAUER, D. C., GULATI, M., NIEVES, J. W., SINGER, A. J., TOTH, P. P., UNDERBERG, J. A., WALLACE, T. C. & WEAVER, C. M. 2016. Lack of evidence linking calcium with or without vitamin D supplementation to cardiovascular disease in generally healthy adults: a clinical guideline from the National Osteoporosis Foundation and the American Society for Preventive Cardiology. *Annals of internal medicine,* 165**,** 867-868.

KRAUSS, R. M., ECKEL, R. H., HOWARD, B., APPEL, L. J., DANIELS, S. R., DECKELBAUM, R. J., ERDMAN JR, J. W., KRIS-ETHERTON, P., GOLDBERG, I. J. & KOTCHEN, T. A. 2000. AHA Dietary Guidelines: revision 2000: A statement for healthcare professionals from the Nutrition Committee of the American Heart Association. *Circulation,* 102**,** 2284-2299.

KRUEGER, R. A. & CASEY, M. A. 2002. Designing and conducting focus group interviews. St Paul, Minnesota, USA.

KRUEGER, R. A. & CASEY, M. A. 2014. *Focus groups: A practical guide for applied research*, Sage publications.

LACROIX, S., CANTIN, J., NIGAM, A. J. A. O. P. & MEDICINE, R. 2017. Contemporary issues regarding nutrition in cardiovascular rehabilitation. 60**,** 36-42.

LAFIANDRA, D., RICCARDI, G. & SHEWRY, P. R. 2014. Improving cereal grain carbohydrates for diet and health. *Journal of cereal science,* 59**,** 312-326.

LANCASHIRE, E., GOODE, J., KEIL, T., BEARDSWORTH, A., HASLAM, C. & BRYMAN, A. 2002. Women, men and food: the significance of gender for nutritional attitudes and choices. *British Food Journal,* 104**,** 470-491.

LAVIE, C. J., MILANI, R. V. & VENTURA, H. O. 2009. Obesity and cardiovascular disease: risk factor, paradox, and impact of weight loss. *Journal of the American college of cardiology,* 53**,** 1925-1932.

LEAF, A. 1999. Dietary prevention of coronary heart disease: the Lyon Diet Heart Study. Am Heart Assoc.

LEE, I.-M., HSIEH, C.-C. & PAFFENBARGER, R. S. 1995. Exercise intensity and longevity in men: the Harvard Alumni Health Study. *Jama,* 273**,** 1179-1184.

LEE, I.-M., MATTHEWS, C. E. & BLAIR, S. N. 2009a. The Legacy of Dr. Ralph Seal Paffenbarger, Jr.–Past, Present, and Future Contributions to Physical Activity Research. *President's Council on Physical Fitness and Sports research digest,* 10**,** 1.

LEE, I. M., MATTHEWS, C. E. & BLAIR, S. N. 2009b. The Legacy of Dr. Ralph Seal Paffenbarger, Jr. - Past, Present, and Future Contributions to Physical Activity Research. *President's Council on Physical Fitness and Sports research digest,* 10**,** 1-8.

LEE, J. J., YIN, X., HOFFMANN, U., FOX, C. S. & BENJAMIN, E. J. 2016. Relation of pericardial fat, intrathoracic fat, and abdominal visceral fat with incident atrial fibrillation (from the Framingham Heart Study). *The American journal of cardiology,* 118**,** 1486-1492.

LEVINE, M. 2018. Vitamins and Herbals.

LEVY, L. & TEDSTONE, A. UK dietary policy for the prevention of cardiovascular disease. Healthcare, 2017. Multidisciplinary Digital Publishing Institute, 9.

LEVY, S. S. & READDY, R. T. 2009. Reliability of the international Physical Activity Questionnaire in research settings: last 7-day self-administered long form. *Measurement in Physical Education and Exercise Science,* 13**,** 191-205.

LIBBY, P. 2012. Inflammation in atherosclerosis. *Arteriosclerosis, thrombosis, and vascular biology,* 32**,** 2045-2051.

LIBBY, P. & AIKAWA, M. 2002. Stabilization of atherosclerotic plaques: new mechanisms and clinical targets. *Nature medicine,* 8**,** 1257.

LIBBY, P., RIDKER, P. M. & HANSSON, G. K. 2009. Inflammation in atherosclerosis: from pathophysiology to practice. *Journal of the American college of cardiology,* 54**,** 2129-2138.

LIBBY, P., RIDKER, P. M. & MASERI, A. 2002. Inflammation and atherosclerosis. *Circulation,* 105**,** 1135-1143.

LITWIN, S. E. 2008. Which measures of obesity best predict cardiovascular risk? : Journal of the American College of Cardiology.

LIU, Z., REN, Z., ZHANG, J., CHUANG, C.-C., KANDASWAMY, E., ZHOU, T. & ZUO, L. 2018. Role of ROS and nutritional antioxidants in human diseases. *Frontiers in physiology,* 9.

LUISI, M. L. E., BIFFI, B., GHERI, C. F., SARLI, E., RAFANELLI, E., GRAZIANO, E., VIDALI, S., FATTIROLLI, F., GENSINI, G. F. & MACCHI, C. 2015. Efficacy of a nutritional education program to improve diet in patients attending a cardiac rehabilitation program: outcomes of a one-year follow-up. *Internal and Emergency Medicine,* 10**,** 671-676.

LYON, C. J., LAW, R. E. & HSUEH, W. A. 2003. Minireview: adiposity, inflammation, and atherogenesis. *Endocrinology,* 144**,** 2195-2200.

MA, Y., LI, W., OLENDZKI, B. C., PAGOTO, S. L., MERRIAM, P. A., CHIRIBOGA, D. E., GRIFFITH, J. A., BODENLOS, J., WANG, Y. & OCKENE, I. S. 2008. Dietary quality 1 year after diagnosis of coronary heart disease. *Journal of the American Dietetic Association,* 108**,** 240-246.

MA, Y., OLENDZKI, B. C., PAGOTO, S. L., MERRIAM, P. A. & OCKENE, I. S. 2010a. What are patients actually eating: the dietary practices of cardiovascular disease patients. *Curr Opin Cardiol,* 25**,** 518-21.

MA, Y., OLENDZKI, B. C., PAGOTO, S. L., MERRIAM, P. A. & OCKENE, I. S. 2010b. What are patients actually eating: the dietary practices of cardiovascular disease patients. *Current opinion in cardiology,* 22**,** 518.

MACDIARMID, J. I., LOE, J., KYLE, J. & MCNEILL, G. 2013. "It was an education in portion size". Experience of eating a healthy diet and barriers to long term dietary change. *Appetite,* 71**,** 411-9.

MACFARLANE, D. J., LEE, C. C., HO, E. Y., CHAN, K. & CHAN, D. T. 2007. Reliability and validity of the Chinese version of IPAQ (short, last 7 days). *Journal of Science and Medicine in Sport,* 10**,** 45-51.

MAKI, K. C., LAWLESS, A. L., KELLEY, K. M., KADEN, V. N., GEIGER, C. J. & DICKLIN, M. R. 2015. Corn oil improves the plasma lipoprotein lipid profile compared with extra-virgin olive oil consumption in men and women with elevated cholesterol: results from a randomized controlled feeding trial. *Journal of clinical lipidology,* 9**,** 49-57.

MALHOTRA, A., REDBERG, R. F. & MEIER, P. 2017. Saturated fat does not clog the arteries: coronary heart disease is a chronic inflammatory condition, the risk of which can be effectively reduced from healthy lifestyle interventions. *British Journal of Sports Medicine,* 51**,** 1111.

MARTIN, S. D. & MCGEE, S. L. 2014. The role of mitochondria in the aetiology of insulin resistance and type 2 diabetes. *Biochimica et Biophysica Acta (BBA)-General Subjects,* 1840**,** 1303-1312.

MARTINEZ-GONZALEZ, M., FERNANDEZ-JARNE, E., SERRANO-MARTINEZ, M., WRIGHT, M. & GOMEZ-GRACIA, E. 2004. Development of a short dietary intake questionnaire for the quantitative estimation of adherence to a cardioprotective Mediterranean diet. *European journal of clinical nutrition,* 58**,** 1550.

MARTÍNEZ-GONZÁLEZ, M. A., GARCÍA-ARELLANO, A., TOLEDO, E., SALAS-SALVADO, J., BUIL-COSIALES, P., CORELLA, D., COVAS, M. I., SCHRÖDER, H., ARÓS, F. & GÓMEZ-GRACIA, E. 2012. A 14-item Mediterranean diet assessment tool and obesity indexes among high-risk subjects: the PREDIMED trial. *PloS one,* 7**,** e43134.

MATHERS, N., FOX, N. & HUNN, A. 2007. Surveys and questionnaires. *The NIHR RDS for the East Midlands/Yorkshire & the Humber*.

MATHIEU, P., LEMIEUX, I. & DESPRÉS, J. P. 2010. Obesity, inflammation, and cardiovascular risk. *Clinical Pharmacology & Therapeutics,* 87**,** 407-416.

MCAVOY, B., KANER, E., LOCK, C. A., HEATHER, N. & GILVARRY, E. 1999. Our Healthier Nation: are general practitioners willing and able to deliver? A survey of attitudes to and involvement in health promotion and lifestyle counselling. *Br J Gen Pract,* 49**,** 187-190.

MCKEAN, M., MITCHELL, L., O'CONNOR, H., PRVAN, T. & SLATER, G. 2019. Are exercise professionals fit to provide nutrition advice? An evaluation of general nutrition knowledge. *Journal of science and medicine in sport,* 22**,** 264-268.

MCKEE, G., BANNON, J., KERINS, M. & FITZGERALD, G. 2007. Changes in diet, exercise and stress behaviours using the stages of change model in cardiac rehabilitation patients. *Eur J Cardiovasc Nurs,* 6**,** 233-40.

MCKEOWN, N. M., DAY, N. E., WELCH, A. A., RUNSWICK, S. A., LUBEN, R. N., MULLIGAN, A. A., MCTAGGART, A. & BINGHAM, S. A. 2001. Use of biological markers to validate self-reported dietary intake in a random sample of the European Prospective Investigation into Cancer United Kingdom Norfolk cohort. *The American journal of clinical nutrition,* 74**,** 188-196.

MCKEOWN, N. M., YOSHIDA, M., SHEA, M. K., JACQUES, P. F., LICHTENSTEIN, A. H., ROGERS, G., BOOTH, S. L. & SALTZMAN, E. 2009. Whole-grain intake and cereal fiber are associated with lower abdominal adiposity in older adults. *The Journal of nutrition,* 139**,** 1950-1955.

MEDICINE, A. C. O. S. 2013. *ACSM's guidelines for exercise testing and prescription*, Lippincott Williams & Wilkins.

MEYER, S. B., COVENEY, J. & WARD, P. R. 2014. A qualitative study of CVD management and dietary changes: problems of 'too much'and 'contradictory'information. *BMC family practice,* 15**,** 25.

MORGAN, D. L. 1996. *Focus groups as qualitative research*, Sage publications.

MORGAN DL, K. R., SCANNELL AU 1998. Planning Focus Groups. *Sage*.

MORRIS, J., MARR, J. W. & CLAYTON, D. 1977. Diet and heart: a postscript. *Br Med J,* 2**,** 1307-1314.

MORRIS, J. N., HEADY, J., RAFFLE, P., ROBERTS, C. & PARKS, J. 1953. Coronary heart-disease and physical activity of work. *The Lancet,* 262**,** 1111-1120.

MORSE, J. M. 1991. Approaches to qualitative-quantitative methodological triangulation. *Nursing research,* 40**,** 120-123.

MOST-WINDHAUSER, D. R. G. O. E. O. N. N. G. S. F. M. V. W. M. B. G. A. M. E. R. I. L. P.-H. K. N. M. 2001. Effects on blood lipids of a blood pressure–lowering diet: the Dietary Approaches to Stop Hypertension (DASH) Trial. *The American journal of clinical nutrition,* 74**,** 80-89.

MOST, M. M. 2004. Estimated phytochemical content of the dietary approaches to stop hypertension (DASH) diet is higher than in the Control Study Diet. *Journal of the American Dietetic Association,* 104**,** 1725-1727.

MOVVA, R. & FIGUEREDO, V. M. 2013. Alcohol and the heart: to abstain or not to abstain? *International journal of cardiology,* 164**,** 267-276.

MOZAFFARIAN, D., BENJAMIN, E. J., GO, A. S., ARNETT, D. K., BLAHA, M. J., CUSHMAN, M., DAS, S. R., DE FERRANTI, S., DESPRÉS, J. P. & FULLERTON, H. J. 2016. Heart disease and stroke statistics-2016 update a report from the American Heart Association. *Circulation,* 133**,** e38-e48.

MOZAFFARIAN, D. & LUDWIG, D. S. 2010. Dietary guidelines in the 21st century—a time for food. *Jama,* 304**,** 681-682.

NADEAU, G. 2019. Modifying DASH and Improving Dietary Habits to Reduce Hypertension Among Micronesian.

NAHLER, G. 2009. minimal clinically important difference (MCID). *Dictionary of Pharmaceutical Medicine.* Springer.

NEVILL, A. M., STEWART, A. D., OLDS, T. & HOLDER, R. 2006. Relationship between adiposity and body size reveals limitations of BMI. *American Journal of Physical Anthropology: The Official Publication of the American Association of Physical Anthropologists,* 129**,** 151-156.

NEWTON, J. N., BRIGGS, A. D., MURRAY, C. J., DICKER, D., FOREMAN, K. J., WANG, H., NAGHAVI, M., FOROUZANFAR, M. H., OHNO, S. L. & BARBER, R. M. 2015. Changes in health in England, with analysis by English regions and areas of deprivation, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet,* 386**,** 2257-2274.

NICHOLLS, C. & MARSHALL, J. 2013. Skin pricking apparatus. Google Patents.

NIELSEN, J. B., LEPPIN, A., GYRD-HANSEN, D. E., JARBOL, D. E., SONDERGAARD, J. & LARSEN, P. V. 2017. Barriers to lifestyle changes for prevention of cardiovascular disease - a survey among 40-60-year old Danes. *BMC Cardiovasc Disord,* 17**,** 245.

NUTRITION, S. A. C. O. 2012. *Dietary reference values for energy*, The Stationery Office.

O'CONNOR, C., GLATT, D., WHITE, L. & REVUELTA INIESTA, R. 2018. Knowledge, attitudes and perceptions towards vitamin D in a UK adult population: A cross-sectional study. *International journal of environmental research and public health,* 15**,** 2387.

OLIVEROS, E., SOMERS, V. K., SOCHOR, O., GOEL, K. & LOPEZ-JIMENEZ, F. 2014. The concept of normal weight obesity. *Progress in cardiovascular diseases,* 56**,** 426-433.

ORGANIZATION, W. H. 2008. The global burden of disease: 2004 update.

ORGANIZATION, W. H. 2011. Waist circumference and waist-hip ratio: report of a WHO expert consultation, Geneva, 8-11 December 2008.

ORTEGA, R. M., PÉREZ-RODRIGO, C. & LÓPEZ-SOBALER, A. M. 2015. Dietary assessment methods: dietary records. *Nutricion hospitalaria,* 31**,** 38-45.

PACK, Q. R., RODRIGUEZ-ESCUDERO, J. P., THOMAS, R. J., ADES, P. A., WEST, C. P., SOMERS, V. K. & LOPEZ-JIMENEZ, F. The prognostic importance of weight loss in coronary artery disease: a systematic review and meta-analysis. Mayo Clinic Proceedings, 2014. Elsevier, 1368-1377.

PAN, A., WANG, Y., TALAEI, M. & HU, F. B. 2015. Relation of smoking with total mortality and cardiovascular events among patients with diabetes mellitus: a meta-analysis and systematic review. *Circulation,* 132**,** 1795-1804.

PANAGIOTAKOS, D. B., PITSAVOS, C., KOKKINOS, P., CHRYSOHOOU, C., VAVURANAKIS, M., STEFANADIS, C. & TOUTOUZAS, P. 2003. Consumption of fruits and vegetables in relation to the risk of developing acute coronary syndromes; the CARDIO2000 case-control study. *Nutrition journal,* 2**,** 2.

PAPADAKI, A., JOHNSON, L., TOUMPAKARI, Z., ENGLAND, C., RAI, M., TOMS, S., PENFOLD, C., ZAZPE, I., MARTÍNEZ-GONZÁLEZ, M. & FEDER, G. 2018. Validation of the English version of the 14-item Mediterranean Diet Adherence Screener of the PREDIMED study, in people at high cardiovascular risk in the UK. *Nutrients,* 10**,** 138.

PARKER, A. & TRITTER, J. 2006. Focus group method and methodology: current practice and recent debate. *International Journal of Research & Method in Education,* 29**,** 23-37.

PARKER, T. & TAYLOR, V. 2018. Cardioprotective whole-diet advice in cardiac rehabilitation. *British Journal of Cardiac Nursing,* 13**,** 428-435.

PARMENTER, K. & WARDLE, J. 1999. Development of a general nutrition knowledge questionnaire for adults. *European journal of clinical nutrition,* 53**,** 298.

PHILLIPS, F. 2003. Nutrition for healthy ageing. *Nutrition Bulletin,* 28**,** 253-263.

PIEPOLI, M. F., CORRÀ, U., ADAMOPOULOS, S., BENZER, W., BJARNASON-WEHRENS, B., CUPPLES, M., DENDALE, P., DOHERTY, P., GAITA, D. & HÖFER, S. 2014. Secondary prevention in the clinical management of patients with cardiovascular diseases. Core components, standards and outcome measures for referral and delivery: a policy statement from the cardiac rehabilitation section of the European Association for Cardiovascular Prevention & Rehabilitation. Endorsed by the Committee for Practice Guidelines of the European Society of Cardiology. *European journal of preventive cardiology,* 21**,** 664-681.

PISCHON, T., BOEING, H., HOFFMANN, K., BERGMANN, M., SCHULZE, M. B., OVERVAD, K., VAN DER SCHOUW, Y., SPENCER, E., MOONS, K. & TJØNNELAND, A. 2008. General and abdominal adiposity and risk of death in Europe. *New England Journal of Medicine,* 359**,** 2105-2120.

POMERLEAU, J., JOINT, F. & ORGANIZATION, W. H. 2005a. Effectiveness of interventions and programmes promoting fruit and vegetable intake [electronic resource].

POMERLEAU, J., LOCK, K., KNAI, C. & MCKEE, M. 2005b. Interventions designed to increase adult fruit and vegetable intake can be effective: a systematic review of the literature. *The Journal of nutrition,* 135**,** 2486-2495.

POPKIN, B. M. 2011. Contemporary nutritional transition: determinants of diet and its impact on body composition. *Proceedings of the Nutrition Society,* 70**,** 82-91.

PRISACARU, A. E. 2016. Effect of antioxidants on polyunsaturated fatty acids–review. *Acta Scientiarum Polonorum Technologia Alimentaria,* 15**,** 121-129.

RASHID, M. N., FUENTES, F., TOUCHON, R. C. & WEHNER, P. S. 2003. Obesity and the risk for cardiovascular disease. *Preventive cardiology,* 6**,** 42-47.

RAYMAN, M. P. 2019. Selenium intake, status, and health: A complex relationship. *Hormones***,** 1-6.

REHABILITATION, N. A. O. C. 2015. The National Audit of Cardiac Rehabilitation Annual Statistical Report.

RICCARDI, G., AGGETT, P., BRIGHENTI, F., DELZENNE, N., FRAYN, K., NIEUWENHUIZEN, A., PANNEMANS, D., THEIS, S., TUIJTELAARS, S. & VESSBY, B. 2004. PASSCLAIM 1—Body weight regulation, insulin sensitivity and diabetes risk. *European Journal of Nutrition,* 43**,** ii7-ii46.

RODRÍGUEZ-RODRÍGUEZ, E., LOMBÁN, B. N. & ª LÓPEZ-SOBALER, A. 2010. Review and future perspectives on recommended calcium intake. *Nutricion hospitalaria,* 25**,** 366-374.

ROININEN, K., FILLION, L., KILCAST, D. & LÄHTEENMÄKI, L. 2004. Exploring difficult textural properties of fruit and vegetables for the elderly in Finland and the United Kingdom. *Food Quality and Preference,* 15**,** 517-530.

RYAN, G. W. & BERNARD, H. R. J. F. M. 2003. Techniques to identify themes. 15**,** 85-109.

SABATÉ, E. & SABATÉ, E. 2003. *Adherence to long-term therapies: evidence for action*, World Health Organization.

SACKS, F. M., MOORE, T. J., APPEL, L. J., OBARZANEK, E., CUTLER, J. A., VOLLMER, W. M., VOGT, T. M., KARANJA, N., SVETKEY, L. P. & LIN, P. H. 1999. A dietary approach to prevent hypertension: a review of the Dietary Approaches to Stop Hypertension (DASH) Study. *Clinical cardiology,* 22**,** 6-10.

SACKS, F. M., SVETKEY, L. P., VOLLMER, W. M., APPEL, L. J., BRAY, G. A., HARSHA, D., OBARZANEK, E., CONLIN, P. R., MILLER, E. R. & SIMONS-MORTON, D. G. 2001. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. *New England journal of medicine,* 344**,** 3-10.

SAGHAEI, M. 2004. Random allocation software for parallel group randomized trials. *BMC medical research methodology,* 4**,** 26.

SALAS-SALVADÓ, J., GUASCH-FERRÉ, M., LEE, C.-H., ESTRUCH, R., CLISH, C. B. & ROS, E. 2015. Protective effects of the Mediterranean diet on type 2 diabetes and metabolic syndrome. *The Journal of nutrition,* 146**,** 920S-927S.

SALEHI-ABARGOUEI, A., MAGHSOUDI, Z., SHIRANI, F. & AZADBAKHT, L. 2013. Effects of Dietary Approaches to Stop Hypertension (DASH)-style diet on fatal or nonfatal cardiovascular diseases—incidence: a systematic review and meta-analysis on observational prospective studies. *Nutrition,* 29**,** 611-618.

SANGUANKEO, A., LAZO, M., UPALA, S., BRANCATI, F. L., BONEKAMP, S., POWNALL, H. J., BALASUBRAMANYAM, A., CLARK, J. M. & GROUP, F. L. S. O. T. L. A. R. 2017. Effects of visceral adipose tissue reduction on CVD risk factors independent of weight loss: The Look AHEAD study. *Endocrine research,* 42**,** 86-95.

SAUNDERS, A. V., CRAIG, W. J. & BAINES, S. K. 2013. Zinc and vegetarian diets. *The medical journal of Australia,* 199**,** S17-S21.

SAVAGE, P. D., LEE, M., HARVEY-BERINO, J., BROCHU, M. & ADES, P. A. 2002. Weight reduction in the cardiac rehabilitation setting. *Journal of Cardiopulmonary Rehabilitation and Prevention,* 22**,** 154-160.

SAVICA, V., BELLINGHIERI, G. & KOPPLE, J. D. 2010. The effect of nutrition on blood pressure. *Annual review of nutrition,* 30**,** 365-401.

SCARBOROUGH, P., NNOAHAM, K. E., CLARKE, D., CAPEWELL, S. & RAYNER, M. 2012. Modelling the impact of a healthy diet on cardiovascular disease and cancer mortality. *J Epidemiol Community Health,* 66**,** 420-426.

SHEN, J., WILMOT, K. A., GHASEMZADEH, N., MOLLOY, D. L., BURKMAN, G., MEKONNEN, G., GONGORA, M. C., QUYYUMI, A. A. & SPERLING, L. S. 2015. Mediterranean dietary patterns and cardiovascular health. *Annual review of nutrition,* 35**,** 425-449.

SHIRANI, F., SALEHI-ABARGOUEI, A. & AZADBAKHT, L. 2013. Effects of Dietary Approaches to Stop Hypertension (DASH) diet on some risk for developing type 2 diabetes: a systematic review and meta-analysis on controlled clinical trials. *Nutrition,* 29**,** 939-47.

SHLISKY, J., BLOOM, D. E., BEAUDREAULT, A. R., TUCKER, K. L., KELLER, H. H., FREUND-LEVI, Y., FIELDING, R. A., CHENG, F. W., JENSEN, G. L. & WU, D. 2017. Nutritional considerations for healthy aging and reduction in age-related chronic disease. *Advances in Nutrition,* 8**,** 17.

SHRIVASTAVA, A. K., SINGH, H. V., RAIZADA, A. & SINGH, S. K. 2015. C-reactive protein, inflammation and coronary heart disease. *The Egyptian Heart Journal,* 67**,** 89-97.

SHULTZ, K. S., HOFFMAN, C. C. & REITER-PALMON, R. 2005. Using archival data for IO research: Advantages, pitfalls, sources, and examples. *The Industrial-Organizational Psychologist,* 42**,** 31.

SIERVO, M., LARA, J., CHOWDHURY, S., ASHOR, A., OGGIONI, C. & MATHERS, J. C. 2015. Effects of the Dietary Approach to Stop Hypertension (DASH) diet on cardiovascular risk factors: a systematic review and meta-analysis. *British Journal of Nutrition,* 113**,** 1-15.

SINGH, R. B., RASTOGI, S. S., VERMA, R., LAXMI, B., SINGH, R., GHOSH, S. & NIAZ, M. A. 1992. Randomised controlled trial of cardioprotective diet in patients with recent acute myocardial infarction: results of one year follow up. *Bmj,* 304**,** 1015-1019.

SIRI-TARINO, P. W., CHIU, S., BERGERON, N. & KRAUSS, R. M. 2015. Saturated fats versus polyunsaturated fats versus carbohydrates for cardiovascular disease prevention and treatment. *Annual review of nutrition,* 35**,** 517-543.

SNATERSE, M., DECKERS, J., LENZEN, M., JORSTAD, H., DE BACQUER, D., PETERS, R., JENNINGS, C., KOTSEVA, K., OP REIMER, W. S. & INVESTIGATORS, E. 2018. Smoking cessation in European patients with coronary heart disease. Results from the EUROASPIRE IV survey: A registry from the European Society of Cardiology. *International journal of cardiology,* 258**,** 1-6.

SOBAL, J. 2005. MEN, MEAT, AND MARRIAGE: MODELS OF MASCULINITY. *Food and Foodways,* 13**,** 135-158.

SOCIETY, B. C., SOCIETY, B. H., DIABETES, U., SOCIETY, P. C. C. & ASSOCIATION, S. 2005. JBS 2: Joint British Societies' guidelines on prevention of cardiovascular disease in clinical practice. *Heart (British Cardiac Society),* 91**,** v1-v52.

SOFI, F., CESARI, F., ABBATE, R., GENSINI, G. F. & CASINI, A. 2008. Adherence to Mediterranean diet and health status: meta-analysis. *Bmj,* 337**,** a1344.

SOFI, F., MACCHI, C., ABBATE, R., GENSINI, G. F. & CASINI, A. 2014. Mediterranean diet and health status: an updated meta-analysis and a proposal for a literature-based adherence score. *Public health nutrition,* 17**,** 2769-2782.

SOLTANI, S., SHIRANI, F., CHITSAZI, M. J. & SALEHI-ABARGOUEI, A. 2016. The effect of dietary approaches to stop hypertension (DASH) diet on weight and body composition in adults: a systematic review and meta-analysis of randomized controlled clinical trials. *Obesity reviews,* 17**,** 442-454.

STAMLER, J., ROSE, G., STAMLER, R., ELLIOTT, P., DYER, A. & MARMOT, M. 1989. INTERSALT study findings. Public health and medical care implications. *Hypertension,* 14**,** 570-577.

STEPHEN, A. M. 2007. The case for diet diaries in longitudinal studies. *International Journal of Social Research Methodology,* 10**,** 365-377.

STEVENSON, C., DOHERTY, G., BARNETT, J., MULDOON, O. T. & TREW, K. 2007. Adolescents' views of food and eating: identifying barriers to healthy eating. *J Adolesc,* 30**,** 417-34.

STEWART, D., SHAMDASANI, P. & ROOK, D. 1990. Applied social research methods series, Vol. 20. Focus groups: Theory and practice. Thousand Oaks, CA, US. Sage Publications, Inc.

STEWART, D. W. & SHAMDASANI, P. N. 2014. *Focus groups: Theory and practice*, Sage publications.

STOVER, P. J. 2010. Vitamin B12 and older adults. *Current opinion in clinical nutrition and metabolic care,* 13**,** 24.

STUBBS, R. J., MORRIS, L., PALLISTER, C., HORGAN, G. & LAVIN, J. H. 2015. Weight outcomes audit in 1.3 million adults during their first 3 months' attendance in a commercial weight management programme. *BMC Public Health,* 15**,** 882.

SUPPLEMENTS, N. O. O. D. 2018. Vitamin C: Fact sheet for health professionals.

SVETKEY, L. P., SIMONS-MORTON, D. G., PROSCHAN, M. A., SACKS, F. M., CONLIN, P. R., HARSHA, D., MOORE, T. J. & GROUP, D. S. C. R. 2004. Effect of the dietary approaches to stop hypertension diet and reduced sodium intake on blood pressure control. *The Journal of Clinical Hypertension,* 6**,** 373-381.

TABAS, I. 2017. 2016 Russell Ross Memorial Lecture in Vascular Biology: Molecular–Cellular Mechanisms in the Progression of Atherosclerosis. *Arteriosclerosis, thrombosis, and vascular biology,* 37**,** 183-189.

TAPIERO, H., BA, G. N., COUVREUR, P. & TEW, K. 2002. Polyunsaturated fatty acids (PUFA) and eicosanoids in human health and pathologies. *Biomedicine & pharmacotherapy,* 56**,** 215-222.

TAYLOR, A. E., EBRAHIM, S., BEN-SHLOMO, Y., MARTIN, R. M., WHINCUP, P. H., YARNELL, J. W., WANNAMETHEE, S. G. & LAWLOR, D. A. 2010. Comparison of the associations of body mass index and measures of central adiposity and fat mass with coronary heart disease, diabetes, and all-cause mortality: a study using data from 4 UK cohorts. *The American journal of clinical nutrition,* 91**,** 547-556.

TAYLOR, R. S., BROWN, A., EBRAHIM, S., JOLLIFFE, J., NOORANI, H., REES, K., SKIDMORE, B., STONE, J. A., THOMPSON, D. R. & OLDRIDGE, N. 2004. Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *The American journal of medicine,* 116**,** 682-692.

TER BORG, S., VERLAAN, S., HEMSWORTH, J., MIJNARENDS, D. M., SCHOLS, J. M., LUIKING, Y. C. & DE GROOT, L. C. 2015. Micronutrient intakes and potential inadequacies of community-dwelling older adults: a systematic review. *British Journal of Nutrition,* 113**,** 1195-1206.

THOMPSON, P. D., BUCHNER, D., PINA, I. L., BALADY, G. J., WILLIAMS, M. A., MARCUS, B. H., BERRA, K., BLAIR, S. N., COSTA, F., FRANKLIN, B., FLETCHER, G. F., GORDON, N. F., PATE, R. R., RODRIGUEZ, B. L., YANCEY, A. K., WENGER, N. K., AMERICAN HEART ASSOCIATION COUNCIL ON CLINICAL CARDIOLOGY SUBCOMMITTEE ON EXERCISE, R., PREVENTION, AMERICAN HEART ASSOCIATION COUNCIL ON NUTRITION, P. A. & METABOLISM SUBCOMMITTEE ON PHYSICAL, A. 2003. Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: a statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity). *Circulation,* 107**,** 3109-16.

TIELAND, M., BORGONJEN-VAN DEN BERG, K. J., VAN LOON, L. J. & DE GROOT, L. C. 2012. Dietary protein intake in community-dwelling, frail, and institutionalized elderly people: scope for improvement. *European journal of nutrition,* 51**,** 173-179.

TINGGI, U. 2008. Selenium: its role as antioxidant in human health. *Environmental health and preventive medicine,* 13**,** 102.

TONSTAD, S., BUTLER, T., YAN, R. & FRASER, G. E. 2009. Type of vegetarian diet, body weight, and prevalence of type 2 diabetes. *Diabetes care,* 32**,** 791-796.

TOWNSEND, N., WICKRAMASINGHE, K., WILLIAMS, J., BHATNAGAR, P. & RAYNER, M. 2015. Physical activity statistics 2015.

TRICHOPOULOU, A., BAMIA, C., NORAT, T., OVERVAD, K., SCHMIDT, E., TJØNNELAND, A., HALKJAER, J., CLAVEL-CHAPELON, F., VERCAMBRE, M.-N. & BOUTRON-RUAULT, M.-C. 2007. Modified Mediterranean diet and survival after myocardial infarction: the EPIC-Elderly study. *European journal of epidemiology,* 22**,** 871-881.

TRUMAN, E. & ELLIOTT, C. 2019. Barriers to Food Literacy: A Conceptual Model to Explore Factors Inhibiting Proficiency. *J Nutr Educ Behav,* 51**,** 107-111.

TSECHKOVSKI, M. 1993. WHO Regional Office for Europe. *Lancet,* 341**,** 1030.

VANNICE, G. & RASMUSSEN, H. 2014. Position of the academy of nutrition and dietetics: dietary fatty acids for healthy adults. *Journal of the Academy of Nutrition and Dietetics,* 114**,** 136-153.

VASSALLO, P., DRIVER, S. L. & STONE, N. J. 2016. Metabolic syndrome: an evolving clinical construct. *Progress in cardiovascular diseases,* 59**,** 172-177.

VIDAL-PETIOT, E., FORD, I., GREENLAW, N., FERRARI, R., FOX, K. M., TARDIF, J.-C., TENDERA, M., TAVAZZI, L., BHATT, D. L. & STEG, P. G. 2016. Cardiovascular event rates and mortality according to achieved systolic and diastolic blood pressure in patients with stable coronary artery disease: an international cohort study. *The Lancet,* 388**,** 2142-2152.

VINCENT, H. K., VINCENT, K. R., BOURGUIGNON, C. & BRAITH, R. W. 2005. Obesity and postexercise oxidative stress in older women. *Medicine and science in sports and exercise,* 37**,** 213-219.

VOLPE, C. M. O., VILLAR-DELFINO, P. H., DOS ANJOS, P. M. F. & NOGUEIRA-MACHADO, J. A. 2018. Cellular death, reactive oxygen species (ROS) and diabetic complications. *Cell death & disease,* 9**,** 1-9.

VOLPI, E., CAMPBELL, W. W., DWYER, J. T., JOHNSON, M. A., JENSEN, G. L., MORLEY, J. E. & WOLFE, R. R. 2012. Is the optimal level of protein intake for older adults greater than the recommended dietary allowance? *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences,* 68**,** 677-681.

WALLS, A. & STEELE, J. 2004. The relationship between oral health and nutrition in older people. *Mechanisms of ageing and development,* 125**,** 853-857.

WANG, E. W., SIU, P. M., PANG, M. Y., WOO, J., COLLINS, A. R. & BENZIE, I. F. 2017. Vitamin D deficiency, oxidative stress and antioxidant status: only weak association seen in the absence of advanced age, obesity or pre-existing disease. *British Journal of Nutrition,* 118**,** 11-16.

WARDLE, J., PARMENTER, K. & WALLER, J. 2000. Nutrition knowledge and food intake. *Appetite,* 34**,** 269-275.

WHELTON, P. K., APPEL, L. J., SACCO, R. L., ANDERSON, C. A., ANTMAN, E. M., CAMPBELL, N., DUNBAR, S. B., FROHLICH, E. D., HALL, J. E. & JESSUP, M. 2012. Sodium, blood pressure, and cardiovascular disease: further evidence supporting the American Heart Association sodium reduction recommendations. *Circulation,* 126**,** 2880-2889.

WHITE, C. 2016. The pathophysiology of coronary heart disease from a student's perspective. *Journal of perioperative practice,* 26**,** 170-173.

WHITE, S., BISSELL, P. & ANDERSON, C. 2011. A qualitative study of cardiac rehabilitation patients' perspectives on making dietary changes. *J Hum Nutr Diet,* 24**,** 122-7.

WITZTUM, J. L. & STEINBERG, D. 1991. Role of oxidized low density lipoprotein in atherogenesis. *The Journal of clinical investigation,* 88**,** 1785-1792.

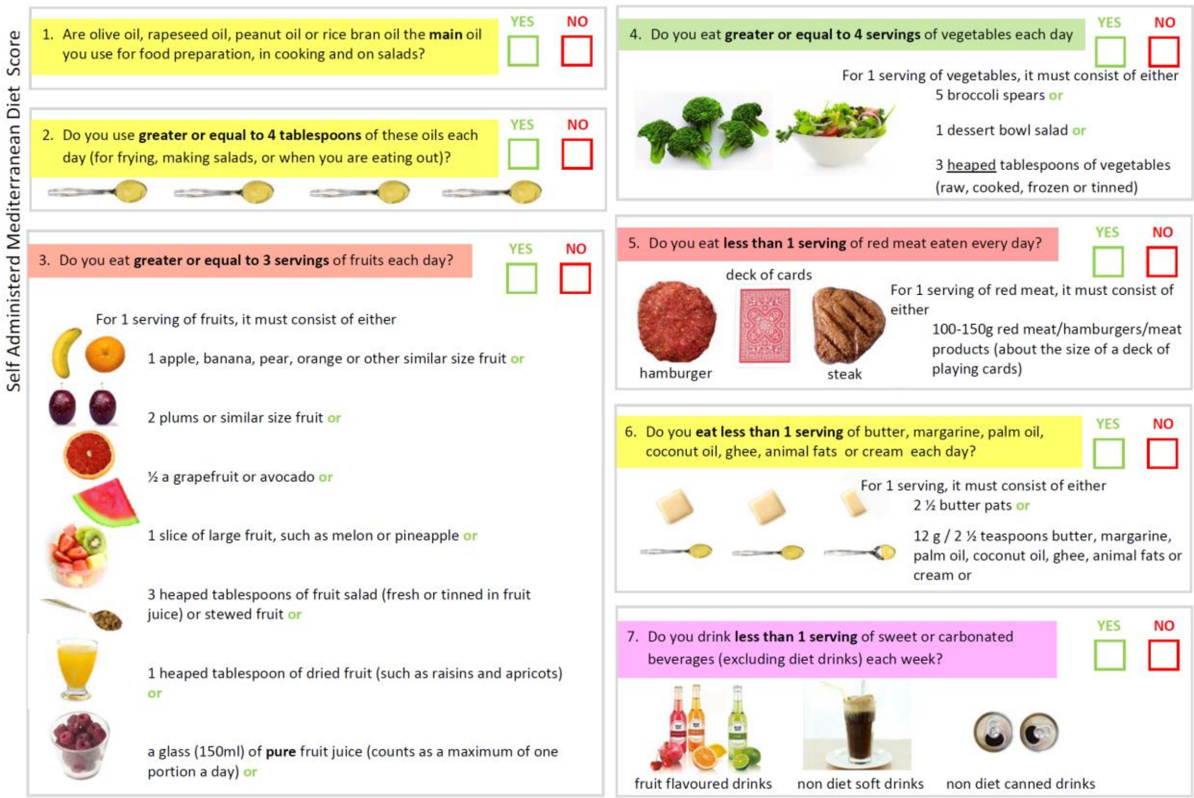
WOO, J., HO, S., YU, A. & SHAM, A. 2002. Is waist circumference a useful measure in predicting health outcomes in the elderly? *International journal of obesity,* 26**,** 1349.

WORSLEY, A. J. A. P. J. O. C. N. 2002. Nutrition knowledge and food consumption: can nutrition knowledge change food behaviour? 11**,** S579-S585.

ZANINOTTO, P., PIERCE, M., BREEZE, E., DE OLIVEIRA, C. & KUMARI, M. 2010. BMI and Waist Circumference as Predictors of Well-being in Older Adults: Findings From the English Longitudinal Study of Ageing. *Obesity,* 18**,** 1981-1987.

Appendices

Appendix 1. the Mediterranean diet score sheet.



Self Administerd Mediterranean Diet Score

1. Are olive oil, rapeseed oil, peanut oil or rice bran oil the **main** oil you use for food preparation, in cooking and on salads? YES NO

2. Do you use **greater or equal to 4 tablespoons** of these oils each day (for frying, making salads, or when you are eating out)? YES NO

3. Do you eat **greater or equal to 3 servings** of fruits each day? YES NO

For 1 serving of fruits, it must consist of either

1 apple, banana, pear, orange or other similar size fruit or

2 plums or similar size fruit or

½ a grapefruit or avocado or

1 slice of large fruit, such as melon or pineapple or

3 heaped tablespoons of fruit salad (fresh or tinned in fruit juice) or stewed fruit or

1 heaped tablespoon of dried fruit (such as raisins and apricots) or

a glass (150ml) of **pure** fruit juice (counts as a maximum of one portion a day) or

4. Do you eat **greater or equal to 4 servings** of vegetables each day YES NO

For 1 serving of vegetables, it must consist of either

5 broccoli spears or

1 dessert bowl salad or

3 heaped tablespoons of vegetables (raw, cooked, frozen or tinned)

5. Do you eat **less than 1 serving** of red meat eaten every day? YES NO

deck of cards

hamburger

steak

For 1 serving of red meat, it must consist of either

100-150g red meat/hamburgers/meat products (about the size of a deck of playing cards)

6. Do you **eat less than 1 serving** of butter, margarine, palm oil, coconut oil, ghee, animal fats or cream each day? YES NO

For 1 serving, it must consist of either

2 ½ butter pats or

12 g / 2 ½ teaspoons butter, margarine, palm oil, coconut oil, ghee, animal fats or cream or

7. Do you drink **less than 1 serving** of sweet or carbonated beverages (excluding diet drinks) each week? YES NO

fruit flavoured drinks

non diet soft drinks

non diet canned drinks

Self Administerd Mediterranean Diet Score

7. Do you drink **greater or equal to 3 small glasses** of wine but **less than 21 small glasses for men** or **14 small glasses for women**

YES ☐ NO ☐

any wine in a small glass (125ml)

8. Do you eat **greater or equal to 3 servings** of legumes (beans, peas, lentils, chickpeas) each week?

YES ☐ NO ☐

3/4 cup of beans

For 1 serving of legumes, it must consist of

150g/3/4 cup /14 tablespoons level cooked

9. Do you eat **greater or equal to 3 servings** of fish or shellfish each week?

YES ☐ NO ☐

fish

shellfish

For 1 serving of fish or shellfish, it must consist of either

200g with shells/10 large/15 medium/20 small shellfish or

100-150g/1-1½ palm size fish

10. Do you **eat less than 3 servings** of commercial sweets/pastries (cakes/biscuits/custard/desserts) each week?

YES ☐ NO ☐

cake | biscuits | tarts | ice cream | crumble and custard

11. Do you **eat greater or equal to 1 serving** (1 serving =30g/2 tablespoon) of unsalted nuts each week?

YES ☐ NO ☐

For 1 serving of unsalted nuts, it must consist of

30g/2 tablespoon

12. Do you eat white or poultry meat (e.g chicken, turkey) **more often** than red meat (beef, veal, pork, lamb, mutton) or processed meat (hamburger, sausage, salami) each week?

YES ☐ NO ☐

white/poultry meat

red meat | processed meat

13. When you eat dishes made from pasta, rice, vegetable or other dishes do you flavour them with tomato and onion, leek, garlic and olive oil more than twice a week

YES ☐ NO ☐

Add up the number of ticks in 'yes' boxes to calculate your Mediterranean Diet Score:

Initials/ Unique id:

Appendix 2. Permission from HBNW service development manager

Letters of support to access HBNW patient's data and recruit participants for each of the studies. There are two letters at different timepoints in confirmation of their continued support throughout the whole of the research project. The researcher was married during the study period hence the change of name and confirmation permission was requested in the new name.

Heartbeat
Rebuilding Lives

8th October 2013

To whomever it may concern

I am writing in regard to April Scott, Heartbeat are happy to support April throughout her PhD.

As April currently works some hours for Heartbeat we will be happy for her to work closely with our service users and staff. We are also happy for her to use data and information to complete the work necessary for her Phd.

If there are any other requirements April understands that she can contact Heartbeat for further assistance.

Yours sincerely

Louise

Louise Bache

Service Development Manager

20th February 2015

To whomever it may concern

I am writing in regard to April Melia, Heartbeat are happy to support April throughout her PhD.

As April currently works some hours for Heartbeat we will be happy for her to work closely with our service users and staff. We are also happy for her to use data and information to complete the work necessary for her PhD.

If there are any other requirements April understands that she can contact Heartbeat for further assistance.

Yours sincerely

Louise

Louise Bache

Service Development Manager

Appendix 3. Ethical approval

12th March 2015

Stephanie Dillon/April Anne Melia

School of Sport, Tourism and the Outdoors

University of Central Lancashire

Dear Stephanie/April,

Re: STEMH Ethics Committee Application Unique Reference Number: STEMH 303

The STEMH ethics committee has granted approval of your proposal application 'Evaluation of current nutrition practice in a cardiac rehabilitation program in Preston, followed by, the design and implementation of an improved nutrition intervention'. Approval is granted up to the end of project date* or for 5 years from the date of this letter, whichever is the longer.

It is your responsibility to ensure that:

- the project is carried out in line with the information provided in the forms you have submitted
- you regularly re-consider the ethical issues that may be raised in generating and analysing your data
- any proposed amendments/changes to the project are raised with, and approved, by Committee
- you notify roffice@uclan.ac.uk if the end date changes or the project does not start
- serious adverse events that occur from the project are reported to Committee
- a closure report is submitted to complete the ethics governance procedures (Existing paperwork can be used for this purposes e.g. funder's end of grant report; abstract for student award or NRES final report. If none of these are available use e-Ethics Closure Report Proforma).

Yours sincerely,

Ambreen Chohan

Deputy Vice-Chair

5 April 2018

Steph Dillon/April Melia

School of Sport and Wellbeing

University of Central Lancashire

Dear Steph and April

Re: STEMH Ethics Committee Application Unique Reference Number: STEMH 634 (Ph.D Phase)

The STEMH ethics committee has granted approval of your proposal application 'Evaluation of current nutrition practice in a cardiac rehabilitation program in Preston, followed by, the design and implementation of a bespoke nutrition education programme'. Approval is granted up to the end of project date*.

It is your responsibility to ensure that

- the project is carried out in line with the information provided in the forms you have submitted
- you regularly re-consider the ethical issues that may be raised in generating and analysing your data
- any proposed amendments/changes to the project are raised with, and approved, by Committee
- you notify EthicsInfo@uclan.ac.uk if the end date changes or the project does not start
- serious adverse events that occur from the project are reported to Committee
- a closure report is submitted to complete the ethics governance procedures (Existing paperwork can be used for this purposes e.g. funder's end of grant report; abstract for student award or NRES final report. If none of these are available use e-Ethics Closure Report Proforma).

Yours sincerely

Karen A. Rouse

Vice Chair

STEMH Ethics Committee

* for research degree students this will be the final lapse date

NB - Ethical approval is contingent on any health and safety checklists having been completed, and necessary approvals as a result of gained.

Appendix 4 Participant information sheets for studies 2, 3 and 4.

Participant Information sheet

Study Title:	**Evaluation of current nutrition practice in a cardiac rehabilitation program in Preston, followed by, the design and implementation of an improved nutrition intervention**
Investigator:	**April Melia**
Supervisors:	**Dr Stephanie Dillon, university of central Lancashire**

The following information is designed to provide you with answers to questions that you may have. Please feel free to ask any other questions in order that you feel happy to consent to take part.

What is the purpose of the study?

The purpose if this study is to investigate the current eating habits of Heartbeat members that regularly attend exercise sessions with Heartbeat.

There are many conflicting health messages in the press and media and it can be difficult to know what a “healthy diet” is, and make informed choices.

By completing this questionnaire the researcher hopes to identify any key issues that arise and draw out any key themes in relation to lifestyle choices.

These key themes will then be analysed and used to inform a future healthy eating guide that will be tailored to the needs of Heartbeat members.

What will be involved?

As a participant in this study you will be asked to complete a questionnaire, this questionnaire is comprised of three sections that will provide details of:

1. Your current eating habits
2. Your understanding of the current recommendations and of healthy eating
3. Your current activity levels

*You will be given a questionnaire and will have **one week** to decide if you would like to return the completed questionnaires.*
These questionnaires will be collected at your normal exercise session, next week, by the researcher who will provide a drop box for completed questionnaires to be deposited.

The questionnaires are anonymous and once a completed questionnaire has been returned and collected by the researcher you will not be able to withdraw from the study.

By returning the questionnaire you are agreeing to participate in this study and your responses used to inform the future healthy eating guide. You **are not** agreeing to take any part in future studies as a result of completing the questionnaire.

What are the risks of taking part?

There are no risks involved with this study.

Do you have to take part?

No, it is entirely voluntary. You do not need to return the questionnaire if you do not wish to participate.

Confidentiality

The data collected as part of this study is completely anonymous. All questionnaires will be stored in a locked filing cabinet in a locked office until they are input onto a password protected computer for analysis.

What will happen to the results?

The findings of the study will be available in summary format for you to view via your Heartbeat notice board.

They will also be used to form part of the researcher's final dissertation.

Ethical Consent

*Ethical approval for this study will be given by The University of Central Lancashire Ethics Committee (*STEMH)

Investigator Details

Researcher Details

April Melia **AAMelia@uclan.ac.uk**

Project Supervisor (DoS)

Dr Stephanie Dillon **SDillon@uclan.ac.uk**

Participant Information sheet.

Study Title:	Evaluation of current nutrition practice in a cardiac rehabilitation program in Preston, followed by, the design and implementation of an improved nutrition intervention
Investigator:	April Melia
Supervisors:	Dr Stephanie Dillon, University of Central Lancashire
ALL FOCUS GROUP SESSIONS TO BE HELD AT HEARTBEAT PNE	

The following information is designed to provide you with answers to questions that you may have. Please feel free to ask any other questions in order that you feel happy to consent to take part.

What is the purpose of the study?

The purpose if this study is to develop an understanding of Heartbeat member's perspectives on healthy eating and the role of nutrition education within the Heartbeat cardiac rehabilitation programme.

There are many conflicting health messages in the press and media, and it can be difficult to know what a "healthy diet" is and make informed choices.

By listening to the views of Heartbeat members, the researcher hopes to identify any key issues that arise and draw out any key themes in relation to lifestyle choices and making dietary changes.

These key themes will then be analysed and used to inform a future healthy eating guide that will be tailored to the needs of Heartbeat members.

What will be involved? - FOCUS GROUP

As a participant in this Study, you are invited to:

- Attend **one Focus Group session**, this session will comprise of group discussions on topics relating to engagement in nutrition education programmes and general perspectives on health eating.
- The session will be approximately an hour and a half to 2 hours duration.
- All information collected during the Focus Groups will be confidential,
- participants will be identified using alpha numerical code,
- You can withdraw from the study at any time up to the point of data collection, as all responses will be anonymised.
- None of the information you have provided will identify you in any way.

You are not committing yourself to take any part in future studies by agreeing to take part in the Focus Groups.

What are the risks of taking part?

There are no risks involved with participating in this study.

The aim of the study is to provide an improved service for the members of Heartbeat and eventually the wider cardiac rehabilitation community. There are potential health benefits from structured nutritional education programme that the Focus Groups will help to inform.

Do you have to take part?

No, it is voluntary.

Confidentiality

The data collected as part of this study is completely anonymous. All information will be stored in a locked filing cabinet in a locked office until they are input onto a password-protected computer for analysis.

What will happen to the results?

The findings of the study will be available in summary format for you to view via your Heartbeat notice board. You are free to contact the researcher with any questions surrounding the questionnaire and use of information gathered following analysis.

The information collected will be used to form part of the researcher's PhD thesis and for future publication in scientific journals and be presented at conferences.

Ethical Consent

Ethical approval for this study will be given by The University of Central Lancashire Ethics Committee (STEMH)

Concerns or Complaints Procedure

If you have any concerns or questions about this study please feel free to contact myself, April Melia AAMelia@uclan.ac.uk

Or for formal concerns or complaints please follow the following procedure:

Concerns should be addresses to the University Officer for Ethics at: officeforethics@uclan.ac.uk . Information provided should include the study name or description (so that it can be identified), the principal investigator or student investigator or researcher, and the substance of concern

The university officer for Ethics will document the concern and refer it to the Chair of the relevant e-Ethics sub-committee within two working days.

Investigator Details

Principal Investigator

April Melia AAMelia@uclan.ac.uk

Project Supervisor (Director of Studies, (DoS))

Dr Stephanie Dillon SDillon@uclan.ac.uk

Participant Information sheet. V3

Study Title:	Design, delivery, and evaluation of a bespoke nutrition education programme for Heartbeat NW members.
Investigator:	April Melia
Supervisors:	Dr Stephanie Dillon, University of Central Lancashire
ALL GROUP SESSIONS TO BE HELD AT HEARTBEAT MAIN CENTRE PNE	
6-week nutrition intervention	

The following information is designed to provide you with answers to questions that you may have. Please feel free to ask any other questions in order that you feel happy to consent to take part.

What is the purpose of the study?

Regular physical activity and Healthy eating are key to reducing known risk factors associated with coronary heart disease (CHD). You have already committed to participate in regular physical activity sessions as part of your Cardiac rehabilitation programme provided by Heartbeat, a healthy diet alongside this may help to further reduce risks associated with CHD.

Healthy eating messages in the media and even information provided by health professionals can be confusing and focus on what you should avoid or remove from your diet, without much focus on what you can, and should, eat.

The purpose of this study is to evaluate whether a bespoke nutrition education programme, designed specifically for Heartbeat members, has a positive effect on nutrient intake and risk factor profile of individuals when compared to a weight loss programme, or exercise alone.

What will be involved?

If you decide to take part in this research, you will be **randomly assigned** to one of three groups:

Group 1. Usual care* you will continue with your usual exercise classes as normal

Group 2. Usual care* Plus the "biggest loser" nutrition education program.

Group 3. **Usual** care* Plus "Healthy Heart Happy YOU" New nutrition education program.

All participants will attend an initial appointment where the following data will be

Collected from you:

- Age
- Blood pressure and resting heart rate, using an automated sphygnomometer
- Height using portable stadiometer
- Weight, personal weighing scale
- Hip and waist measurements, using fabric tape measure
- Current medication used
- Capillary blood samples

Blood glucose and lipids will be measured using simple capillary blood sampling (finger prick). This will involve taking 2-3 drops of blood, which will be used to test blood glucose levels, blood lipids, and cholesterol levels. All blood testing strips and sharps will be disposed of as clinical waste immediately following testing, no samples will be stored. In the event of any unusual test results, participant will be informed immediately, and they may be referred to their own GP or practice nurse.

You will complete a Mediterranean diet score sheet and a 4-day diet diary, detailed information on how to complete these wills be provided by the researcher.

These measurements will be repeated at the end of the 6-week intervention and then at the follow up session at week 12.

If you are assigned to one of the intervention groups, you will be required to attend one session per week, for 6 weeks, in addition to your usual exercise classes.

If you are assigned to the usual care "control group" you will continue with your normal routine and attend your regular exercise classes.

What are the risks of taking part?

There are no risks involved with participating in this study. There may be some minor discomfort while measures are taken, however the researcher is fully trained, and discomfort will be minimal.

The aim of the study is to provide an improved service for the members of Heartbeat and eventually the wider cardiac rehabilitation community. There are potential health benefits from attending the structured nutritional education programme.

Eligibility

All Heartbeat members are eligible to participate unless:

- Your condition or medication has changed in the last month

Do you have to take part?

No, it is voluntary.

Confidentiality

You will be identified with a number; names will not be used in any reporting of information arising from this study. All information will be taken back to UCLan and stored in a locked filing cabinet in a locked office until they are input onto an encrypted password protected folder, on UCLan computer for analysis. This information will be stored on UCLan system for 5 years.

What will happen to the results?

The findings of the study will be available in summary format for you to view via your Heartbeat notice board. You are free to contact the researcher with any questions surrounding any part of the research and use of information gathered following analysis.

The information collected will be used to form part of the researcher's PhD thesis and for future publication in scientific journals and be presented at conferences.

Withdrawal procedure

You are free to withdraw from the study, without giving a reason, anytime up until final data collection at 12 weeks, any data collected before that point will be removed from the study and destroyed.

Once final data collection has taken place your data will be included in the study. However, you will not be identified in any way in publications arising from this research.

Please email the researcher on AAMelia@uclan.ac.uk to withdraw.

Ethical Consent

Ethical approval for this study has been provided by The University of Central Lancashire Ethics Committee (STEMH)

Concerns or Complaints Procedure

If you have any concerns or questions about this study please feel free to contact myself, April Melia AAMelia@uclan.ac.uk

Or for formal concerns or complaints please follow the following procedure:

Concerns should be addresses to the University Officer for Ethics at: officeforethics@uclan.ac.uk . Information provided should include the study name or description (so that it can be identified), the principal investigator or student investigator or researcher, and the substance of concern

The university officer for Ethics will document the concern and refer it to the Chair of the relevant e-Ethics sub-committee within two working days.

Investigator Details

Principal Investigator

Project Supervisor (Director of Studies, (DoS))

Dr Stephanie Dillon SDillon@uclan.ac.uk

Student investigator April Melia AAMelia@uclan.ac.uk

Appendix 5 Permission to use the BHF questionnaire

Dear April,

Thank you for your query. It is fine for you to use the questionnaire. Please can you ensure that the BHF copyright statement is used where appropriate –

© British Heart Foundation, [**YEAR**]. Reproduced with kind permission of the British Heart Foundation, a charity registered in England and Wales (reg. no 225971) and Scotland (reg. no SC039426)."

Many thanks,

Frances

Health at Work
British Heart Foundation
Greater London House | 180 Hampstead Road
London | NW1 7AW
+442075540355

bhf.org.uk **Join the fight for every heartbeat**

People with heart problems can come in all shapes and sizes. Meet the baby who has a 50/50 chance of inheriting a heart condition from one of her parents and see how we're fighting back with our ground-breaking research. To watch our TV ad and find out more visit bhf.org.uk/fight #jointhefight

FIGHT FOR EVERY HEARTBEAT bhf.org.uk

NOTE

This questionnaire does not have a scoring sheet. None needed or available.

Appendix 6 Permission to use the NKQ questionnaire

From: Block, Francesca [mailto:francesca.block@ucl.ac.uk]
Sent: 29 October 2014 14:11
To: April Anne Melia
Subject: RE: Use of NKQ questionnaire

Hi April,

Thank you for your email. Professor Wardle is pleased to hear that you are interested in using the General Nutrition Knowledge Questionnaire for adults in your own research.

You can find this measure, including the correct answers, on our website, although the webpage for it is currently being modified and will be going live in the next few days. I will send you the new link once it has gone live.

Before embarking on your research project, we advise you to be mindful of the fact that the questionnaire was created in the 90's and a wealth of new evidence has come to light since then. Please note that we are currently in the process of updating the questionnaire.

Therefore, we suggest that when you assess and interpret the nutritional knowledge of your participants that you acknowledge the latest evidence in the area and observe any evidence based changes to nutritional knowledge since the 90's.

It would also be deemed good practice to reflect any differences in the current and previous evidence in the context of your own research findings.

Best wishes,

Fran

On behalf of Professor Jane Wardle
Fran Block
Research Assistant
Health Behaviour Research Centre
Department of Epidemiology and Public Health
University College London
1-19 Torrington Place
London WC1E 6BT, UK
Tel: +44 (0)20 7679 1720
Fax: +44 (0)20 7679 8354

Email: francesca.block@ucl.ac.uk

Appendix 7 permission to use the IPAQ questionnaire

gives permissions to use. We do not need to apply for separate permission as it is freely available.

They say:

Using IPAQ

Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made in the order or wording of the questionnaire as this will affect the psychometric properties of the instruments.

Appendix 8 Informed consent

Examples of two informed consent forms FG and Questionnaires

University of Central Lancashire

Centre for Applied Sport & Exercise Sciences

Informed Consent Form

Focus Group Research

The nature demands and the risks associated with the project have been explained to me, and I agree to participate in the above-named study. I understand that I may withdraw my consent and discontinue participation at any time without having to give an explanation.

Participant's signature:

I certify that I have explained to the above individual the nature and demands associated with participation in this research study, have answered any questions that have been raised, and have witnessed the above signature

Signature of investigator:

Age:

Gender: F M

University of Central Lancashire
Centre for Applied Sport & Exercise Sciences
Informed Consent Form

Randomised Control Trial

Title of Project:
Evaluation of current nutrition practice in a cardiac rehabilitation program in Preston, followed by, the design and implementation of a bespoke nutrition education programme.

Name of Researcher: April Melia AAMelia@uclan.ac.uk

The nature demands and the risks associated with the project have been explained to me, and I agree to participate in the above named study. I understand that I may contact the researcher on the above email address to withdraw my consent and discontinue participation at any time, up until the 12-week data collection point. I can withdraw without having to give an explanation.

Participant's signature:

Procedures for the capillary blood sample test have been fully explained to me and I agree to participate in the above-named study. I understand that I may contact the researcher on the above email address to withdraw my consent and discontinue participation at any time up until the 12-week data collection point. I can withdraw without having to give an explanation.

Participant's signature:

I certify that I have explained to the above individual the nature and demands associated with participation in this research study, have answered any questions that have been raised, and have witnessed the above signature

Signature of investigator:

Appendix 9 so you want to lose weight for good,

BHF resource booklet for Biggest loser intervention

So you want to

British Heart

Contents

The British Heart Foundation (BHF) takes your health and your weight very seriously.We don't guarantee quick fixes or magical cures for weight loss.In fact we're dubious about anyone who does.We prefer a sensible and permanent approach to losing weight.All the research findings suggest that losing it steadily and gradually is the safest way and the weight is much more likely to stay off than if you lose it quickly.

We're not keen on the word 'diet'either.It sounds restrictive and very

The British Heart Foundation and weight

If you’re interested in losing weight for health benefits,we’ve produced this booklet for you.Whether you’re male or female,in your twenties or in your sixties,whether you have any signs of heart disease or not, the advice which follows is written for you.In fact the whole family could benefit from our tips on healthy eating for life.

And your health isn’t the only thing which stands to improve.Getting in shape can mean getting fitter and feeling more energetic.Many people notice a boost to their confidence too as they can wear different clothes, play more with children or grandchildren and generally get more out of life.

“The best thing about the front of the booklet is the BHF logo. You immediately know it’s going to be sensible.”

(35 - 44 yr old overweight woman)

Heart disease and weight

If you’re very overweight you’re more likely to have a heart attack,especially if your extra weight is around your middle.The good news is that by losing weight you can cut your risk of heart disease considerably.

Research studies also suggest that many overweight people with angina,raised blood cholesterol and high blood pressure found that their conditions improved greatly,even after losing only some of their excess weight.Many of those who kept the weight off were able to reduce their medication or even stop it altogether.

What is heart disease?

The most common form of heart disease among adults is called coronary heart disease (CHD).It occurs when the coronary arteries bringing oxygen-rich blood to your heart muscle get 'furred up'by fatty deposits (atheroma).

A heart attack occurs if a coronary artery becomes completely blocked,which can happen,for example, when a blood clot forms on a pre-existing atheroma.

Angina occurs when your heart does not receive enough blood and oxygen. An attack can be brought on by physical activity or emotional stress.

High blood pressure(the medical name is 'hypertension') increases your risk of heart disease, strokes and kidney disease.The cause of most high blood pressure is not clear but the following can all contribute:being overweight; excessive salt intake;drinking too much alcohol;physical inactivity.

High blood cholesterol increases your risk of coronary heart disease.The most common cause of high blood cholesterol is too much fat in the diet. Occasionally people have high levels due to an inherited condition.

Coronary heart disease is usually the result of several risk factors.These include:

- high blood cholesterol
- smoking
- high blood pressure
- physical inactivity
- being overweight
- family history
- diabetes

“When I became a teacher, my lifestyle changed but my diet didn’t. I’ve been sitting around much more, getting no time for exercise, and eating as much as ever, especially late at night. Since then I’ve been putting on about a stone a year.”
(25-34 year old overweight man)

Weight gain

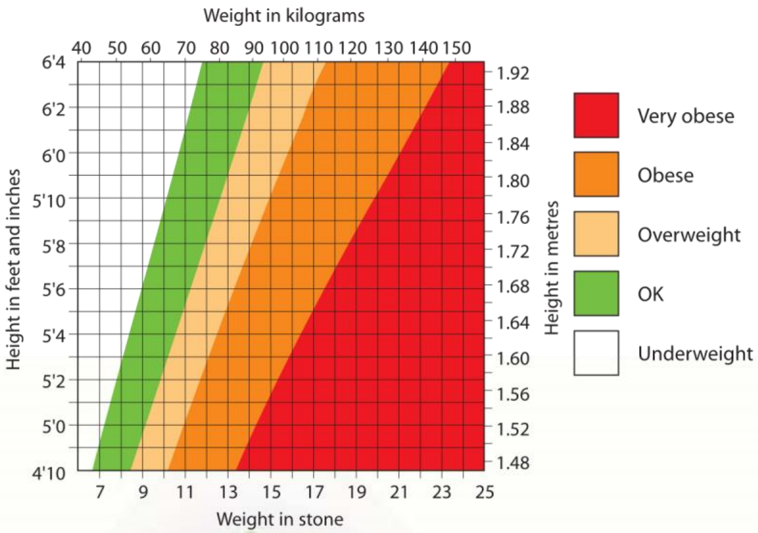
You may be one of those people who has always been big and battled with your weight on and off for years.Or, you may have been steadily gaining weight over the years as many people gain weight with age.Many people are less active as they get older because of family commitments,long working hours and other pressures.Leisure time is often spent in front of the television or computer which doesn't help.Whichever is true you're not alone.Over half of all adults in the UK are now overweight and this is true for men and women. Remember that just preventing any further weight gain is a very valuable and worthwhile goal in itself.

Motivated to lose weight?

Protecting yourself from heart disease is one very good reason to think about losing weight.Getting and keeping to a healthy weight also reduces your risk of other health problems like diabetes, some cancers and arthritis, too.

Most of us know if we're overweight by looking in a mirror or by the size or tightness of our clothes. You may like to check your weight on the chart below, which also takes account of your height. If your weight is within the overweight or obese section (fat or very fat),you are wise to be thinking about trying to lose some.The 'healthy weight' section (OK) is your long term goal but in the short term you may wish to set yourself a more realistic target of perhaps losing 5 or 10lbs.Don't be too ambitious in your goal otherwise you are almost certain to be disappointed with the results. Remember that maintaining your current weight (ie not gaining more) is an achievement in itself.

Your shape, as much as your weight, could be affecting your health risk.The more apple-shaped you are, rather than pear-shaped, the more at risk of heart disease you are.You can assess this simply by measuring your waist. Find the bottom of your ribs and the top of your hips,measure around your middle at a point mid-way between these,for many people this will be the tummy button. If you measure more than 32 ins (80cm) for a woman or more than 37 ins (94 cm) for a man,your health is at risk.If the measurement



is more than 35 ins (88 cm) for a woman or 40 ins (102 cm) for a man, your risk is much higher.

Other reasons for trying to lose weight may be as important to you as health.You might want to get fitter,get in-shape,look better,feel better or just be able to get into clothes which no longer fit.

Whatever your reasons,you've made an important step by getting hold of this booklet. Read on to find out more about losing weight - for good.

Eating or exercise - or both

To lose weight you need to use up more energy (calories or joules) than your body takes in from food and drink.You can do this in three ways:

- by eating and drinking fewer calories
- using more calories by getting more active
- a bit of both

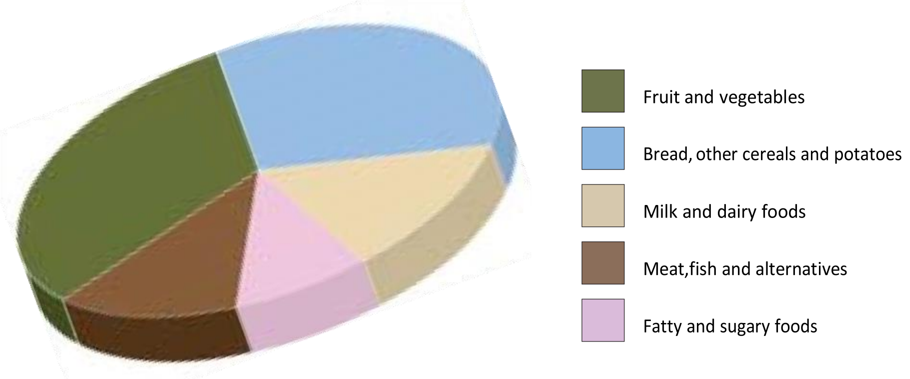
Most people find that doing both achieves the best results.You may prefer to start off with changes to what you eat and think about exercise later.It's up to you.For exercise to greatly reduce the risk of heart disease you need to aim for 30 minutes of moderate activity at least five times a week which leaves you warm and breathing more heavily, but still able to hold a conversation with someone! If this sounds impossible for you just now,remember that doing anything more than you do now is a step in the right direction and will certainly help.But remember,however much you change your eating and exercise patterns, a weight loss of 1lb (1/2 kg) a week is all you should expect.Any more than that is a bonus! Losing weight too quickly may not be good for you (see page 29).

To greatly reduce the risk of heart disease you need to aim for 30 minutes of moderate activity at least five times a week.

Following The Balance of Good Health will give you the best possible eating plan for good health.

Your weight loss plan

Eating and drinking fewer calories doesn’t mean that you have to count



them.The British Heart Foundation is as interested in the quality of the foods you eat as the amount.The Balance of Good Health pictured below shows the best proportion of foods, from the five food groups, for healthy eating and for weight loss.

It goes like this:

- plenty of fruit and vegetables
- plenty of starchy foods such as bread, rice, grains and potatoes, try to choose wholegrains whenever possible
- smaller amounts of milk and dairy foods, low fat where possible
- smaller amounts of meat, fish, beans and nuts, low fat where possible
- tiny amounts of fatty and sugary foods, and alcoholic drinks

The Balance of Good Health

In essence, this is healthy eating.Eating these types of foods in the proportions shown will make sure you get the right balance of vitamins (like vitamin C) and minerals (like iron and calcium).It also provides lots of starch and fibre keeping the bowels healthy,while keeping fat and sugar down - to reduce the risk of heart disease, some cancers, weight gain and dental problems

and keep the bowels healthy.

Healthy eating for weight loss means eating the right balance and a suitable amount of food.This plan helps you manage the quantities - see page 10.Many people think they are already eating very healthily and this may be true for you. However,we know from studies that many people still haven’t quite got it right and their diet doesn’t quite represent the proportions of foods shown in The Balance of Good Health below.

How much is too much?

Following The Balance of Good Health will give you the best possible eating plan for good health.It’s more about what you *can* eat than what you can’t.In fact, nothing is banned.It gives you the flexibility to choose the foods you enjoy *and* to indulge in treats like chocolate, crisps and cakes now and then. Even the odd glass of wine or a beer is fine.

When watching your weight, you also have to plan the *amounts* of food you eat.It’s not just the *quality* - the *quantity* matters too.Although everyone is different, as a rule, most people will

So you want to los

Daily portions based on The Balance of Good Health

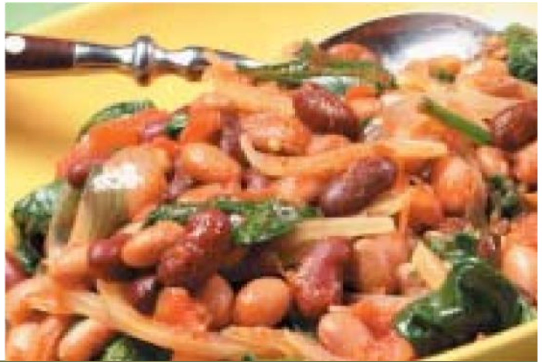
Food Group		1,500 calories	1,800 calories	Your Plan
Fruit and vegetables		or more	or more	
Bread, other cereals and potatoes		7	8	
Milk and dairy foods		2	3	
Meat,fish and alternatives		2	2	
Fatty and sugary foods	Fats	2	2	
	Occasional foods	1	1	
Alcohol (If you choose not to drink alcohol at all, you can have the points as fatty and sugary foods instead.)		up to 1	up to 2	

lose weight if they eat or drink between 1,500 and 1,800 calories a day.Women tend to need less than men, so if you're female, choose 1,500 calories.If you're male, choose 1,800 calories.The table below shows how many portions you would eat from each food group, for 1,500 or 1,800 calories a day.You could write your own plan in the blank right hand column. If you would like individualised advice ask your GP to refer you to a dietitian or your practice nurse.

But what's a portion?

With this weight loss plan, you won't have to count calories at all.And you won't have to weigh out your food.Instead the list of common foods from all the food groups on pages 13-16 show handy amounts - or portions - beside each food, for you to choose as you wish.But remember, portions are a funny thing.One person's idea of a normal portion is often quite different from someone else's! If you're having a larger amount than the list shows, it could be a double or triple portion so would count as two or three.

We don't want to be negative. In fact we recommend that you *must eat* plenty of many foods.Five portions a day from the fruit and vegetable group is a minimum and you can aim for 7,8 or even more! They are low in calories and full of goodness.The antioxidants they contain, especially if they are green, yellow, orange or red, offer some protection against CHD and some cancers.Any vegetables are fine as are most fruits, but note the word of caution in the box.



A word of caution:
We encourage you to eat lots of foods from the fruit and vegetable group.However there are just a few exceptions:
Avocado pears are high in monounsaturated fats and high in calories.Have as a salad garnish only once a week at the most and half an avocado only occasionally as a special treat.
Fruit juice is nourishing but quite concentrated in calories.Keep to only one portion of unsweetened fruit juice - a small glass - a day.
Avoid sugary squash or fruit juice drinks.
Dried fruits are quite concentrated in natural sugar so have only one portion of these daily.

Also, make sure you eat enough foods from the 'Bread, other cereals and potatoes'group.These starchy foods were once thought to be 'stodgy'. In fact,they're not! They are filling but don't contain too many calories - unless you add fat to them.If you add fat, such as spread on bread, oil on pasta or butter on your baked potato, remember that these come from your portions in the 'Fatty foods' section.Enjoy them but keep to your limit.

Can I indulge?

Nothing is banned in this weight loss plan, but foods from the 'Fatty and

sugary foods group' provide a lot of calories with little goodness. Think of these as treats or extras to be enjoyed occasionally, rather than everyday necessities. Your daily limit of fatty and sugary foods is just one portion, but you could save them up over the week if you prefer, so have none on one day and two or three on another.Many people find they eat differently at weekends or when eating out, so this way you can keep your indulgences 'up your sleeve'for those times you really need them!

We believe in a weight loss plan for life.That doesn't mean having to survive for ever on salads and crispbreads!

How much is a portion?

Fruit and vegetables (have 7 - 8 portions per day)	
Vegetables eg.cauliflower, cabbage, peas, carrots, mushrooms, tomatoes, leeks, swede, courgettes, broccoli, french beans, peppers	2 large tablespoons
Salad - mixed green eg. lettuce, cucumber, onion, pepper	1 small bowl
Tomato	1 medium
Whole fresh fruit	eg.1 apple, 1 pear, 1 orange, 1 banana, 1 peach
Tinned fruit in natural juice eg.peaches, pineapple, raspberries and pears	3 large tablespoons
Stewed fruit eg.apple, rhubarb, cherries	4 large tablespoons
Large fruits	1 slice melon or pineapple, $^1/_2$ grapefruit
Small fruits	12 grapes, 3 apricots, 2 plums, 2 kiwi fruits, 7 strawberries
Dried fruit eg.raisins	1 baby box - matchbox size
Fruit juice (maximum one per day)	1 small glass or small carton

Bread, other cereals and potatoes (have 7 - 8 portions per day)	
Breakfast cereal eg.flakes or crispies	3 tablespoons
Muesli	2 tablespoons
Shredded wheat	1
Weetabix	1
Bread or toast	1 large slice (medium thick)
Bread bun or roll	1/2 large
Pitta bread	1 mini or picnic size
Chapatti	1 small
Crackers	3
Crispbreads	4
Plain naan bread	1 small
Rice, plain boiled	2 heaped tablespoons

Bread, other cereals and potatoes (have 7 - 8 portions per day) Cont...	
Pasta, plain, boiled	3 heaped tablespoons
Egg noodles, boiled	half packet
Potatoes	2 egg size
Bagel, plain or cinnamon & raisin	$^1/_2$
Crumpet/pikelet	1
Muffin	1
Malt loaf	1 small slice
Muesli bar	1

Milk and dairy foods (have 2 - 3 portions per day)	
Milk (preferably semi-skimmed or better still, skimmed)	1 medium glass, 200ml ($^1/_3$ pint)

Yoghurt, plain or flavoured, low fat and low sugar	1 small pot, 150g (5oz)
Cheese - preferably low fat	1 matchbox size, 40g (1½oz) (Brie, Camembert, Edam, reduced fat cheddar, Smoked Austrian are good). The mini portion size cheeses are handy.
Cream cheese - light	the size of 2 small matchboxes, 80g (3oz)
Cottage cheese	1 large pot, 200g (8oz)
Fromage frais - light	1 small pot 150g (5oz)

Meat, fish and alternatives (have 2 -3 portions per day)

Lean meat like beef,pork,ham,lamb,chicken (without skin)	3 slices (an amount the size of a pack of playing cards)
Fish - white or oily	as meat
Fish fingers	3
Eggs	2
Baked beans in tomato sauce (low sugar and salt if possible)	5 tablespoons
Lentils	4 tablespoons cooked
Beans eg.red kidney beans, butter beans, chick peas	4 tablespoons cooked
Nuts or peanut butter	2 tablespoons

Fatty and sugary foods (see amounts below)	
Fats (have 2 portions per day)	

Spreading fats and oils	
Butter or margarine spread	1 teaspoon
Low fat spread	2 teaspoons
Oil (any type)	1 teaspoon
Dressings and sauces	
Mayonnaise	1 teaspoon
Low calorie mayonnaise	2 teaspoons
Blue cheese dressing	1 teaspoon
Salad cream	1 tablespoon
Low calorie salad cream	2 tablespoons
Gravy or white sauce (roux)	1 tablespoon
Gravy or white sauce (made with cornflour)	4 tablespoons
Occasional foods (have 1 portion per day or 7 per week)	

Sugar	3 teaspoons
Jam or honey	1 heaped teaspoon
Crisps, preferably low fat	1 small packet
Cream	1 tablespoon
Ice cream	1 small scoop
Biscuits, plain	2
Slice of cake	$^1/_2$
Doughnut	$^1/_2$
Danish pastry	$^1/_2$
Chocolate	1 small bar or 2 mini bars
Sweets	1 small tube/bag
Pastry in savoury item eg.pork pie, sausage roll, quiche lorraine	$^1/_2$

Half a slice of cake or half a sausage roll may seem rather impractical.You may wish to save up your weekly ‘ration’of cakes and pastries to have at weekends or a time when you know you would like to enjoy a special treat.For example, one doughnut would be 2 portions,so 2 day’s ‘rations’.

Alcoholic drinks (max 1- 2 per day or 7 - 14 per week)	
Ordinary strength beer or lager	1 small, 300 ml (1/2 pint)
Wine	1 glass, 100ml (4 fl oz)
Spirits	1 tot (pub measure), 25 ml (1 fl oz)

An example of a day's eating plan

The day's eating plan below shows how someone having 1,500 calories a day might choose from The Balance of Good Health.Obviously no two days are ever the same, so this is just an example.

Meals	Food Group	Fruit and veg	Bread, other cereals and potatoes	Milk and dairy	Meat, fish and alternatives	Fats	Fatty & sugary foods/ and alcohol
For 1,500 Calories	(portions)	7	7	2	2	2	1/1
Breakfast							
Bran flakes	6 tablespoons		2				
Semi-skimmed milk	200 ml (1/3 pint)			1			
Small fruit juice		1					
Cups of tea, milk no sugar							
Mid morning							
Coffee, milk no sugar							
Apple		1					
Lunch							
Chicken salad sandwich:							
2 slices bread			2				
low fat spread	1 teaspoon					1	
Sliced chicken					1		
Mixed salad filling		1					
Mineral water							
Small slice Malt Loaf			1				
Mid afternoon							
Pot of tea, milk no sugar							
Large glass water							
Dinner							
Pasta twirls (boiled)	6 large tablespoons		2				
Small lean pork steak					1		
Sauce made with olive oil (onions,tomato & mushrooms)		1				1	
Carrots		1					
Broccoli		1					
Peaches in natural juice		1					
Cream	1 tablespoon						1

A word about fat

Keeping the fat in your diet low is the best possible aid to weight loss and The Balance of Good Health is designed to do this.By choosing low fat options in all the food groups,you will be keeping your fat intake well within the recommended limit for good health. But remember fat is sometimes hidden in foods so may not be obvious.Watch out! And always count the fat portions up to ensure you don’t go over your daily or weekly limit. Here are things to look out for in the different food groups:

Bread, cereal and potatoes

Choose a vegetable/tomato based sauce for your pasta rather than a rich cream/cheese sauce.Do you really need to add margarine to the mashed potato? Greasy chips? Try low fat oven chips for flavour without fat. Experiment with different breads which are so tasty they don’t need spread.Choose steamed or boiled rice rather than fried.

Fruit and vegetables Have your vegetables been stir-fried in oil or served with a daub of margarine? Count the fat! Has your salad been drowned in an oil rich dressing? Choose low calorie or fat free instead.Wouldn’t your fresh fruit taste even better without the cream?

Milk and dairy foods Semi-skimmed milk is great, skimmed even better.Choose low fat but remember, with yoghurts that doesn’t always mean low sugar or low calorie! Choose fromage frais and choose the very low fat type. Watch out for creme fraiche which sounds very low fat but isn’t! Have tiny servings of strong tasty cheeses in sandwiches and cooking to make a little go a long way.

Meat, fish and alternatives Is your chicken breast coated in fried crumbs or basted in butter? Have red meat but keep it lean and make a little go a long way using vegetables to bulk out the dish (eg.casseroles, stir fry).Has your fish been battered and deep fried? Ask for it uncoated! Or have grilled fish fingers.Is your sausage or burger fried or grilled? Grilled is much healthier.Choose a vegetarian meal from time to time but watch out for pastry and lots of extra cheese.Have eggs! Not fried, but poached or boiled. Keep it to 3-4 eggs a week if you have high blood cholesterol levels.Vegetarian alternatives to meat and fish such as nuts and beans or lentils are very tasty and much cheaper.

Try them.

Fatty and sugary foods

Fats

Use cornflour to thicken cooking sauces or gravies for meat or fish, so you won't need fat.Have mixed salads with low calorie salad dressings rather than mayonnaise and oily dressings.Oil is better than lard for cooking but is still calorie-rich so use as little as you can get away with, even olive or sunflower oil. What exactly are you spreading on your bread? (see page 20)

Occasional foods Make or buy fruit pies with a top crust only to save half the fat and get more fruit. Have bread-based pizza or bagels with low fat cream cheese instead of fat-laden savoury pastries like sausage rolls and quiche.Choose low fat biscuits and cakes as these will contain a bit less fat than the traditional product.But beware they can still be quite high in fat.Those in wrappers may help you keep to a small portion.Compare the labels of different savoury snacks such as potato crisps, tortilla chips and maize-curls.Choose the brand with the lowest fat in the pack.

A word about spreading fats

It’s hard to keep pace of the full range of new ‘fat spreads’on the market which are intended as alternatives to butter.Remember that strictly, butter and margarine contain the same amount of fat and calories.A good rule of thumb is to avoid butter altogether if you can and use whichever type of alternative you prefer but spread it very thinly.Choose one which contains the best type of fat;‘high in unsaturated fat’,which could be *poly*unsaturates or *mono*unsaturates, both are recommended. Also choose one which is labelled ‘reduced fat’or ‘low fat’- the lower the better.If you really can’t resist butter have it as a special treat once a week.Despite what you may have read in the papers, it really is bad news for the heart as well as the waistline.

Avoid spreading fats that have hydrogenated or partially hydrogenated fat listed in the ingredients. They contain trans fat which can raise LDL cholesterol. Hydrogenated fat is also often found in commercially baked biscuits, cakes, crackers and pastries, fried foods, shortening and snack foods.

A word about sugar

Sugar can count for a lot of wasted calories especially if you have one or two spoons full in every drink.Three teaspoons is one portion from the ‘Fatty and sugary foods’group so it quickly uses up your limit.Try to wean yourself off it or if you really need the sweet taste, try artificial sweeteners instead.

The majority of the salt we eat is hidden within pre-cooked or pre-prepared meals.

A word about salt

Alcohol

You should avoid eating too much salt as it is linked with high blood pressure. Table salt is made up of the minerals sodium and chloride. It is the sodium in salt that is linked to increased health risks.

The guidelines for daily salt intake are less than 6 grams a day for an adult, or about one level teaspoon. The majority of adults in the UK are eating over 9 grams a day and it's easy to see why. Salt is in many of the processed foods we eat such as bread, biscuits, crisps, tinned vegetables, baked beans, canned soups, takeaways, sauces and ready meals. Approximately 65-85% of the salt we eat comes from processed foods.

There are three ways that you can reduce the salt that you eat.

Non-alcoholic drinks

- Don't add it to your food when cooking, use herbs, spices and lemon juice to flavour food instead
- Don't add salt to your food at the table. Your taste buds will soon adapt to change and you may even find that you prefer the taste!
- Check the nutrition labels when buying food. You will often see sodium listed rather than salt so watch out for that. 6 grams of salt is equivalent to 2.5 grams of sodium.

Most people enjoy a drink or two and there's no reason why you shouldn't have an occasional drink when you're trying to lose weight. Remember though, that alcoholic drinks are low on nourishment and high on calories. So the more you drink the more extra calories you'll be taking in.Less is definitely better.Also, because alcohol is an appetite stimulant some people notice they tend to eat more when they drink alcohol.High calorie nibbles like nuts, crisps and cheese are especially damaging or worse still, a late night take-away meal!

So, if you drink, count up the extra portions on your weight loss plan and keep within your weekly limit.Avoid the strong ales and sugary mixers and choose 'diet','lite'or sugar free drinks where possible.The following amounts count as one portion (or one UNIT) of alcohol:

1 small bitter, lager or cider, 300 ml (1/2 pint)

1 small glass of white or red wine, 100ml (4 fl oz)

1 pub measure of spirits, 25 ml (1 fl oz)

1 small glass of sherry, 50 ml (2 fl oz)

Of course the message which applies to everyone, whether trying to lose weight or not is about alcohol and safety.Safety for your own health and others.Keep within the safe limits of NO MORE THAN 14 units of alcohol per week for women and 21 units per week for men.The maximum that men should drink each day is four units, the maximum per day for women is three units

If you're keeping off the alcohol, or just don't like drinking alcohol,choose alternative drinks carefully. Alcohol free does not mean calorie free! If in doubt, read the label.

The best choices:

- Tap water with ice and a slice of lemon
- Plain spring water or mineral water, sparkling or still
- Sugar free or 'diet'fizzy drinks (coca-cola,lemonade) and mixers (tonic, dry ginger, bitter lemon)
- Flavoured waters with a hint of fruit (maycontain a small amount of sugar)
- Your own diluted fruit juice (1 part juice to 8 water) • Tea or coffee, without sugar

Things to beware of:

- Low alcohol or 'lite'beers or lagers
- Sugary fizzy drinks like lemonade or coca-cola
- Fruit juice
- Cream liqueurs
- Cocktails
- Alcopops

Looking at labels

The BHF has a separate leaflet 'Guide to Food Labelling'which may be of interest. Checking food labels isn't necessary for your weight loss plan but it does help identify hidden fats and hidden salts in processed foods and may identify the types of fats in food.You won't have time while shopping to read everything.Here are some things you can check at a glance.

Choose foods making general claims such as:

- diet,reduced calorie, low calorie
- reduced fat, low fat, virtually fat free
- healthy eating

Although these don’t guarantee that the product is perfect for your needs,they suggest the product was made with the health-conscious person in mind.Remember that sugar free doesn’t mean low calorie or low fat. Such foods may be

high in both.But, beware of 0% cholesterol - as such foods may still have plenty of fat and calories!

Look at the nutritional information, especially energy (calories), fat and saturated fat, per 100g or per serving.Compare similar products and choose the brand with the lowest.The fat content is probably the most helpful piece of information and the amount you can eat in a day depends on the total daily calorie level you are aiming for.

	1,500 kcals	1,800 kcals
Total fat per day	57 grams	68 grams
Saturated fat per day	15 grams	18 grams

Walking is particularly good because it doesn't cost anything and you don't need a gym or any special kit other than sensible shoes for it!

Changing behaviour

Getting moving

Exercise and activity can make a real difference to your weight loss,as well as your state of mind.Being more active will help use up more calories as well as keeping your mind off food! It doesn't have to mean going to classes or taking up jogging. It's more about finding something which suits you - which is safe and enjoyable.Aim to increase your activity levels gradually up to half an hour a day of moderate activity on at least five days of the week.

You can build this into your everyday life with a bit of thought and determination. Walking is particularly good because it doesn't cost anything and you don't need a gym or any special kit other than sensible shoes for it! People have found that taking the stairs instead of the lift (up as well as down),walking to the shops, cycling to work, digging the garden or playing outdoors with the children can make quite a difference.

If more structured exercise appeals to you, such as swimming, the gym or exercise classes,find out if your local leisure centre runs sessions for people like you at a time which suits you. Remember that for weight loss and heart health you need to get slightly breathless (but still able to talk) and a little hot and sweaty for the exercise to be worthwhile.If you have any health problems, check with your doctor before starting an exercise programme.

As you know, changing your diet or getting more active both need a lot of careful thought and effort.That's not to say it's an uphill battle, but there are some ways you can help to make it a bit easier for yourself.Many of these things involve a little planning ahead or thinking about things differently.They all help you feel more in control of what you are trying to achieve.For a lot of people these ‘behaviour modifications’are the key to successful and permanent weight loss.

The list below shows some simple actions which people have found helpful.Tick those which you do:

Do nothing else while eating

(Don’t waste the calories - taste and enjoy them)

- Eat at regular times
- Eat sitting down
- Pause during meals and put your knife and fork down between mouthfuls
- Aim to be the last to finish
- Shop on a full stomach
- Write a shopping list and stick to it
- Keep healthy snacks easily to hand (eg fresh fruit in a bowl, chopped salad/vegetables in the fridge)
- Clean your teeth after a meal or when you get the urge to overeat
- Serve your meal straight on to a plate and remove serving dishes from the table so you're less tempted to eat too much.
- Wait at least five minutes after finishing your meal before deciding whether to have second helpings
- Practice refusing offers to overeat.Learn to say ‘no thank you’,politely but firmly and convincingly.

As well as things you can do differently, there are also ways you can teach yourself to *think* differently. To understand more about your eating habits,you may find it helpful to keep a food diary, recording what you eat each day.You could also note when you ate, where and how you were feeling at the time.You will probably find you glean a lot of useful information from your food diary.Use that information to plan your coping strategies. Along with your food diary,using the suggestions below can help you get your ‘mind over matter’and feel more in control of your weight loss plans.

Understanding patterns

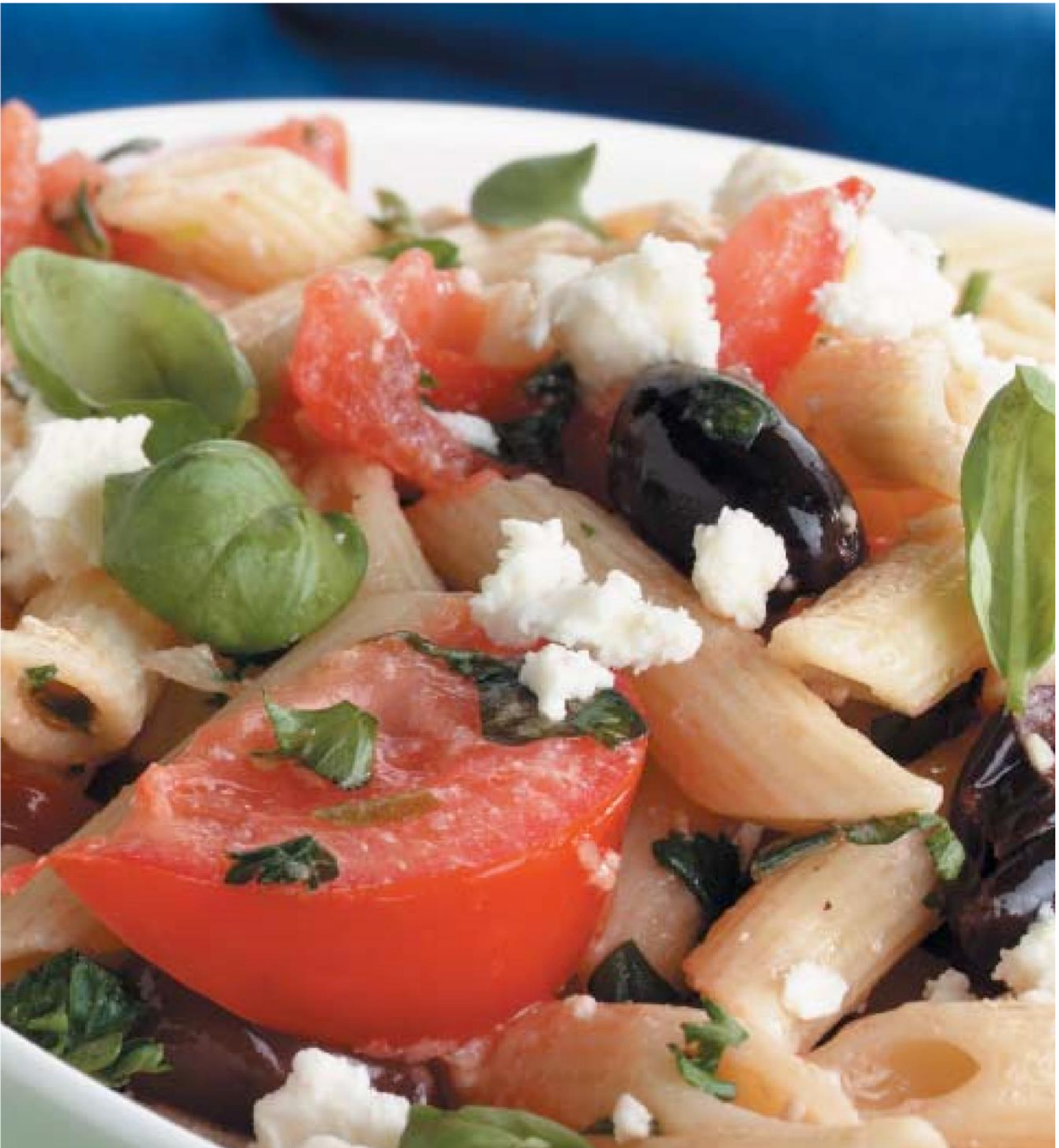
Plan for the times of day when you know you are more likely to want to eat.For example,save some bread or cereal to have at 10pm if you know evenings are a danger time for you.

Real hunger?

Before you eat, check that you’re really hungry (in your stomach) rather than just eating at a certain time or occasion out of habit.

Feelings

Be aware of how your feelings affect what you want to eat.For example do you eat more when you’re feeling angry, upset, lonely or bored? Noticing a pattern can help you plan how to cope.



A lapse is not a collapse. If you break your plan for a few hours or days, it's not the end of the world!

Triggers

Be aware of triggers which are likely to lead you to overeat. For example, being at home alone, watching a cookery programme on TV, driving past a fast food restaurant, preparing a snack for your children or grandchildren. Planning ahead may help you cope.

Events

Plan ahead for special occasions when you know you'll be tempted.For example, eat a little less during the week when you're going to a party at the weekend,so you can indulge in a special dessert.

Distractions

Use distractions to help control your eating.For example, go for a walk, phone a friend, buy a magazine, flip through your photo albums.

Don’t be hard on yourself

A lapse is not a collapse.If you break your plan for a few hours or days, it’s not the end of the world! Try not to see your goals as ‘all or nothing’. Try to learn from what went wrong and get back on track as soon as you feel ready.

Gradual weight loss really is the safest and most effective way.

Your questions answered

Food combining seems popular.Does it work?

At the end of the day, people who successfully lose weight on this diet seem to have done so simply because their calorie intake is restricted. Food combining involves eating foods containing protein, fat and carbohydrate in very strict combinations and sequences. Some people say it has worked for them and it certainly involves eating plenty of fruit and vegetables.But it does have drawbacks as it means careful planning. For example,a sandwich (carbohydrate) cannot include a protein filling like chicken, tuna or egg - only salad or fruit such as mashed banana.At other times meals must exclude carbohydrate, which means a roast dinner without potatoes or an Italian meal without the pasta or bread.This sort of food combining bans high calorie foods containing a combination of fat and carbohydrate which rules out all 'fatty and sugary foods'like chocolate, cakes, crisps, puddings and pastries.It is quite restrictive so difficult to keep up especially when eating out or at someone else's house.

What about 'high protein, low carbohydrate'diets like the Atkins diet?

It is not recommended.The Atkins diet is the best-selling diet book in popular bookshops and has been widely promoted by celebrities for whom it seems to have worked - at least in the short term.It is based on high intakes of protein foods like meat,cheese and eggs and high fat foods like cream and butter.It severely restricts carbohydrate foods - not only chocolate, cakes and puddings but also bread, potatoes, pasta, rice and cereals.It even restricts many fruits and some vegetables because of their carbohydrate content.

Although people seem to lose weight very quickly in the short term on this type of diet, it does not fit with the requirements for a balanced diet as set out in The Balance of Good Health.It has not been tested for long-term safety and there is no guarantee that it does not cause damage to health, especially if people follow it long term.A quick fix is not a permanent solution to weight control.

Features of the Atkins diet	What it means	Why it can be a problem
High in protein	The kidneys have to work extra hard to break down protein in the body.	This protein burden may damage the kidneys especially in people who, unknowingly, have kidneys not working as well as they could. There may also be a risk of kidney stones.
Low in carbohydrate, high in fat	Restricting the very foods we should eat 'plenty of'. Butter and cream can be eaten freely possibly affecting blood cholesterol levels, especially in the weight maintenance phase.	Restricting foods such as fruit and vegetables and wholegrain cereals - which we know have been associated with preventing coronary heart disease and diabetes is cause for concern. Low intakes of cereal and fibre can also cause constipation and other bowel problems.

Would it help to become a vegetarian?

A diet based heavily on vegetables, fruit and cereals/grains is a very healthy way to eat.But a vegetarian diet is *not* automatically a weight loss plan.It can be quite high in calories because butter, oil, cheese and pastries tend to be popular with vegetarians.Fried vegetable dishes such as vegetable samosa,spring rolls and cheese and onion pasties are all high in calories.

If you don't eat meat, make sure you choose some healthy alternatives from the 'Meat, fish and alternatives'food group, such as eggs, nuts, beans, peas and lentils.These foods are essential for the iron they provide which in turn helps carry oxygen around the body. Interestingly, research suggests that fish eaters (who just avoid meat and poultry) and vegans (who avoid milk and dairy foods as well as meat and fish) have less coronary heart disease than meat eaters or vegetarians.Vegans, however,have to be especially careful not to become 'deficient'in important minerals and vitamins such as calcium, iron and vitamin B12.

Quick weight loss - isn't it more rewarding?

Many people want to lose weight quickly in just a few weeks ready for a special event or a holiday.Unfortunately our body rebels against this kind of crash dieting in a number of ways. Firstly,eating so little means feeling hungry, listless and sometimes faint so it is difficult to sustain for long.It also means the body is unlikely to be adequately nourished as such a small food intake can't provide enough vitamins and minerals for good health. Secondly, losing weight quickly involves losing essential water and muscle as well as fat.So, although the scales may read less, your body has not lost much fat! Thirdly, your metabolic rate slows down and it becomes even harder to lose weight.Gradual weight loss really is the safest and most effective way.

A vegetarian diet is not automatically a weight loss plan. It can be quite high in calories.

Meal ideas

Of course,your weight loss plan will mean making changes, but that doesn't mean you have to stop eating your favourite meals.Neither does it mean you have to spend hours in the kitchen preparing special foods. In fact many meals are easy to prepare.What could be quicker than baking fish dishes, boiling some pasta or stir-frying a mixture of chopped vegetables with thin strips of meat for flavour?

Cost and convenience may also matter to you. Choose wisely and you'll find that foods like fish fingers (grilled), low-fat ready-made cooking sauces, and 'ready meals'can all be included in your weight loss plan.If you have a microwave oven use it to speed up cooking time as well as cutting out the fat. Cut your shopping bill by buying smaller amounts of lean meat and chicken and bulk it out with fillers like baked beans, chick peas or red kidney beans.

Support

Many people like the idea of support with their weight loss plan, from someone they know well, like a friend, relative or colleague or by going to a group. If you know someone else who is wanting to lose weight you could ask them to be your 'buddy'.You can then help keep track on each others progress and offer support when things aren't going so well.At the British Heart Foundation we believe this could really make a difference to your chances of success.

Here are a few ideas:

Baked beans on toast

Baked potato with a chicken portion, barbecue sauce, peas and sweetcorn Smoked mackerel risotto with a large green salad Fish fingers with mashed potato and mixed frozen vegetables

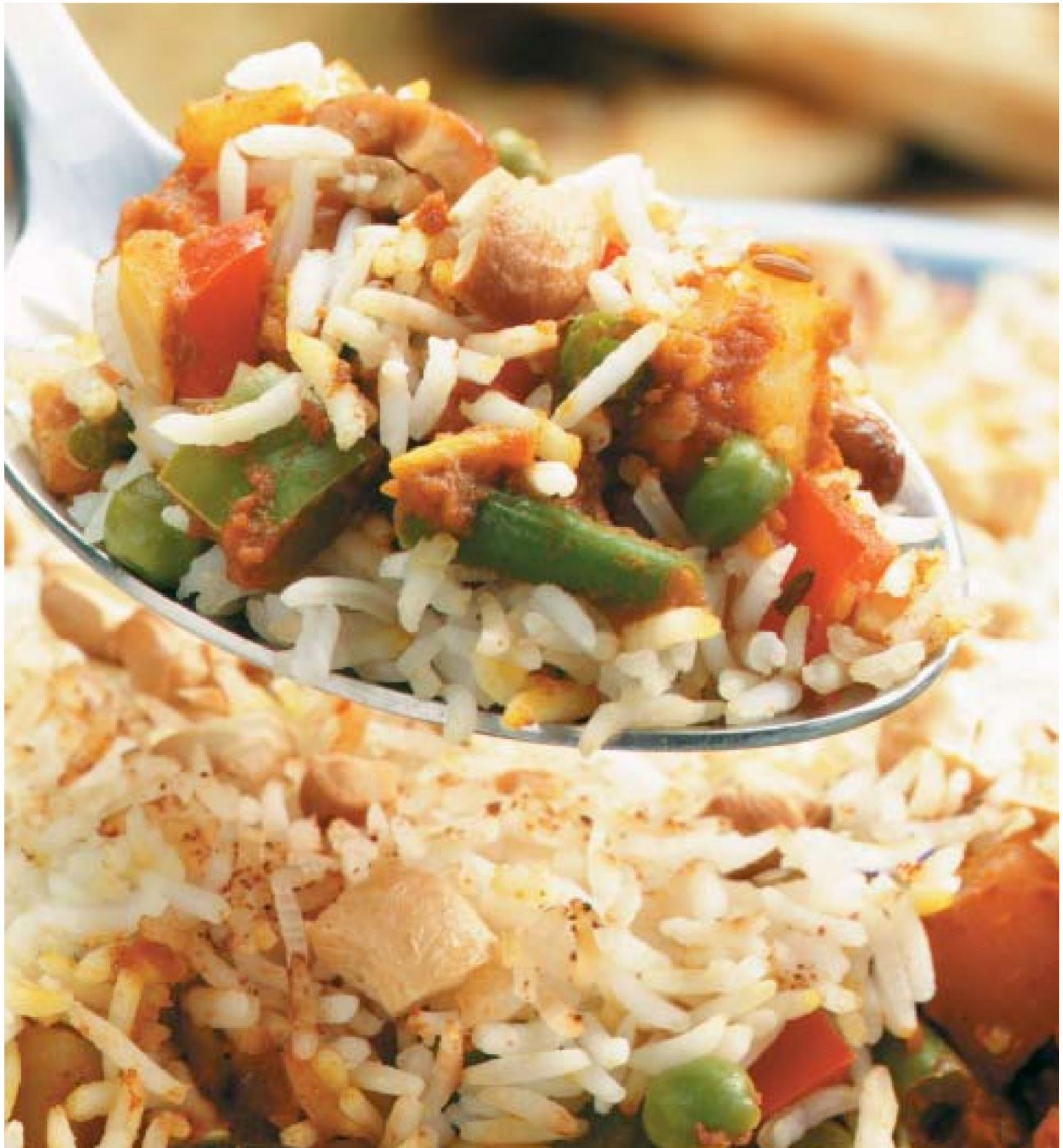
Sliced ham with lettuce,beetroot,tomato,grated carrot and warm crusty bread Potato and bean curry on a bed of rice, with sliced banana and grated cucumber Strips of cooked chicken with red kidney beans and sweetcorn on a large bed of mixed salad.

Serve with granary bread roll. Beef and vegetable casserole with boiled potatoes, mashed swede and carrot Pasta quills with tomato and mushroom sauce.

When watching your weight, you also have to plan the amounts of food you eat.It’s not just the quality - the quantity matters too.

Tracking progress

You may find it useful to fill in a record chart to keep track of your weight loss.Weigh yourself on the same scales and at the same time of day, without clothes if possible.Don’t be tempted to weigh yourself more than once a week.The chart on page 33 is to help you do this and to monitor your progress in other ways.Set your own goals and try to be realistic! For example, there may be a favourite item of clothing you could aim to fit into or an activity you would like to be able to do such as a 10 minute walk.Or your goals may be about your feelings of self-confidence.Very specific goals such as ‘eating 3 pieces of fruit each day’or ‘stop eating chocolate’are helpful, as they are easy to measure and you will definitely know whether you have achieved them or not.We think rewards are also a good idea, to keep you going when it gets tough,and to give yourself a pat on the back when you get there. Rewards should be non-food based and you can earn them for reaching ‘behaviour’goals not just weight goals. Buying a new book or going to see a film are ideas.The best rewards are those which really would be a treat for you.Decide in advance what your GOALS and REWARDS will be and fill in these columns at the start.Record your ACHIEVEMENTS after each week or month, whichever you prefer.



The chart is only for 12 weeks (3 months) but you can draw out another one for your new goals over the next 12 weeks on a separate sheet of paper if you wish.

Progress Chart

		Goals			Achievements	
Week	Date	Weight	Behaviours/ activities	Rewards	Weight	Behaviours/ activities
1						
2						
3						
4						

5 6 7 8						
9 10 11 12						

Finally...........Keeping at it

Some people say losing weight is not too difficult.It’s keeping it off that’s the hard bit.If you have a tendency to gain weight, it’s true that you’ll always have to keep an eye on your weight. Remember, we said at the start, this is a weight loss plan for life.

To keep your weight healthy,or to prevent weight gain, keep following the rules of ‘The Balance of Good Health’as we’ve described throughout this booklet.You may find that it becomes easier over time and that filling up on foods from the main four food groups leaves you with less space for the calorific ‘Fatty and sugary foods’.Think of yourself as someone who isn’t a big eater and practice saying ‘no’when people offer you bigger portions or second helpings.Remind yourself how good it feels to have reached some of your goals.If your weight goes up a bit, don’t despair. We’re all human.You may well be able to learn something from your lapse.By reassessing things, making a few small changes,and getting support, you will start to lose a few pounds again.

More help?

If you would like help from someone who can talk through your weight loss plan personally, ask your doctor to refer you to a dietitian or the practice nurse.

You may also like to think about getting support from others.Look in the yellow pages for local leisure centres and health clubs or ask at your local

library who may know of ‘weight watching’ or ‘slimming’groups or classes in the area.

Further Information

The British Heart Foundation (BHF) also produces other educational materials that may be of interest. To find out about these or to order your Publications and videos catalogue please go to bhf.org.uk/publications or call the BHF Orderline on 0870 600 6566 or email orderline@bhf.org.uk. Many of our publications are downloadable from bhf.org.uk/publications.

Give something back

We do not charge for our educational materials, but a donation will help us to help others.

Have your say

We would welcome your comments to help us produce the best information for you.Why not let us know what you think? Contact us through our website at bhf.org.uk/yoursay.

Original text by: Paula Hunt, BSc(Hons) Nut, SRD. Nutrition Consultant and State Registered Dietitian, Ilkley, West Yorkshire.

Edited by the British Heart Foundation.

Acknowledgments:Thanks to Kay Scott of Kay Scott Associates for the market research and testing of this booklet and to the people who kindly took part in this research. Thanks also to the 'Food Standards Agency'for the use of 'The Balance of Good Health', and to 'Weight Concern'and the 'British Dietetic Association'for their helpful comments on this booklet.

Photography, Chris King (CK)

Food Styling, Kit Chan (KC)

Heart Information Line 08450 70 80 70 (A local rate number)
An information service for the public and health professionals on issues relating to heart health.

M2 08/2005

British Heart Foundation
14 Fitzhardinge Street
London W1H 6DH
Phone:020 7935 0185
Fax:020 7486 5820
Website:bhf.org.uk

Appendix 10 Questionnaire (study 2)

The BHF how healthy is your diet, Nutritional knowledge Questionnaire (NKQ) and the international physical activity questionnaire (IPAQ)

How healthy is your diet? Questionnaire

MISSION VERY POSSIBLE!

Sugar		Yes	No
17	Do you regularly eat sugar-coated breakfast cereals or add sugar to your breakfast cereals?		

How healthy is your diet? Questionnaire

MISSION VERY POSSIBLE!

Salt		Yes	No
21	Do you regularly add salt to food during cooking?		
22	Do you regularly add salt to meals at the table?		
23	Do you regularly eat savoury snacks at work? For example, crisps or salted nuts.		
24	Do you regularly eat pre-prepared meals? For example, pre-prepared sandwiches, ready meals or canned soups.		
25	Do you regularly eat processed meats such as ham or bacon, or smoked fish?		
26	Has your GP advised you that you have high blood pressure?		

If you have answered*yes* to most of these questions, you may want to consider making some changes to your diet:

Reducing the amount of salt in your diet can help keep your blood pressure down, especially if this is part of a healthy diet that includes plenty of fruit and vegetables. Reducing your blood pressure reduces your risk of having a heart attack or stroke.

How healthy is your diet? Questionnaire

MISSION VERY POSSIBLE!

Drinks and alcohol		Yes	No
21	Do you drink plenty of fluids at regular intervals during the working day?		
22	Do you opt for a variety of different drinks, including water, at work?		
23	Do you avoid sugary fizzy drinks?		
24	Do you drink less than 2-3 units of alcohol a day if you're a woman, or less than 3-4 units of alcohol a day if you're a man? **1 unit of alcohol is equivalent to 100ml of 10% ABV (alcohol by volume)** For example 1 unit is: *1/2 pint (300ml) of bitter, lager or cider (3% to 5% ABV), or* *1 small glass of white or red white, 100ml (4fl oz), 10% ABV, or* *1 pub measure of spirits, 25ml (1fl oz), or* *1 small glass of sherry, 50ml (2fl oz)*		

If you answered *no* to most of these questions, you may want to consider making some changes to your diet:

Too much alcohol can lead to damage to the heart muscle, high blood pressure.,stroke and some cancers. Alcohol is high in calories too, and so it can lead to weight gain. However, moderate

NUTRITION SURVEY

This is a survey, <u>not</u> a test. Your answers will help identify which dietary advice people find confusing.

It is important that you complete it by yourself.

Your answers will remain anonymous.

If you do not know the answer, mark "not sure" rather than guess.

Thank you for your time.

The first few items are about what advice you think experts are giving us.

1. **Do you think health experts recommend that people should be eating more, the same amount, or less of these foods?** *(tick one box per food)*

	More	Same	Less	Not Sure
Vegetables	☐	☐	☐	☐
Sugary foods	☐	☐	☐	☐
Meat	☐	☐	☐	☐
Starchy foods	☐	☐	☐	☐
Fatty foods	☐	☐	☐	☐
High fibre foods	☐	☐	☐	☐
Fruit	☐	☐	☐	☐
Salty foods	☐	☐	☐	☐

---

2. **How many servings of fruit and vegetables a day do you think experts are advising people to eat?** (One serving could be, for example, an apple or a handful of chopped carrots)

✍ ________

Experts classify foods into groups. We are interested to see whether people are aware of what foods are in these groups.

1. **Do you think these are high or low in added sugar?** *(tick one box per food)*

	High	Low	Not Sure
Bananas			
Unflavoured yoghurt			
Ice-cream			
Orange squash			
Tomato ketchup			
Tinned fruit in natural juice			

---

2. **Do you think these are high or low in fat?** *(tick one box per food)*

	High	Low	Not Sure
Pasta (without sauce)			
Low fat spread			
Baked beans			

3. **Do you think experts put these in the starchy foods group?** *(tick one box per food)*

	Yes	No	Not Sure
Cheese			
Pasta			
Butter			
Nuts			
Rice			
Porridge			

4. **Do you think these are high or low in salt?** *(tick one box per food)*

	High	Low	Not Sure
Sausages			
Pasta			
Kippers			
Red meat			
Frozen vegetables			
Cheese			

5. **Do you think these are high or low in protein?**

6. **Do you think these are high or low in fibre/roughage?** *(tick one box per food)*

	High	Low	Not Sure
Cornflakes			
Bananas			
Eggs			
Red Meat			
Broccoli			
Nuts			
Fish			
Baked potatoes with skins			
Chicken			
Baked beans			

7. **Do you think these fatty foods are high or low in saturated fat?** *(tick one box per food)*

	High	Low	Not Sure
Mackerel			
Whole milk			
Olive oil			

9. **Do you think experts call these <u>a healthy alternative to red meat</u>?** *(tick one box per food)*

	Yes	No	Not Sure
Liver pate			
Luncheon meat			
Baked beans			
Nuts			
Low fat cheese			
Quiche			

10. **A glass of unsweetened fruit juice counts as a helping of fruit.**
    (a) agree ❑
    (b) disagree ❑
    (c) not sure ❑

11. **Saturated fats are mainly found in:** *(tick one)*
    (a) vegetable oils ❑
    (b) dairy products ❑
    (c) both (a) and (b) ❑
    (d) not sure ❑

12. **Brown sugar is a healthy alternative to white sugar.**
    (a) agree ❑
    (b) disagree ❑
    (c) not sure ❑

15. **Which of these breads contain the most vitamins and minerals?** *(tick one)*
    (a) white ❑
    (b) brown ❑
    (c) wholegrain ❑
    (d) not sure ❑

16. **Which do you think is higher in calories: butter or regular margarine?** *(tick one)*
    (a) butter ❑
    (b) regular margarine ❑
    (c) both the same ❑
    (d) not sure ❑

17. **A type of oil which contains mostly monounsaturated fat is:** *(tick one)*
    (a) coconut oil ❑
    (b) sunflower oil ❑
    (c) olive oil ❑
    (d) palm oil ❑
    (e) not sure ❑

18. **There is more calcium in a glass of whole milk than a glass of skimmed milk.**
    (a) agree ❑
    (b) disagree ❑
    (c) not sure ❑

19. **Which *one* of the following has the most calories for the same weight?** *(tick one)*
    (a) sugar ❑
    (b) starchy foods ❑
    (c) fibre/roughage ❑
    (d) fat ❑
    (e) not sure ❑

The next few items are about choosing foods.

Please answer what is being asked and not whether you like or dislike the food!

For example, suppose you were asked ...

"If a person wanted to cut down on fat, which cheese would be best to eat?"

(a) cheddar cheese
(b) camembert
(c) cream cheese
(d) cottage cheese

If you didn't *like* cottage cheese, but knew it was the right answer, you would still tick cottage cheese.

1. **Which would be the best choice for a low fat, high fibre snack?** *(tick one)*
   - (a) diet strawberry yoghurt ❑
   - (b) raisins ❑
   - (c) muesli bar ❑
   - (d) wholemeal crackers and cheddar cheese ❑

---

2. **Which would be the best choice for a low fat, high fibre light meal?** *(tick one)*
   - (a) grilled chicken ❑
   - (b) cheese on wholemeal toast ❑
   - (c) beans on wholemeal toast ❑
   - (d) quiche ❑

---

3. **Which kind of sandwich do you think is healthier?** *(tick one)*

5. **If a person wanted to reduce the amount of fat in their diet, which would be the best choice?** *(tick one)*
   - (a) steak, grilled ❑
   - (b) sausages, grilled ❑
   - (c) turkey, grilled ❑
   - (d) pork chop, grilled ❑

---

6. **If a person wanted to reduce the amount of fat in their diet, but didn't want to give up chips, which one would be the best choice?** *(tick one)*
   - (a) thick cut chips ❑
   - (b) thin cut chips ❑
   - (c) crinkle cut chips ❑

---

7. **If a person felt like something sweet, but was trying to cut down on sugar, which would be the best choice?** *(tick one)*
   - (a) honey on toast ❑
   - (b) a cereal snack bar ❑
   - (c) plain Digestive biscuit ❑
   - (d) banana with plain yoghurt ❑

---

8. **Which of these would be the healthiest pudding?** *(tick one)*
   - (a) baked apple ❑
   - (b) strawberry yoghurt ❑
   - (c) wholemeal crackers and cheddar cheese ❑
   - (d) carrot cake with cream cheese topping ❑

---

9. **Which cheese would be the best choice as a lower fat option?** *(tick one)*
   - (a) plain cream cheese ❑

This section is about health problems or diseases.

1. **Are you aware of any major health problems or diseases that are related to a <u>low intake of fruit and vegetables</u>?**

   (a) yes ❑
   (b) no ❑
   (c) not sure ❑

   If yes, what diseases or health problems do you think are related to a low intake of fruit and vegetables?

   ✍ ______________________

   ____

   ____

2. **Are you aware of any major health problems or diseases that are related to a <u>low intake of fibre</u>?**

   (a) yes ❑
   (b) no ❑
   (c) not sure ❑

   If yes, what diseases or health problems do you think are related to a low intake of fibre?

   ✍ ______________________

   ____

   ____

4. **Are you aware of any major health problems or diseases that are related to <u>how much salt</u> or sodium people eat?**

   (a) yes ❑
   (b) no ❑
   (c) not sure ❑

   If yes, what diseases or health problems do you think are related to salt?

   ✍ ______________________

   ____

   ____

5. **Are you aware of any major health problems or diseases that are related to the <u>amount of fat</u> people eat?**

   (a) yes ❑
   (b) no ❑
   (c) not sure ❑

   If yes, what diseases or health problems do you think are related to fat?

   ✍ ______________________

   ____

   ____

6. **Do you think these help to reduce the chances of getting certain kinds of cancer?** *<u>(answer each one)</u>*

	Yes	No	Not Sure

7. **Do you think these help prevent heart disease?** *(answer each one)*

	Yes	No	Not Sure
eating more fibre	❑	❑	❑
eating less saturated fat	❑	❑	❑
eating less salt	❑	❑	❑
eating more fruit and vegetables	❑	❑	❑
eating less preservatives/additives	❑	❑	❑

8. **Which one of these is more likely to raise people's blood cholesterol level?** *(tick one)*
   - (a) antioxidants ❑
   - (b) polyunsaturated fats ❑
   - (c) saturated fats ❑
   - (d) cholesterol in the diet ❑
   - (e) not sure ❑

9. **Have you heard of antioxidant vitamins?**
   - (a) yes ❑
   - (b) no ❑

10. **If YES to question 9, do you think these are antioxidant vitamins?** *(answer each one)*

	Yes	No	Not Sure

Finally, we would like to ask you a few questions about yourself.

1. **Are you male or female?**
   - (a) Male ❑
   - (b) Female ❑

2. **How old are you?**
   - (a) less than 18 ❑
   - (b) 18 - 24 ❑
   - (c) 25 - 34 ❑
   - (d) 35 - 44 ❑
   - (e) 45 - 54 ❑
   - (f) 55 - 64 ❑
   - (g) 65 - 74 ❑
   - (h) more than 75 ❑

3. **Are you:**
   - (a) single ❑
   - (b) married ❑
   - (c) living as married ❑
   - (d) separated ❑
   - (e) divorced ❑
   - (f) widowed ❑

4. **What is your ethnic origin?**
   - (a) White ❑
   - (b) Black Caribbean ❑
   - (c) Black African ❑
   - (d) Black other ❑
   - (e) Indian ❑
   - (f) Pakistani ❑
   - (g) Bangladeshi ❑

5. **Do you have any children?**
   - (a) No ☐
   - (b) 1 ☐
   - (c) 2 ☐
   - (d) 3 ☐
   - (e) 4 ☐
   - (f) more than 4 ☐

6. **Do you have any children, under 18 years, living with you?**
   - (a) Yes ☐
   - (b) No ☐

7. **What is the highest level of education you have completed?**
   - (a) primary school ☐
   - (b) secondary school ☐
   - (c) O levels / GCSEs ☐
   - (d) A levels ☐
   - (e) Technical or Trade Certificate ☐
   - (f) Diploma ☐
   - (g) Degree ☐
   - (h) Post-graduate degree ☐

8. **Do you have any health or nutrition related qualifications?**
   - (a) Yes ☐
     Please specify:
     ✍_______________
   - (b) No ☐

9. **What is your job?** *If you are not working now, what is your usual job? (please be specific).*

11. **Are you currently:**
    - (a) employed full time ☐
    - (b) employed part time ☐
    - (c) unemployed ☐
    - (d) full time homemaker ☐
    - (e) retired ☐
    - (f) student ☐
    - (g) disabled or too ill to work ☐

12. **Are you on a special diet?**
    - (a) Yes ☐
      Please specify:
      ✍_______________
    - (b) No ☐

THE END

Thank you very much for your time.

If there are any comments you would like to make about this questionnaire, please do so below, they would be very welcome.

✍________________________

____

____

____

____

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

(October 2002)

LONG LAST 7 DAYS SELF-ADMINISTERED FORMAT

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health–related physical activity.

Background on IPAQ

The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (14 sites) during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages, and are suitable for national population-based prevalence studies of participation in physical activity.

Using IPAQ

Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instruments.

Translation from English and Cultural Adaptation

Translation from English is encouraged to facilitate worldwide use of IPAQ. Information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se. If a new translation is undertaken we highly recommend using the prescribed back translation methods available on the IPAQ website. If possible please consider making your translated version of IPAQ available to others by contributing it to the IPAQ website. Further details on translation and cultural adaptation can be downloaded from the website.

Further Developments of IPAQ

International collaboration on IPAQ is on-going and an *International Physical Activity Prevalence Study* is in progress. For further information see the IPAQ website.

More Information

More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000). *Assessment of Physical Activity: An International Perspective.* Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous and moderate activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

los

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

Yes ☐

☐

No → *Skip to PART 2: TRANSPORTATION*

The next questions are about all the physical activity you did in the last 7 days as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, heavy construction, or climbing up stairs as part of your work? Think about only those physical activities that you did for at least 10 minutes at a time.

_____ days per week

☐ No vigorous job-related physical activity → *Skip to question 4*

los

3. How much time did you usually spend on one of those days doing vigorous physical activities as part of your work?

_____ hours per day _____ minutes per day

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads as part of your work? Please do not include walking.

_____ days per week

☐ No moderate job-related physical activity → *Skip to question 6*

5. How much time did you usually spend on one of those days doing moderate physical activities as part of your work?

_____ hours per day _____ minutes per day

6. During the last 7 days, on how many days did you walk for at least 10 minutes at a time as part of your work? Please do not count any walking you did to travel to or from work.

_____ days per week

los

☐ No job-related walking → Skip to PART 2: TRANSPORTATION

7. How much time did you usually spend on one of those days walking as part of your work?

_____ hours per day _____ minutes per day

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. During the last 7 days, on how many days did you travel in a motor vehicle like a train, bus, car, or tram?

_____ days per week

☐ No traveling in a motor vehicle → *Skip to question 10*

9. How much time did you usually spend on one of those days traveling in a train, bus, car, tram, or other kind of motor vehicle?

los

_____ hours per day _____ minutes per day

Now think only about the bicycling and walking you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the last 7 days, on how many days did you bicycle for at least 10 minutes at a time to go from place to place?

_____ days per week

☐ No bicycling from place to place → *Skip to question 12*

11. How much time did you usually spend on one of those days to bicycle from place to place?

_____ hours per day _____ minutes per day

12. During the last 7 days, on how many days did you walk for at least 10 minutes at a time to go from place to place?

_____ days per week

☐ No walking from place to place → *Skip to PART 3: HOUSEWORK,*

HOUSE MAINTENANCE, AND CARING FOR FAMILY

13. How much time did you usually spend on one of those days walking from place to place?

_____ hours per day _____ minutes per day

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the last 7 days in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, chopping wood, shoveling snow, or digging in the garden or yard?

_____ days per week

☐ No vigorous activity in garden or yard → *Skip to question 16*

15. How much time did you usually spend on one of those days doing vigorous physical activities in the garden or yard?

los

_____ hours per day _____ minutes per day

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate activities like carrying light loads, sweeping, washing windows, and raking in the garden or yard?

_____ days per week

☐ No moderate activity in garden or yard → *Skip to question 18*

17. How much time did you usually spend on one of those days doing moderate physical activities in the garden or yard?

_____ hours per day _____ minutes per day

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate activities like carrying light loads, washing windows, scrubbing floors and sweeping inside your home?

_____ days per week

☐ No moderate activity inside home → *Skip to PART 4: RECREATION,*

SPORT AND LEISURE-TIME PHYSICAL ACTIVITY

los

19. How much time did you usually spend on one of those days doing moderate physical activities inside your home?

_____ hours per day _____ minutes per day

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the last 7 days solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the last 7 days, on how many days did you walk for at least 10 minutes at a time in your leisure time?

_____ days per week

☐ No walking in leisure time → *Skip to question 22*

21. How much time did you usually spend on one of those days walking in your leisure time?

los

_____ hours per day _____ minutes per day

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activities like aerobics, running, fast bicycling, or fast swimming in your leisure time?

_____ days per week

☐ No vigorous activity in leisure time → *Skip to question 24*

23. How much time did you usually spend on one of those days doing vigorous physical activities in your leisure time?

_____ hours per day _____ minutes per day

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis in your leisure time?

_____ days per week

☐ No moderate activity in leisure time → *Skip to PART 5: TIME SPENT SITTING*

los

25. How much time did you usually spend on one of those days doing moderate physical activities in your leisure time?

______ hours per day ______ minutes per day

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the last 7 days, how much time did you usually spend sitting on a weekday?

______ hours per day ______ minutes per day

27. During the last 7 days, how much time did you usually spend sitting on a weekend day?

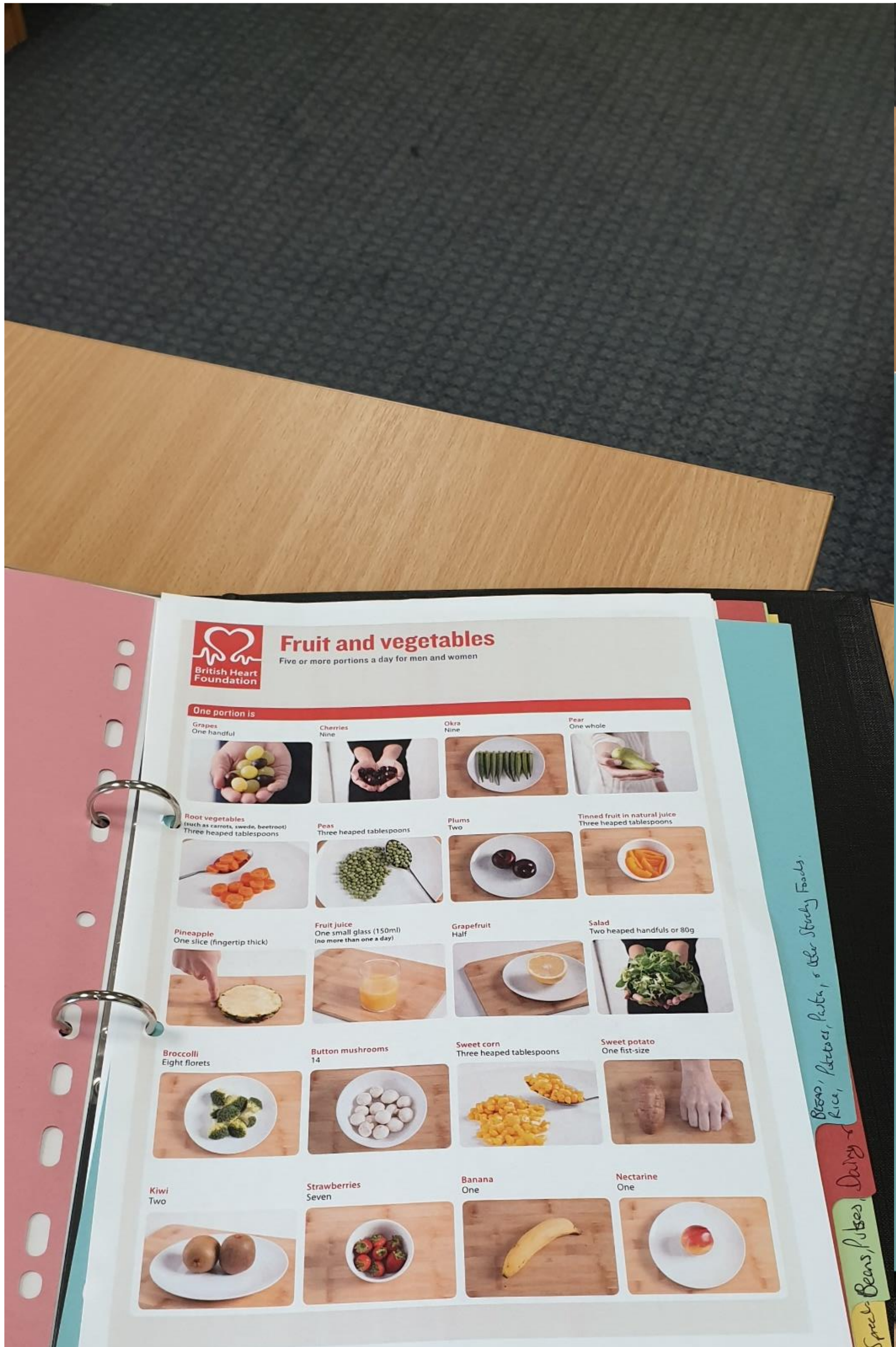
______ hours per day ______ minutes per day

This is the end of the questionnaire, thank you for participating.

los

Appendix 11 New Education materials

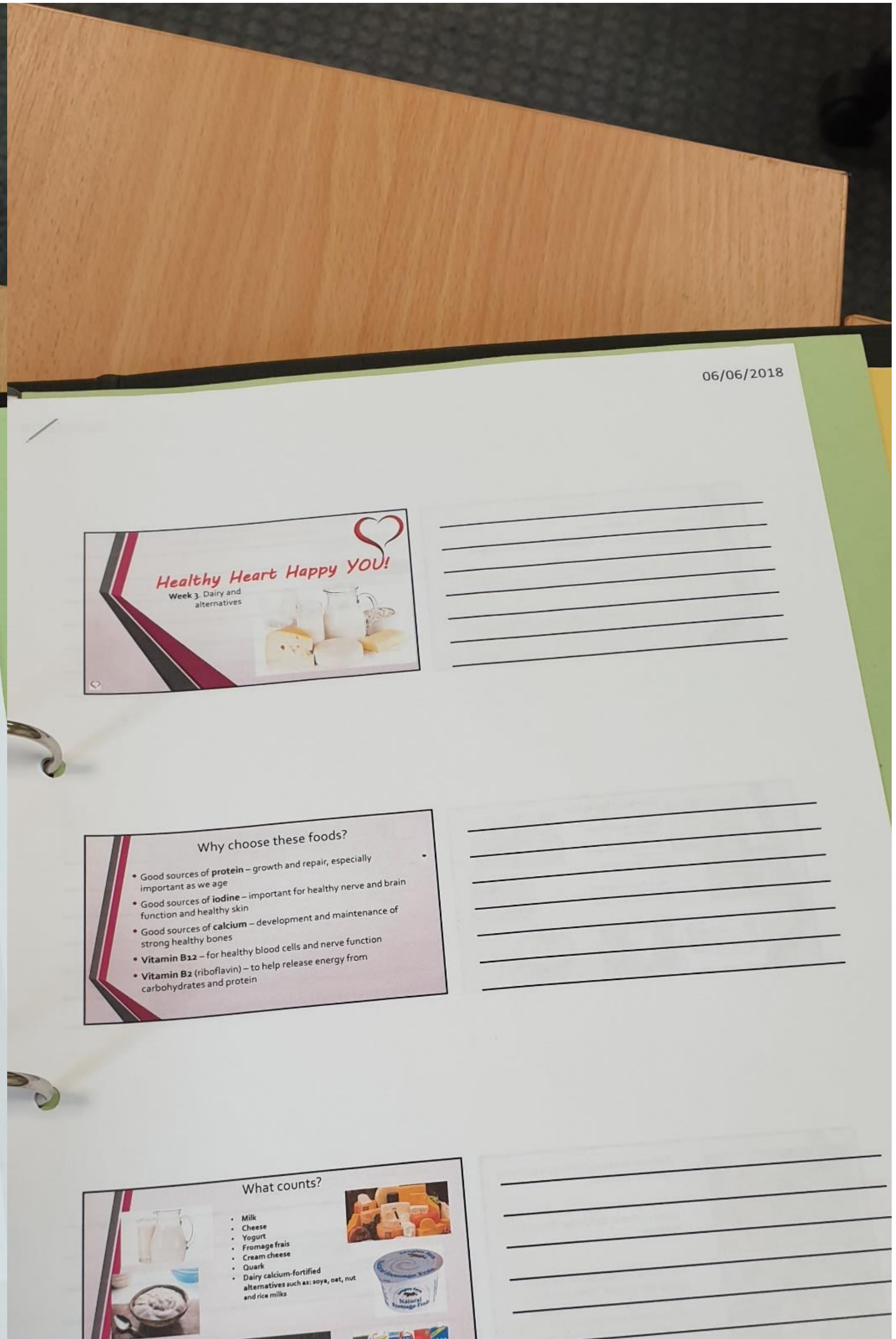
The folder containing some of the materials used from BHF, Eatwell guide and a sample of the lecture slides on a handout provided to the patients in the NE group.


British Heart Foundation
Fruit and vegetables
Five or more portions a day for men and women
One portion is
Grapes
One handful
Cherries
Nine
Okra
Nine
Pear
One whole
Root vegetables
(such as carrots, swede, beetroot)
Three heaped tablespoons
Peas
Three heaped tablespoons
Plums
Two
Tinned fruit in natural juice
Three heaped tablespoons
Pineapple
One slice (fingertip thick)
Fruit juice
One small glass (150ml)
(no more than one a day)
Grapefruit
Half
Salad
Two heaped handfuls or 80g
Broccoli
Eight florets
Button mushrooms
14
Sweet corn
Three heaped tablespoons
Sweet potato
One fist-size
Kiwi
Two
Strawberries
Seven
Banana
One
Nectarine
One
Bread, Potatoes, Pasta, & other Starchy Foods
Rice,
Dairy &
Beans, Pulses,


British Heart Foundation
Potatoes, bread, rice, pasta
and other starchy foods
Eight portions a day for men, seven portions a day for women
One portion is
Brown roll
One small
Cooked pasta
Two tablespoons or...
Uncooked pasta
One handful
Pitta bread (brown)
Half
Rice
Two heaped tablespoons
Rice cakes
Three
Weetabix
One
Oven chips
Nine
Potato
One fist-size
Egg noodles
Half a pack
Brown bread or toast
One slice of medium sliced
Crackers
Three
Wrap
Half a wrap
Plantain
One
Crumpet
One whole
Baguette
Length of a hand
English muffin
Half a muffin
Bagel
Half a bagel
Granola
One tablespoon
Muesli
Two tablespoons

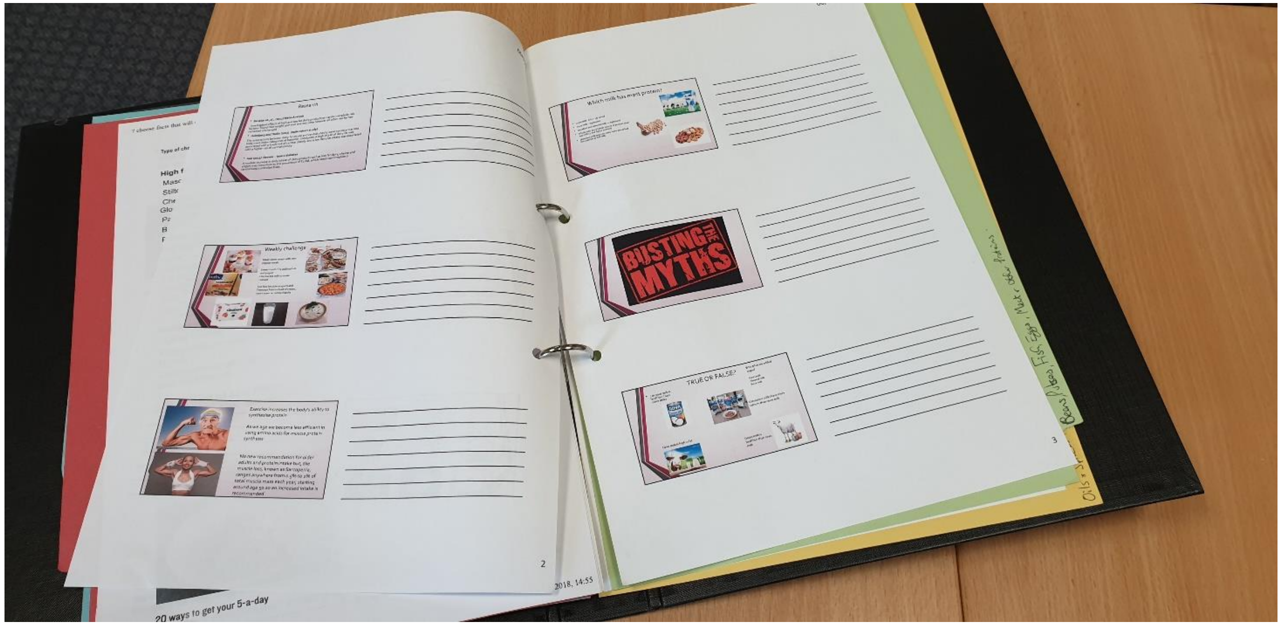
los

British Heart Foundation
Dairy foods and alternatives
Three portions a day for men and women
One portion is
Cheese (preferably low-fat)
(Brie, Camembert, Edam)
One index finger (l), fingertip (h)*
Reduced-fat or low-fat cream cheese varieties
Two tablespoons
Cream cheese
One tablespoon
Cottage cheese
Three heaped tablespoons
Milk
(semi-skimmed or skimmed)
One small glass (200ml)
Alternative milks
(Soya, nut, rice milks)
One small glass (200ml)
Low-fat natural yogurt
One small pot 150g
Natural yogurt
Three tablespoons
* length (l) and height (h)
This group doesn't include butter, margarine or cream.
If you don't drink milk or eat dairy foods, it's good to use a milk substitute like soya milk, with added calcium – go for the unsweetened versions.
The fat content varies a lot between foods in this group. Choose lower-fat versions when you can.
Swap cream for low-fat natural yogurt and increase your portion size



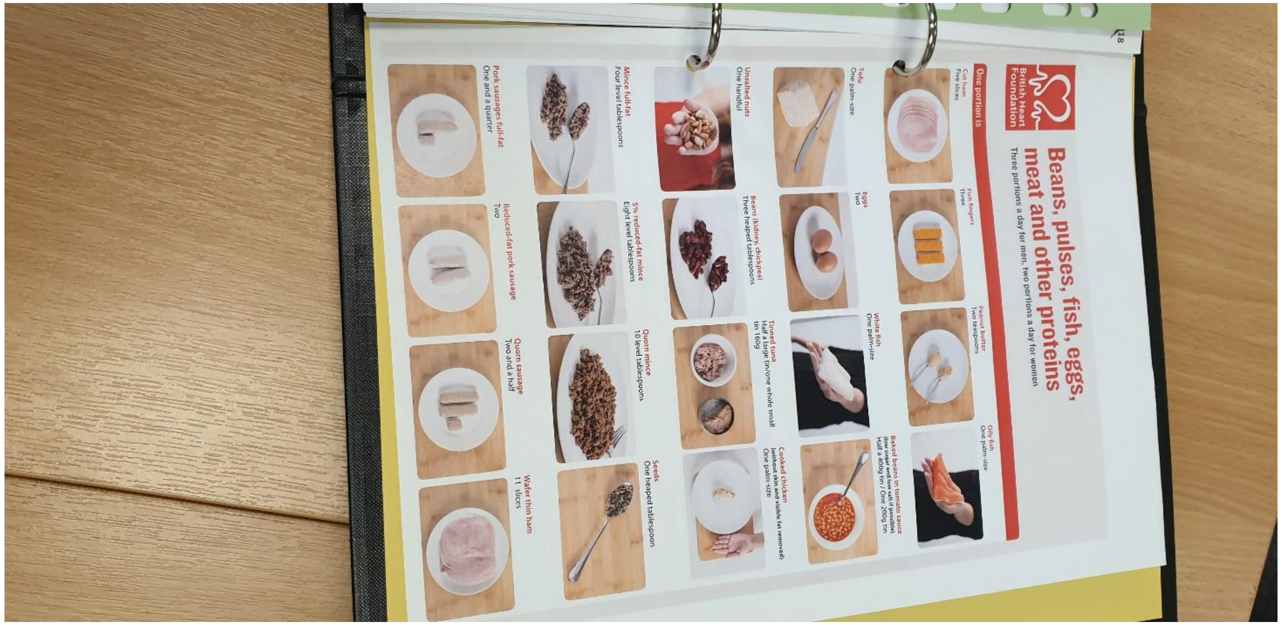
06/06/2018
Healthy Heart Happy YOU!
Week 3. Dairy and alternatives
Why choose these foods?
Good sources of protein – growth and repair, especially important as we age
Good sources of iodine – important for healthy nerve and brain function and healthy skin
Good sources of calcium – development and maintenance of strong healthy bones
Vitamin B12 – for healthy blood cells and nerve function
Vitamin B2 (riboflavin) – to help release energy from carbohydrates and protein
What counts?
Milk
Cheese
Yogurt
Fromage frais
Cream cheese
Quark
Dairy calcium-fortified alternatives such as: soya, oat, nut and rice milks

los


Which milk has more protein?
Weekly challenge
BUSTING THE MYTHS
TRUE OR FALSE?
2
3
2018, 14:55
20 ways to get your 5-a-day

los

los


British Heart Foundation
Beans, pulses, fish, eggs, meat and other proteins
Three portions a day for men, two portions a day for women
One portion is
Cut ham
Five slices
Fish fingers
Three
Peanut butter
Two teaspoons
Oily fish
One palm-size
Tofu
One palm-size
Eggs
Two
White fish
One palm-size
Baked beans in tomato sauce
(low sugar and low salt if possible)
Half a 400g tin / One 200g tin
Unsalted nuts
One handful
Beans (kidney, chickpea)
Three heaped tablespoons
Tinned tuna
Half a large tin/one whole small tin 160g
Cooked chicken
(without skin and visible fat removed)
One palm-size
Mince full-fat
Four level tablespoons
5% reduced-fat mince
Eight level tablespoons
Quorn mince
10 level tablespoons
Seeds
One heaped tablespoon
Pork sausages full-fat
One and a quarter
Reduced-fat pork sausage
Two
Quorn sausage
Two and a half
Wafer thin ham
11 slices

los

Appendix 12 4-day diet diary

Division of Sport, Exercise, and Nutritional Sciences

4-DAY DIET DIARY

The aim of this diary is to help you keep an accurate record of everything you eat and drink over a consecutive 4day period (3 week days and 1 weekend days). This will enable us to determine dietary macro- and micro-nutrient intake. If you have any problems or queries regarding completing this diary please contact: **-AAMelia@uclan.ac.uk** (April Melia).

Individual's information/body measurements (to be completed by the researcher)

Instructions

The aim of this diary is to help you keep an accurate record of everything you eat and drink over a 4 day period. This will enable us to determine dietary macro- and micro-nutrient intake.

1. Use this diary to write down everything you eat and drink for 4 days. This includes all snacks, meals, and beverages, including alcoholic beverages.
2. Keep your diary with you at all times and fill it in immediately after eating. Also include the time at which you consumed the food/drink.
3. Start a new page each day and fill in your name, date, and day of food record e.g. Monday Day 1.
4. We need to know as much detail as possible about types, amounts (weights if possible) and cooking methods.

Include brand names wherever possible.

Day 1

Date:…………………..

Meal	Food/Drink	Amount	Cooking Method	Office use only
Early morning or breakfast				
Mid-morning				
Lunch				

Afternoon				
Evening meal				
Supper				

Day 2

Date:…………………..

Meal	Food/Drink	Amount	Cooking Method	Office use only
Early morning or breakfast				
Mid-morning				

Lunch				
Afternoon				
Evening meal				

Supper				

Day 3

Date:…………………..

Meal	Food/Drink	Amount	Cooking Method	Office use only

Early morning or breakfast				
Mid-morning				
Lunch				

Afternoon				
Evening meal				
Supper				

Day 4

Date:…………………..

Meal	Food/Drink	Amount	Cooking Method	Office use only
Early morning or breakfast				

Mid-morning				
Lunch				
Afternoon				
Evening meal				

Supper				

Appendix 13. Statistical raw data

Outputs from Study 1 Biggest loser

DATASET ACTIVATE DataSet1.

T-TEST PAIRS=pre_kg Pre_BMI WC_PRE WITH post_kg Post_BMI WC_POST (PAIRED)

T-Test

Notes

Output Created		07-AUG-2014 09:37:18
Comments		
Input	Data	\\lha-024\pers-H\0003D77B\My Documents\HEARTBEAT NUTRITION INTERVENTION DETAILS\PRE-POST DATR JS.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.

	Cases Used	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
Syntax		T-TEST PAIRS=pre_kg pre_BMI WC_PRE WITH post_kg POST_bmi WC_POST (PAIRED) /CRITERIA=CI(.9500) /MISSING=ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pre_kg	84.3476	42	15.54707	2.39896
	post_kg	81.8476	42	15.04329	2.32123

Pair 2	pre_BMI	29.7048	42	5.96657	.92066
	POST_bmi	28.8214	42	5.68754	.87761
Pair 3	WC_PRE	104.1026	39	14.38619	2.30363
	WC_POST	99.1692	39	12.39495	1.98478

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	pre_kg & post_kg	42	.986	.000
Pair 2	pre_BMI & POST_bmi	42	.988	.000
Pair 3	WC_PRE & WC_POST	39	.946	.000

Paired Samples Test

	Paired Differences						
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	t		

					Lower	Upper			
Pair 1	pre_kg - post_kg	2.50000	2.58325	.39860	1.69500	3.30500	6.272		
Pair 2	pre_BMI - POST_bmi	.88333	.93806	.14475	.59101	1.17565	6.103		
Pair 3	WC_PRE - WC_POST	4.93333	4.81267	.77064	3.37325	6.49342	6.402		

General Linear Model

Notes

Output Created		14-MAY-2015 15:25:54
Comments		
Input	Data	\\lha-024\pers-H\0003D77B\My Documents\HEARTBEAT NUTRITION INTERVENTION DETAILS\PRE-POST DATR JS.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		GLM pre_kg post_kg /WSFACTOR=mass_kg 2 Polynomial /METHOD=SSTYPE(3) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /WSDESIGN=mass_kg.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.04

Within-Subjects Factors

Measure: MEASURE_1

mass_kg	Dependent Variable
1	pre_kg
2	post_kg

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
mass_kg	Pillai's Trace	.490	39.337[b]	1.000	41.000	.000	.490
	Wilks' Lambda	.510	39.337[b]	1.000	41.000	.000	.490
	Hotelling's Trace	.959	39.337[b]	1.000	41.000	.000	.490
	Roy's Largest Root	.959	39.337[b]	1.000	41.000	.000	.490

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
mass_kg	1.000	.000	0	.	1.000	1.000	1.000

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	
mass_kg	Sphericity Assumed	131.250	1	131.250	39.337	.000	
	Greenhouse-Geisser	131.250	1.000	131.250	39.337	.000	
	Huynh-Feldt	131.250	1.000	131.250	39.337	.000	
	Lower-bound	131.250	1.000	131.250	39.337	.000	

Error(mass_kg)	Sphericity Assumed	136.800	41	3.337			
	Greenhouse-Geisser	136.800	41.000	3.337			
	Huynh-Feldt	136.800	41.000	3.337			
	Lower-bound	136.800	41.000	3.337			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	mass_kg	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
mass_kg	Linear	131.250	1	131.250	39.337	.000	.490
Error(mass_kg)	Linear	136.800	41	3.337			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	580038.000	1	580038.000	1248.265	.000	.968
Error	19051.690	41	464.675			

GLM pre_BMI POST_bmi

General Linear Model

Notes

Output Created		14-MAY-2015 15:26:23
Comments		
Input	Data	\\lha-024\pers-H\0003D77B\My Documents\HEARTBEAT NUTRITION INTERVENTION DETAILS\PRE-POST DATR JS.sav
	Active Dataset	DataSet1

	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	42
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		GLM pre_BMI POST_bmi /WSFACTOR=BMI 2 Polynomial /METHOD=SSTYPE(3) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /WSDESIGN=BMI.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

Within-Subjects Factors

Measure: MEASURE_1

BMI	Dependent Variable
1	pre_BMI
2	POST_bmi

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
BMI	Pillai's Trace	.476	37.242[b]	1.000	41.000	.000	.476
	Wilks' Lambda	.524	37.242[b]	1.000	41.000	.000	.476
	Hotelling's Trace	.908	37.242[b]	1.000	41.000	.000	.476
	Roy's Largest Root	.908	37.242[b]	1.000	41.000	.000	.476

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
BMI	1.000	.000	0	.	1.000	1.000	1.000

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
BMI	Sphericity Assumed	16.386	1	16.386	37.242	.000	.476
	Greenhouse-Geisser	16.386	1.000	16.386	37.242	.000	.476
	Huynh-Feldt	16.386	1.000	16.386	37.242	.000	.476

	Lower-bound	16.386	1.000	16.386	37.242	.000	.476
Error(BMI)	Sphericity Assumed	18.039	41	.440			
	Greenhouse-Geisser	18.039	41.000	.440			
	Huynh-Feldt	18.039	41.000	.440			
	Lower-bound	18.039	41.000	.440			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	BMI	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
BMI	Linear	16.386	1	16.386	37.242	.000	.476
Error(BMI)	Linear	18.039	41	.440			

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	71931.614	1	71931.614	1065.526	.000	.963
Error	2767.831	41	67.508			

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

WC	Dependent Variable
1	WC_PRE
2	WC_POST

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
WC	Pillai's Trace	.519	40.980[b]	1.000	38.000	.000	.519
	Wilks' Lambda	.481	40.980[b]	1.000	38.000	.000	.519
	Hotelling's Trace	1.078	40.980[b]	1.000	38.000	.000	.519
	Roy's Largest Root	1.078	40.980[b]	1.000	38.000	.000	.519

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
WC	1.000	.000	0	.	1.000	1.000	1.000

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
WC	Sphericity Assumed	474.587	1	474.587	40.980	.000	.519
	Greenhouse-Geisser	474.587	1.000	474.587	40.980	.000	.519
	Huynh-Feldt	474.587	1.000	474.587	40.980	.000	.519
	Lower-bound	474.587	1.000	474.587	40.980	.000	.519
Error(WC)	Sphericity Assumed	440.073	38	11.581			
	Greenhouse-Geisser	440.073	38.000	11.581			
	Huynh-Feldt	440.073	38.000	11.581			
	Lower-bound	440.073	38.000	11.581			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	WC	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
WC	Linear	474.587	1	474.587	40.980	.000	.519
Error(WC)	Linear	440.073	38	11.581			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	805728.741	1	805728.741	2308.571	.000	.984
Error	13262.619	38	349.016			

Descriptives from study 2 - Questionnaires

DESCRIPTIVES VARIABLES=Height Weight BMI Waist_circumference

/STATISTICS=MEAN STDDEV MIN MAX.

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Height	242	1.50	2.01	1.7150	.08299
Weight	242	54.60	126.00	80.1563	13.51740
BMI	242	19.70	46.37	27.2235	4.11588
Waist_circumference	240	71.00	132.00	96.0444	10.26146
Valid N (listwise)	240				

Frequencies

		Male_female	Age_are_you	Marital_status	Ethnic_origin	Children_question	Under_eighteen_living_with
N	Valid	251	251	251	251	249	249
	Missing	3	3	3	3	5	5
Mean		1.1873	7.0398	2.4980	1.0797	3.0683	1.9598
Median		1.0000	7.0000	2.0000	1.0000	3.0000	2.0000
Mode		1.00	7.00	2.00	1.00	3.00	2.00
Std. Deviation		.39089	.82365	1.32778	.66455	1.21788	.19673

Frequency Table

Male_female

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MALE	204	80.3	81.3	81.3
	FEMALE	47	18.5	18.7	100.0

	Total	251	98.8	100.0	
Missing	System	3	1.2		
Total		254	100.0		

Age_are_you

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	45-54	14	5.5	5.6	5.6
	55-64	38	15.0	15.1	20.7
	65-74	123	48.4	49.0	69.7
	75+	76	29.9	30.3	100.0
	Total	251	98.8	100.0	
Missing	System	3	1.2		
Total		254	100.0		

Marital_status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SINGLE	11	4.3	4.4	4.4
	MARRIED	198	78.0	78.9	83.3
	LIVING AS MARRIED	6	2.4	2.4	85.7
	SEPERATED	4	1.6	1.6	87.3
	DIVORCED	6	2.4	2.4	89.6
	WIDOW	26	10.2	10.4	100.0
	Total	251	98.8	100.0	
Missing	System	3	1.2		
Total		254	100.0		

Ethnic_origin

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	white	247	97.2	98.4	98.4
	indian	3	1.2	1.2	99.6
	asian other	1	.4	.4	100.0
	Total	251	98.8	100.0	
Missing	System	3	1.2		
Total		254	100.0		

Children_question

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	33	13.0	13.3	13.3
	1	34	13.4	13.7	26.9
	2	100	39.4	40.2	67.1
	3	55	21.7	22.1	89.2
	4	19	7.5	7.6	96.8
	4+	8	3.1	3.2	100.0

	Total	249	98.0	100.0	
Missing	System	5	2.0		
Total		254	100.0		

Under_eighteen_living_with

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	10	3.9	4.0	4.0
	no	239	94.1	96.0	100.0
	Total	249	98.0	100.0	
Missing	System	5	2.0		
Total		254	100.0		

Highest_level_of_education

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	primary	11	4.3	4.5	4.5
	secondary	37	14.6	15.1	19.6
	o level	31	12.2	12.7	32.2
	a level	6	2.4	2.4	34.7
	technical	49	19.3	20.0	54.7
	diploma	43	16.9	17.6	72.2
	degree	48	18.9	19.6	91.8
	post grad	20	7.9	8.2	100.0
	Total	245	96.5	100.0	
Missing	System	9	3.5		
Total		254	100.0		

Health_nutrition_qualifications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	17	6.7	6.9	6.9

	no	230	90.6	93.1	100.0
	Total	247	97.2	100.0	
Missing	System	7	2.8		
Total		254	100.0		

Employment_status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	employed	31	12.2	12.4	12.4
	part time	16	6.3	6.4	18.9
	unemployed	3	1.2	1.2	20.1
	retired	195	76.8	78.3	98.4
	student	2	.8	.8	99.2
	disabled	2	.8	.8	100.0
	Total	249	98.0	100.0	
Missing	System	5	2.0		

Total	254	100.0		

Special_diet

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	23	9.1	9.3	9.3
	no	223	87.8	90.7	100.0
	Total	246	96.9	100.0	
Missing	System	8	3.1		
Total		254	100.0		

Study 4

GLM Mean_Kcal_baseline Mean_Kcal_6_weeks Mean_Kcal_12_weeks BY GROUP

Within-Subjects Factors

Measure: MEASURE_1

TIME	Dependent Variable
1	Mean_Kcal_baseine
	Mean_Kcal_6_weeks
3	Mean_Kcal_12_weeks

Between-Subjects Factors

		Value Label	N
GROUP	1.00	USUAL CARE	14
	2.00	BIGGEST LOSER	10
	3.00	NEW EDUCATION	12

Descriptive Statistics

	GROUP	Mean	Std. Deviation	N

Mean_Kcal_baseline	USUAL CARE	1768.9286	395.61315	14
	BIGGEST LOSER	1828.8000	424.26009	10
	NEW EDUCATION	1559.5833	413.30452	12
	Total	1715.7778	413.82102	36
Mean_Kcal_6_weeks	USUAL CARE	1718.3571	379.51500	14
	BIGGEST LOSER	1759.5000	687.80153	10
	NEW EDUCATION	1362.8333	285.15190	12
	Total	1611.2778	482.41639	36
Mean_Kcal_12_weeks	USUAL CARE	1703.3571	530.35193	14
	BIGGEST LOSER	1603.1000	465.55808	10
	NEW EDUCATION	1506.0833	407.75025	12
	Total	1609.7500	468.68170	36

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	
TIME	Pillai's Trace	.089	1.557[b]	2.000	32.000	.226	
	Wilks' Lambda	.911	1.557[b]	2.000	32.000	.226	

	Hotelling's Trace	.097	1.557[b]	2.000	32.000	.226	
	Roy's Largest Root	.097	1.557[b]	2.000	32.000	.226	
TIME * GROUP	Pillai's Trace	.082	.706	4.000	66.000	.591	
	Wilks' Lambda	.919	.693[b]	4.000	64.000	.600	
	Hotelling's Trace	.088	.679	4.000	62.000	.609	
	Roy's Largest Root	.076	1.249[c]	2.000	33.000	.300	

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

					Epsilon[b]		
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser		
TIME	.997	.084	2	.959	.997		

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F		
TIME	Sphericity Assumed	287731.257	2	143865.629	1.525		
	Greenhouse-Geisser	287731.257	1.995	144243.025	1.525		
	Huynh-Feldt	287731.257	2.000	143865.629	1.525		
	Lower-bound	287731.257	1.000	287731.257	1.525		
TIME * GROUP	Sphericity Assumed	282795.996	4	70698.999	.749		
	Greenhouse-Geisser	282795.996	3.990	70884.461	.749		
	Huynh-Feldt	282795.996	4.000	70698.999	.749		
	Lower-bound	282795.996	2.000	141397.998	.749		
Error(TIME)	Sphericity Assumed	6228314.319	66	94368.399			

	Greenhouse-Geisser	6228314.319	65.827	94615.952			
	Huynh-Feldt	6228314.319	66.000	94368.399			
	Lower-bound	6228314.319	33.000	188736.798			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	TIME	Type III Sum of Squares	df	Mean Square	F	Sig.	
TIME	Linear	233291.037	1	233291.037	2.531	.121	
	Quadratic	54440.220	1	54440.220	.564	.458	
TIME * GROUP	Linear	99619.222	2	49809.611	.540	.588	
	Quadratic	183176.774	2	91588.387	.948	.398	
Error(TIME)	Linear	3041701.264	33	92172.766			
	Quadratic	3186613.055	33	96564.032			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	287002851.974	1	287002851.974	688.011	.000	.954
GROUP	1550248.342	2	775124.171	1.858	.172	.101
Error	13765899.538	33	417148.471			

Estimated Marginal Means

1. GROUP

Estimates

Measure: MEASURE_1

GROUP	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
USUAL CARE	1730.214	99.660	1527.455	1932.974
BIGGEST LOSER	1730.467	117.919	1490.558	1970.375

NEW EDUCATION	1476.167	107.645	1257.161	1695.172

Pairwise Comparisons

Measure: MEASURE_1

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	
USUAL CARE	BIGGEST LOSER	-.252	154.393	1.000	-389.663	
	NEW EDUCATION	254.048	146.695	.278	-115.950	

BIGGEST LOSER	USUAL CARE	.252	154.393	1.000	-389.158	
	NEW EDUCATION	254.300	159.663	.362	-148.405	
NEW EDUCATION	USUAL CARE	-254.048	146.695	.278	-624.045	
	BIGGEST LOSER	-254.300	159.663	.362	-657.005	

Univariate Tests

Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	516749.447	2	258374.724	1.858	.172	.101
Error	4588633.179	33	139049.490			

The F tests the effect of GROUP. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. TIME

Estimates

Measure: MEASURE_1

TIME	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	1719.104	68.896	1578.934	1859.274
2	1613.563	77.624	1455.636	1771.491
3	1604.180	79.866	1441.692	1766.669

Pairwise Comparisons

Measure: MEASURE_1

(I) TIME	(J) TIME	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound

1	2	105.540	72.067	.458	-76.227	287.308
	3	114.924	72.237	.363	-67.274	297.122
2	1	-105.540	72.067	.458	-287.308	76.227
	3	9.383	74.939	1.000	-179.628	198.395
3	1	-114.924	72.237	.363	-297.122	67.274
	2	-9.383	74.939	1.000	-198.395	179.628

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.089	1.557[a]	2.000	32.000	.226	.089
Wilks' lambda	.911	1.557[a]	2.000	32.000	.226	.089
Hotelling's trace	.097	1.557[a]	2.000	32.000	.226	.089

Roy's largest root	.097	1.557[a]	2.000	32.000	.226	.089

Each F tests the multivariate effect of TIME. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

3. GROUP * TIME

Measure: MEASURE_1

GROUP	TIME	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
USUAL CARE	1	1768.929	109.442	1546.267	1991.590
	2	1718.357	123.307	1467.488	1969.226
	3	1703.357	126.868	1445.242	1961.472
BIGGEST LOSER	1	1828.800	129.493	1565.344	2092.256
	2	1759.500	145.898	1462.668	2056.332
	3	1603.100	150.112	1297.694	1908.506
NEW EDUCATION	1	1559.583	118.211	1319.082	1800.085
	2	1362.833	133.186	1091.864	1633.803

3	1506.083	137.033	1227.287	1784.879

Example of a windiets analysis (mean for 4 days from one participant)

NUTRIENT		AMT	
Energ	kJ	6430	
kcal	kc	1524	
Fat	g	33.8	19.5 % energy
SFA	g	12.4	6.9 % energy
PUFA	g	6.3	3.4 % energy
Monos	g	12.3	6.9 % energy
Prot	g	92.2	24.3 % energy
CHO	g	220.6	54.9 % energy
Sugrs	g	66.3	16.4 % energy
Strch	g	152.5	38 % energy
FreeS	g	16.7	
DF	g	20.2	
Alcoh	g	0	0 % energy
Water	g	2279.4	
VitA	ug	403	
Thiam	mg	1.89	
Ribof	mg	1.65	
Niac	mg	39	
VitB6	mg	1.65	
B12	ug	2.51	
Fol	ug	195	
Pant	mg	5.3	

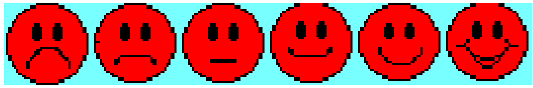
Biot	ug	52.8	
VitC	mg	60.1	
VitD	ug	1.5	
VitE	mg	5.19	
Ca	mg	934	23.35 mmol
Mg	mg	354	14.57 mmol
Na	mg	1266	55.04 mmol 3.22 g as salt
K	mg	3340	85.42 mmol
Cl	mg	2169	61.1 mmol
P	mg	1697	54.74 mmol
Fe	mg	9.2	161.29 umol
Zn	mg	10.8	168.2 umol
Cu	mg	1.2	15.75 umol
Mn	mg	6.23	109.29 umol
Se	ug	44	0.56 umol
I	ug	128	1.01 umol
NSP	g	16.2	
Chol	mg	160	
Retin	ug	224	
Carot	ug	1087	

Analysis of 4 days

Nutrient	Unit	Amt	DRV	%DRV	
Energ	kJ	6430	11000	58	Estimated Average Requirement
kcal	kc	1524			
Fat	g	33.8	104.1	32	
SFA	g	12.4	32.7	37	
PUFA	g	6.3	18.6	33	
Monos	g	12.3			
Prot	g	92.2	55.5	166	Reference Nutrient Intake
CHO	g	220.6			
Sugrs	g	66.3			
Strch	g	152.5			

FreeS	g	16.7	34.4	48	
DF	g	20.2	30	67	
Alcoh	g	0			
Water	g	2279.4			
VitA	ug	403	700	57	Reference Nutrient Intake
Thiam	mg	1.89	1	189	Reference Nutrient Intake
Ribof	mg	1.65	1.3	126	Reference Nutrient Intake
Niac	mg	39	17	229	Reference Nutrient Intake
VitB6	mg	1.65			
B12	ug	2.51	1.5	167	Reference Nutrient Intake
Fol	ug	195	200	97	Reference Nutrient Intake
Pant	mg	5.3			
Biot	ug	52.8			
VitC	mg	60.1	40	150	Reference Nutrient Intake
VitD	ug	1.5			
VitE	mg	5.19			
Ca	mg	934	700	133	Reference Nutrient Intake
Mg	mg	354	300	118	Reference Nutrient Intake
Na	mg	1266	1600	79	Reference Nutrient Intake
K	mg	3340	3500	95	Reference Nutrient Intake
Cl	mg	2169			
P	mg	1697	550	308	Reference Nutrient Intake
Fe	mg	9.2	8.7	105	Reference Nutrient Intake
Zn	mg	10.8	9.5	113	Reference Nutrient Intake
Cu	mg	1.2			
Mn	mg	6.23			
Se	ug	44			
I	ug	128			
NSP	g	16.2			
Chol	mg	160			
Retin	ug	224			
Carot	ug	1087			

Report on Diet



The 'healthiness' of the diet is expressed simply in terms of the face, which can smile or frown, depending on the balance of these nutrients and the type of fatty acids in the fat component. The possible faces are shown here with the relevant one for this diet indicated. No face is highlighted when the diet is low in energy. The decision about which face is appropriate depends on cut-off values and nutritional decisions depending on the relative importance of food components to health. The happiest faces require low saturated fat and sugar and the presence of a reasonable amount of dietary fibre. The face does not indicate whether there is enough or too much energy or micronutrients in the diet, so further analsysis is needed as shown below.

Because you did not fill in an activity diary, we can only use the Dietary Reference Values for groups of people of your sex and age:

NUTRIENT		Amt	DRV	%DRV
Energ	kJ	6430	11000	58.5
Fat	g	34	104.1	32.5
SFA	g	12	32.7	37.8
FreeS	g	17	34.4	48.5
DF	g	20	30	67.2
Prot	g	92	55.5	166.1
Thiam	mg	2	1	188.9

Ribof	mg	2	1.3	126.8
Niac	mg	39	17	229.2
Fol	ug	195	200	97.3
VitC	mg	60	40	150.2
VitA	ug	403	700	57.6
Ca	mg	934	700	133.4
Fe	mg	9	8.7	105.3

- This diet has 58.5% of your energy needs. It is difficult to measure average energy intake because people vary in their daily intakes and even a seven-day period is not sufficient to be sure of the average intake. If this diet is consumed over a very long period it will probably not be sufficient to match needs and weight may be lost.It is difficult to measure average energy intake because people vary in their daily intakes and even a seven-day period is not sufficient to be sure of the average intake. If this diet is consumed over a very long period it will probably not be sufficient to match needs and weight may be lost.
- The provision of saturated fatty acids as a proportion of energy is 64.7% of that suggested. This nutrient does not need attention.
- The provision of non-milk extrinsic sugars as a proportion of energy is 83% of that suggested. Most people consume more sugar than this and are being recommended to lower their consumption. The sugar (lactose) in milk is excluded from this calculation as it is less harmful to your teeth. The sugars are called extrinsic because they exclude those present in raw fruits and vegetables. It is best to consume the sugar that is included in the diet at meals rather than as snacks. It is particularly harmful to sip sugary drinks as this gives bacteria in the plaque more time to produce acid that dissolves enamel.
- The provision of non-starch polysaccharide is 67.2% of the dietary reference value. Non-starch polysaccharide is a scientific way of saying dietary fibre. It helps to promote a healthy digestive system. It can be increased by using less refined cereal products and more of the wholemeal varieties, taking bran-based breakfast cereals and eating more fruit and vegetables.
- The provision of vitamin C is 150.2% of the reference nutrient intake. Although the reference nutrient intake is sufficient of this vitamin to prevent deficiency, it is often recommended that you take even more because vitamin C acts as an antioxidant and also helps in the absorption of iron. There is no need to take supplements as there is plenty of this vitamin in some fruits like oranges and hence in orange juice. Research has shown that supplements of vitamin C do not prevent you catching colds, but it has been found to reduce symptoms when you have a already caught a cold.
- The provision of calcium is 133.4% of the reference nutrient intake. There is apparently no problem with this nutrient. The reference nutrient intake in the UK is however lower than recommended in many other countries such as the USA. You might take this information into account when interpreting this diet and generally more calcium might be considered beneficial and unlikely to be harmful.

- The provision of iron is 105.3% of the reference nutrient intake. It is not possible to state that consumption of a diet containing this amount of iron will definitely not lead to anaemia because the proportion of iron absorbed depends on other substances in the diet; assuming that there are not excessive amounts of inhibitors to absorption in the diet, this ought to be sufficient for most people.

Chapter 6 graphs.

Anthropometric measures **Indicates a significant effect was found.

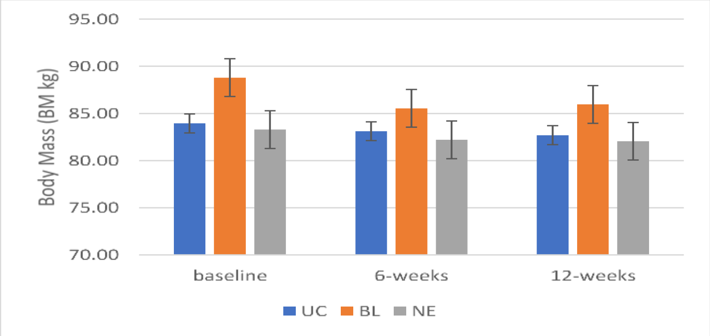


Figure 6.1 Body Mass** (Mean ± SD) at each time point for each group. The mean reductions in BM for each group were UC -1.25kg, BL -2.84kg and NE -1.23kg over the 12-week period, one patient in each group met the minimal clinical important difference (MCID) for weight loss of >5%, UC (5.8%), BL (6.52%) and NE (5.23%).

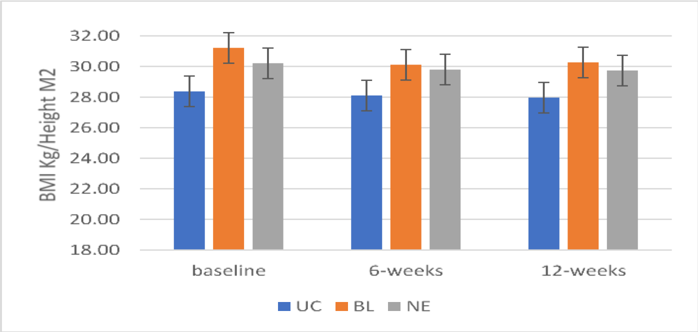


Figure 6.2 BMI** (Mean ± SD) at each time point for each group. Healthy BMI range is between 18.5 kg/m^2 -24.9 kg/m^2 patients in all three groups were in the overweight or obese categories.

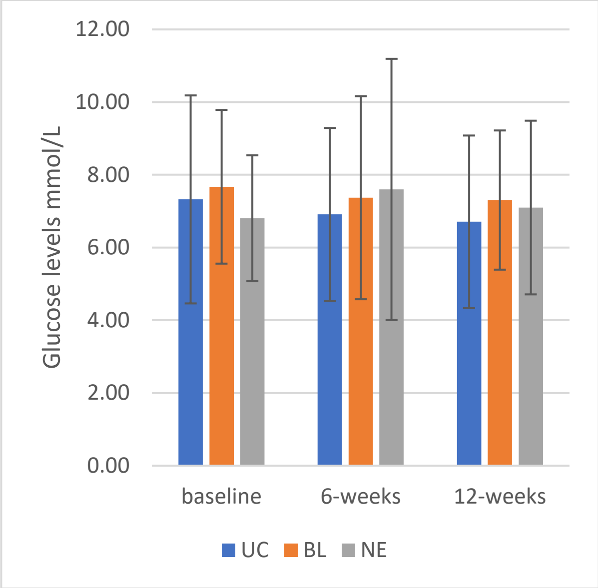


Figure 6.5 Glucose (Mean ± SD) at each time point for each group.

Non-fasting glucose levels place patients in the normal range.

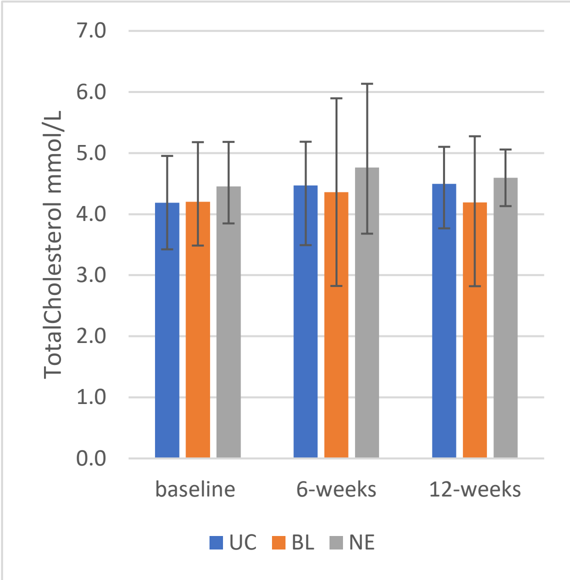


Figure 6.6 Total cholesterol (Mean ± SD) at each time point for each group.

Non-fasting blood levels of cholesterol are in the normal range.

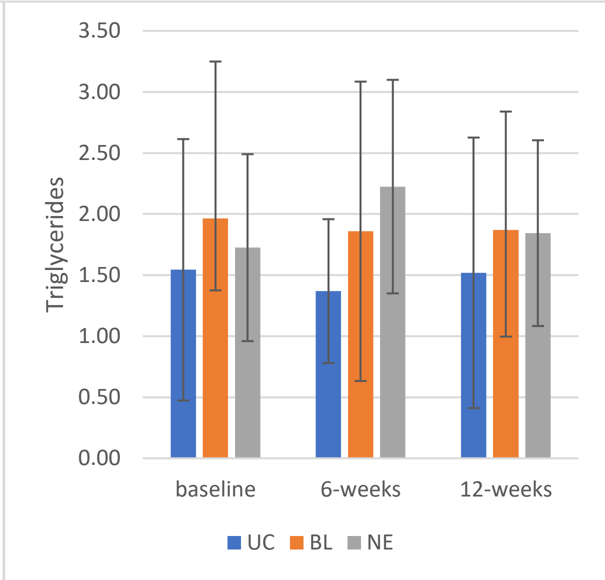
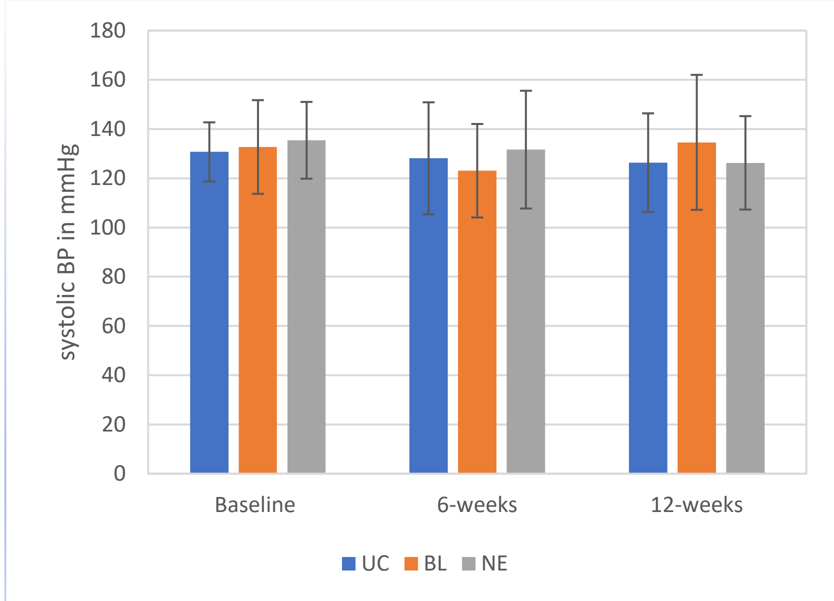


Figure 6.7 Triglycerides (Mean ± SD) at each time point for each group.

Non-fasted triglyceride levels are within normal range.



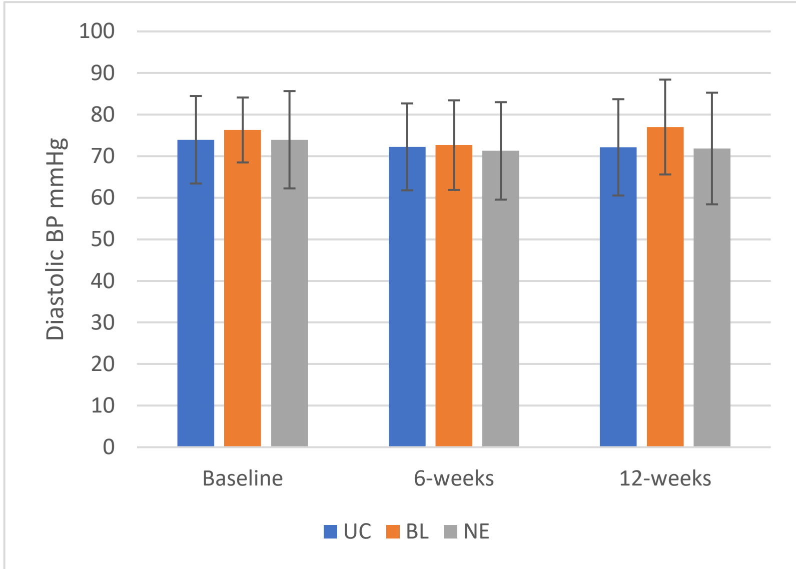
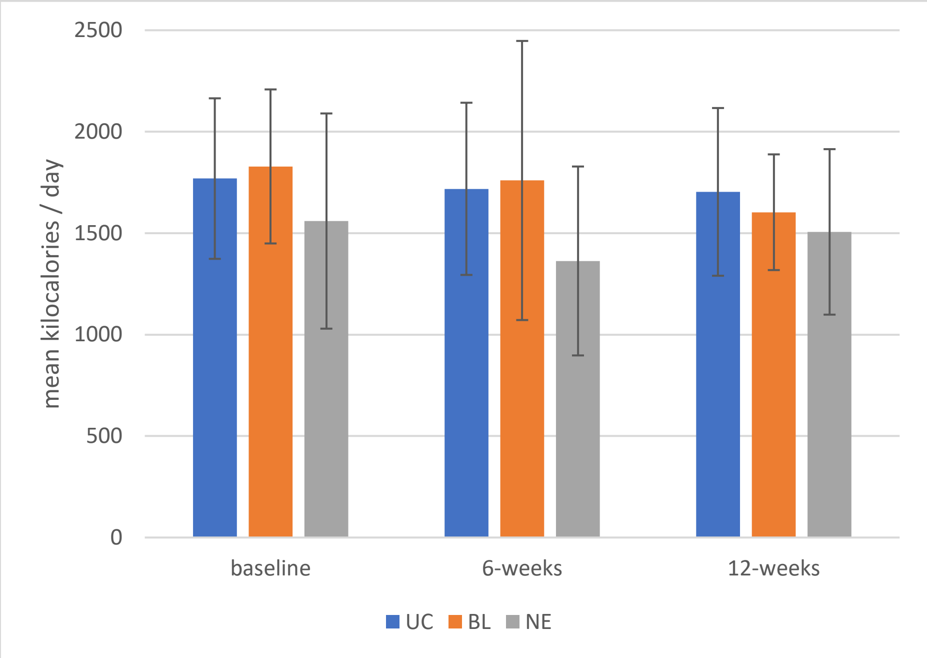


Figure 6.8 SBP (Mean ± SD) at each time point for each group.
MCID was found for SBP with NE group seeing a reduction of 9mmHg, and UC group aw 4mmHg reduction while BL saw an increase of 2mmHg.

Figure 6.9 DBP (Mean ± SD) at each time point for each group.
MCID was found for DBP with NE and UC seeing a 2mmHg reduction and BL increased by 1mmHg



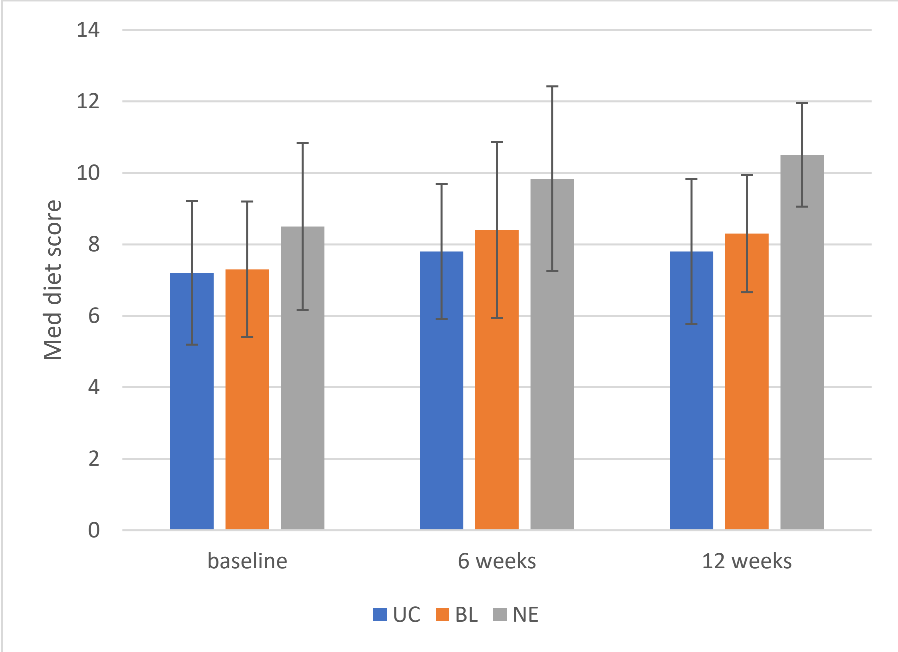


Figure 6.10 Total energy (Mean ± SD) at each time point for each group.

Total energy intakes for all three groups fall below RNI of 1,900-2,350kcalories per day.

Figure 6.11 Med diet score ****(Mean ± SD) at each time point for each group.

MCID was found for the NE group with a 2-point increase in Med diet score

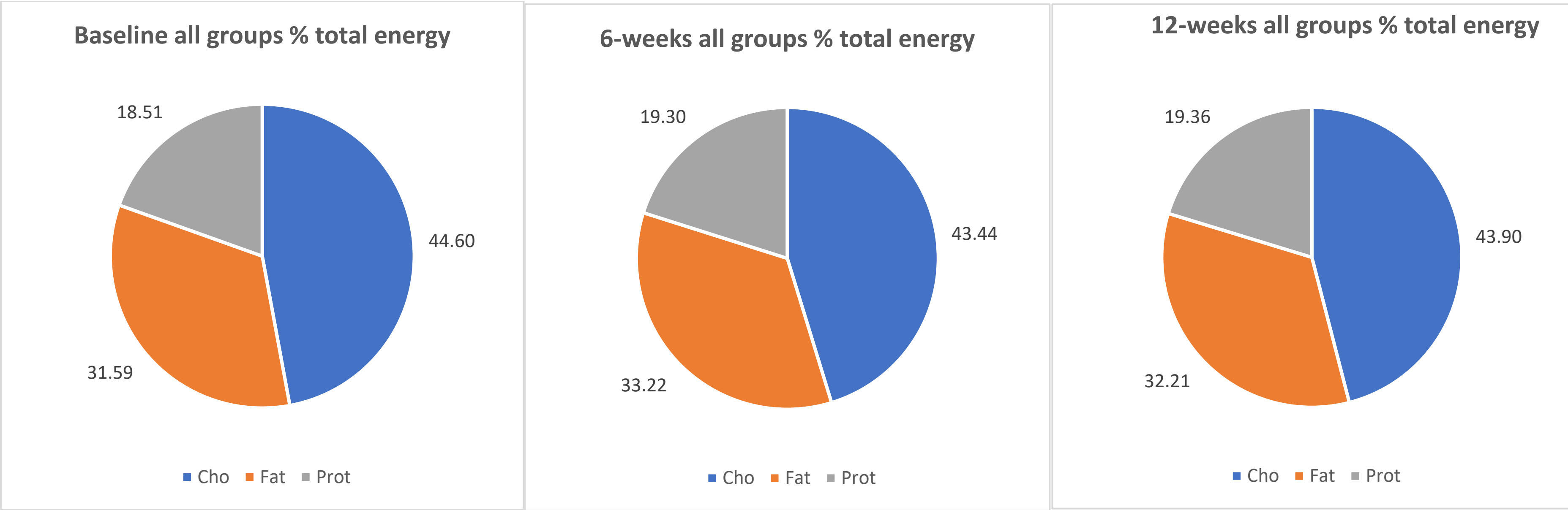
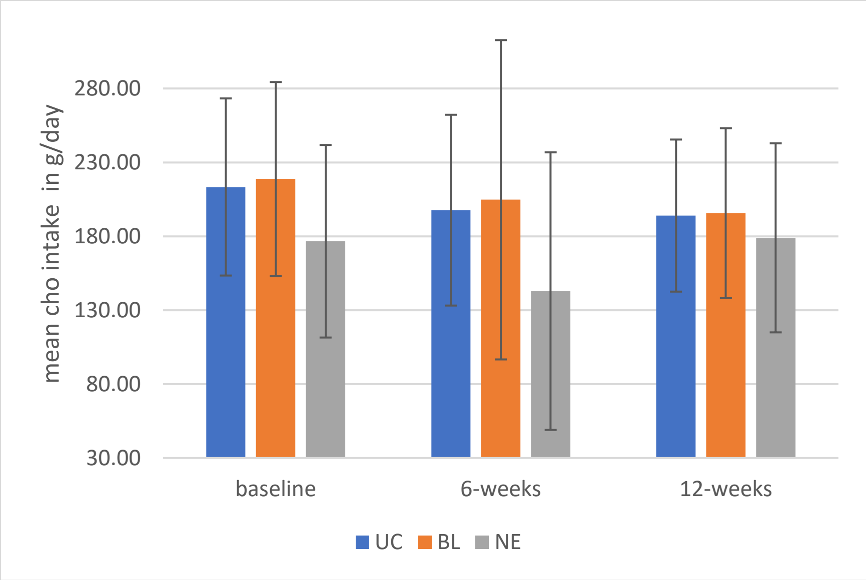


Figure 6.12 Mean macronutrient intakes for all three groups at all three timepoints shown as a percent (%) of total energy intake.

RNI for Carbohydrates are minimum of 50% of total energy intake, total fat intake no more than 30% of total energy and protein 2between 10 and 20% of total energy intakes.



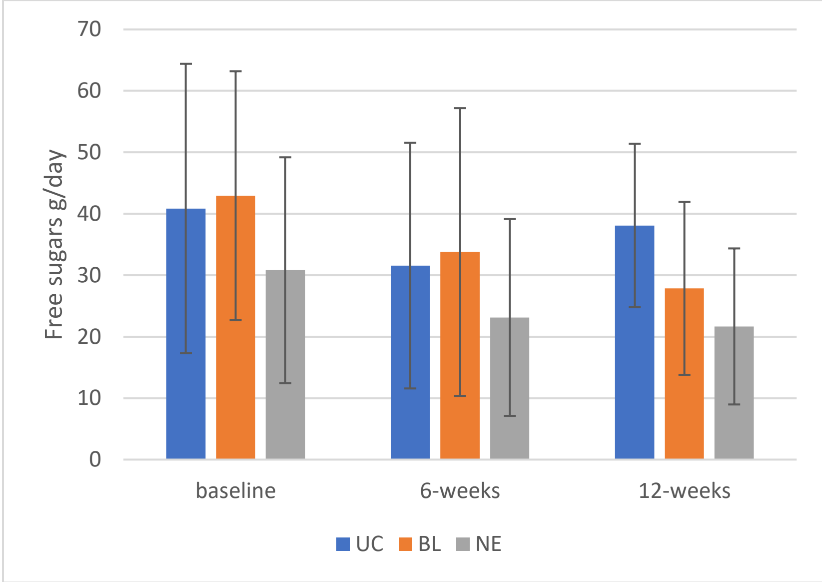


Figure 6.13 Carbohydrate intakes (Mean ± SD) at each time point for each group.
Total CHO intakes are lower than RNI at less than 45%/d and cho g/d is also lower than RNI of 250g/d

Figure 6.14 Free sugars** (Mean ± SD) at each time point for each group.
Intakes have reduced over the duration of the intervention with intervention groups seeing a greater reduction compared to the UC group

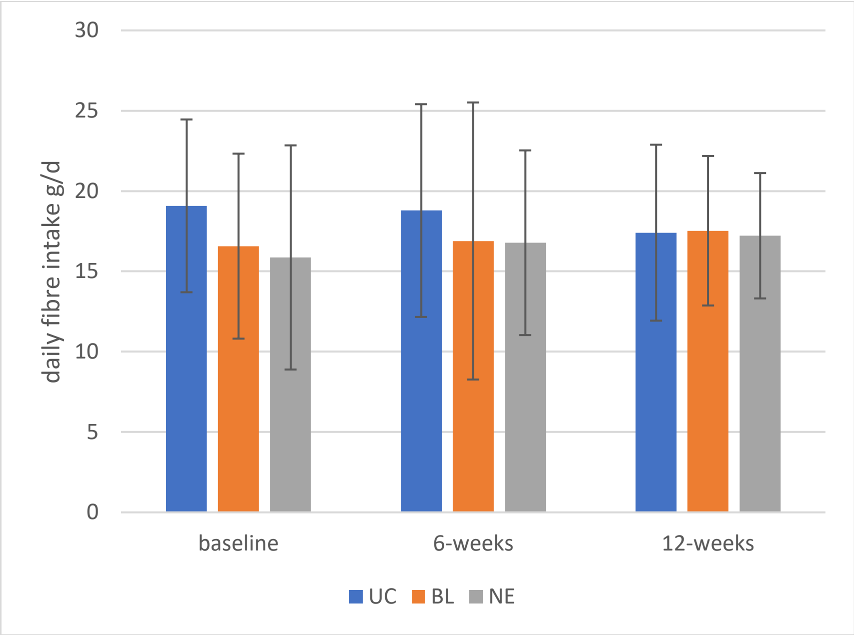


Figure 6.15 Fibre intake (Mean ± SD) at each time point for each group.
Fibre intakes are lower than the recommended intakes of 30g/d in all three groups

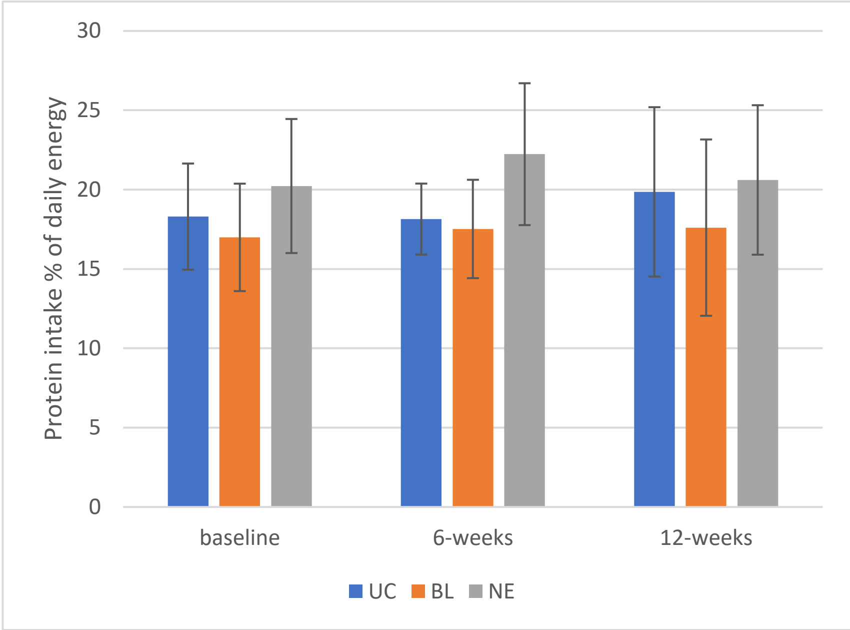


Figure 6.16 Protein intake (Mean ± SD) at each time point for each group.
Protein intakes are within the normal range for all three groups

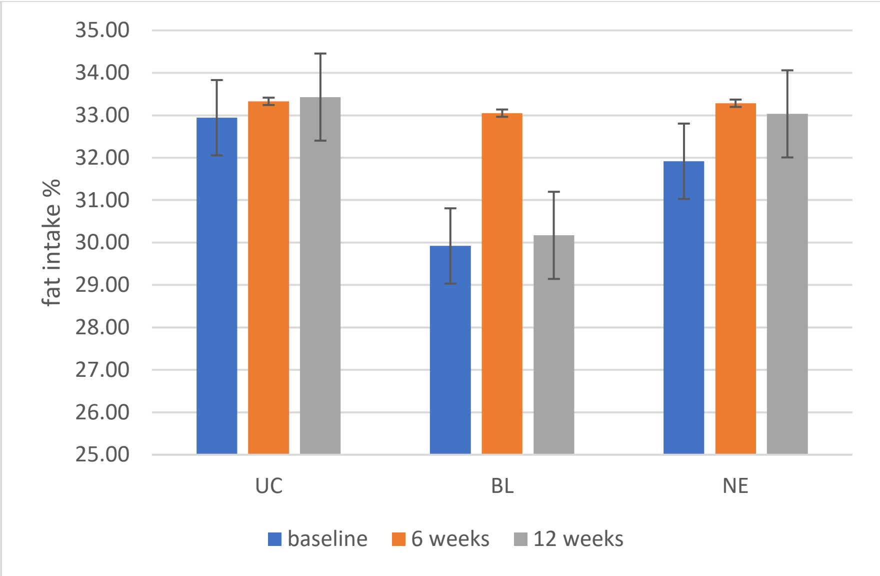


Figure 6.17 total fat intake (Mean ± SD) at each time point for each group.
All three groups have a mean intake meeting the RNI of less than 35%

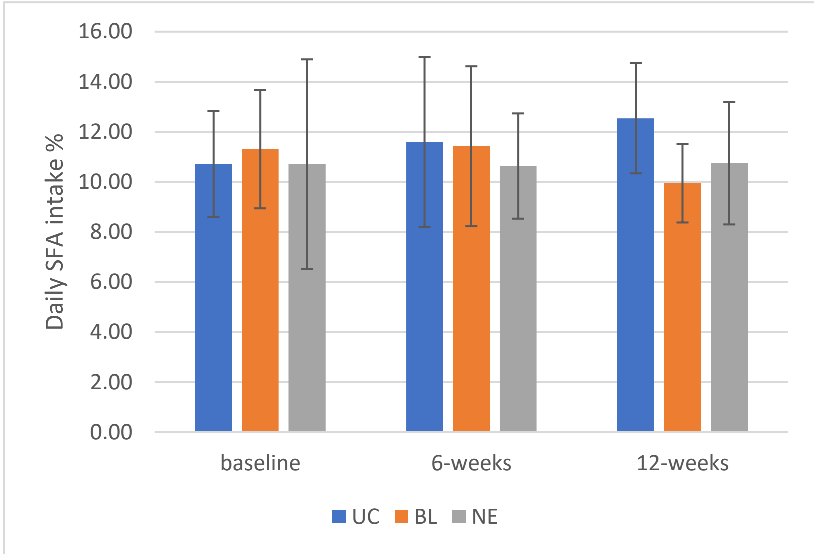
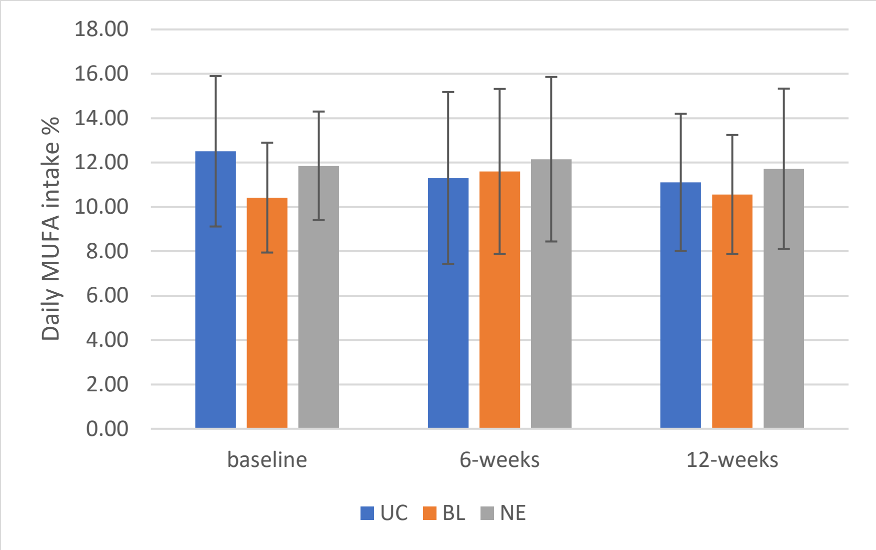


Figure 6.18 SFA intake (Mean ± SD) at each time point for each group.
All three groups have mean intakes meeting the RNI of less than 11% total intake.



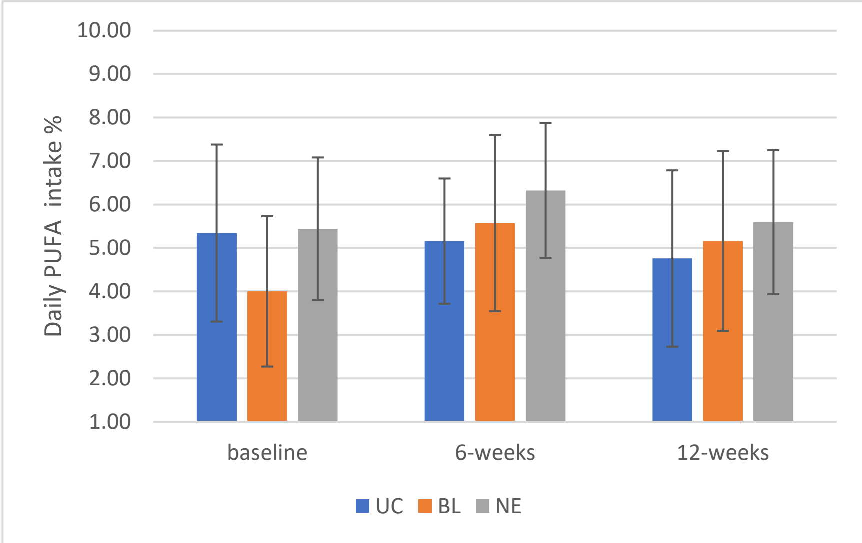
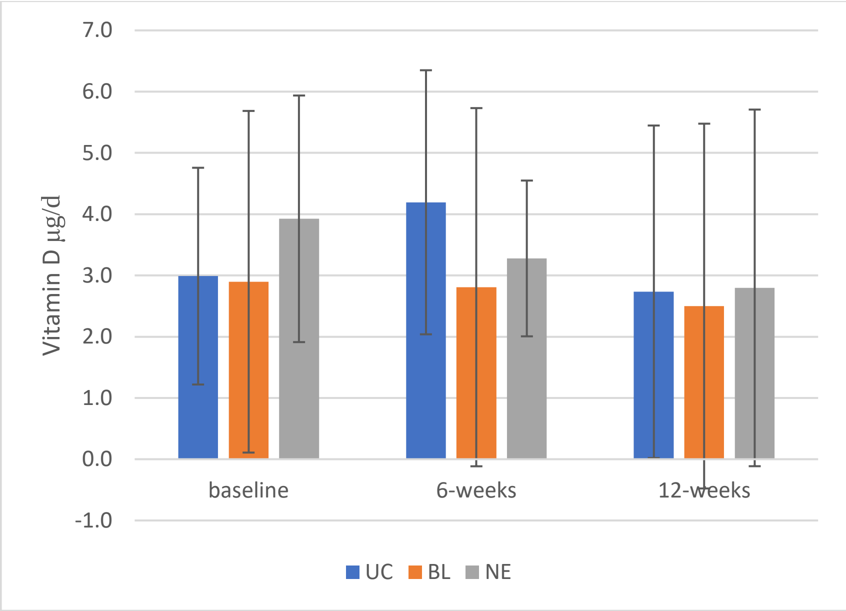


Figure 6.19 MUFA Intake (Mean ± SD) at each time point for each group.
Mean intakes for all groups are within the RNI of 12% total fat intake

Figure 6.20 PUFA Intake (Mean ± SD) at each time point for each group.
Mean intakes for all groups are below the RNI of 6% total fat intake.



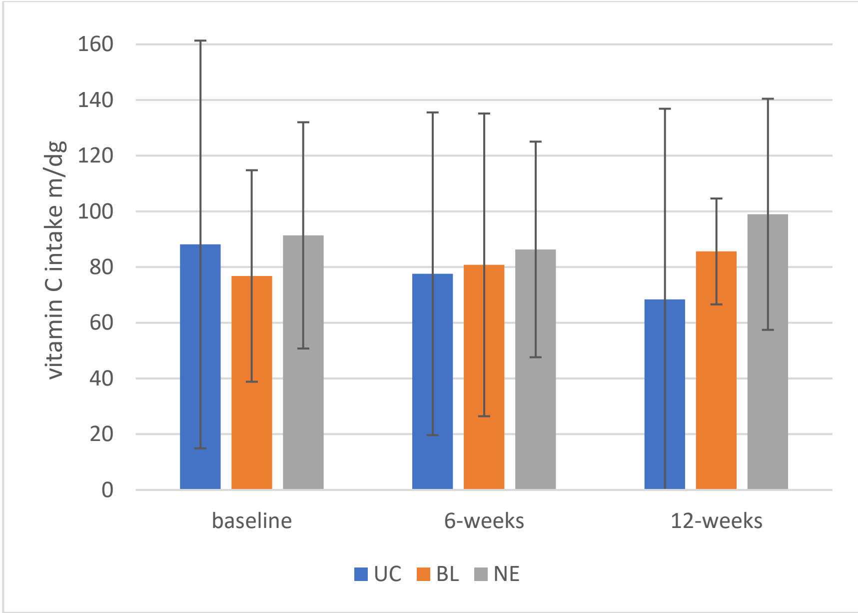


Figure 6.21 Vitamin D intake (Mean ± SD) at each time point for each group.
Vitamin D intakes are below the RNI of 10µg/d

Figure 6.22 Vitamin C intake (Mean ± SD) at each time point for each group.
Vitamin C intakes are twice the RNI however it is unlikely to cause harm.

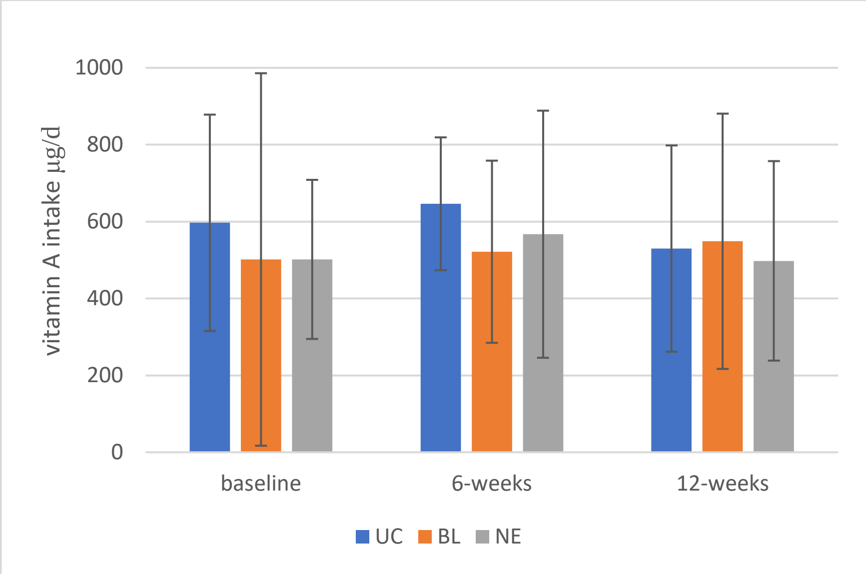


Figure 6.23 Vitamin A intake (Mean ± SD) at each time point for each group.
RNI is 600 µg/d all groups are below the RNI

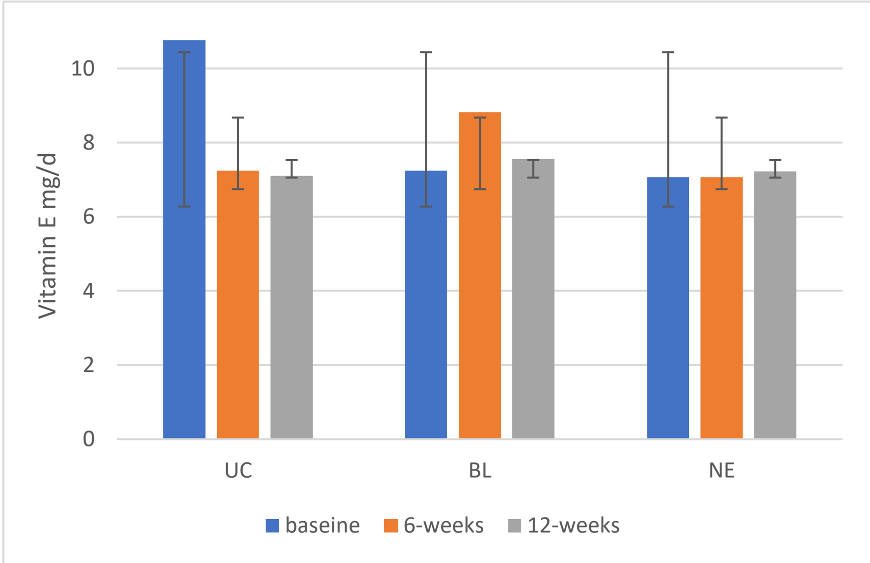
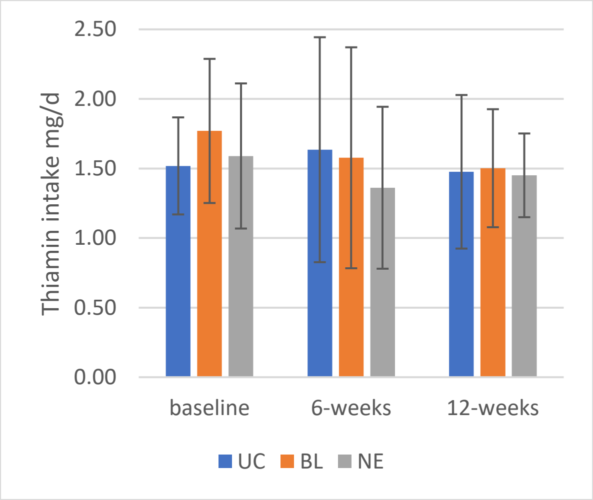
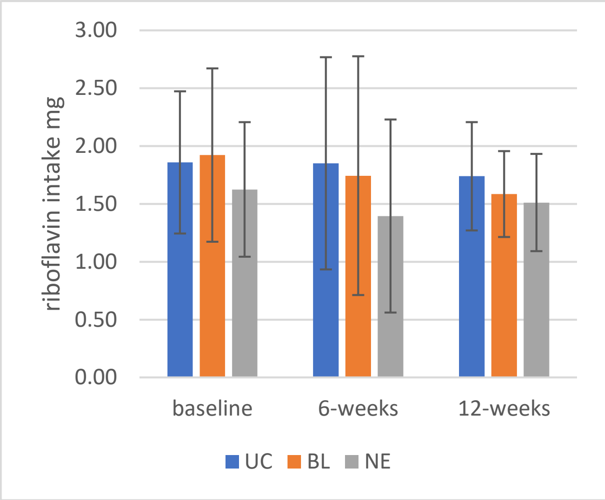


Figure 6.24 Vitamin E intake (Mean ± SD) at each time point for each group.
All groups are below the RNI of 15mg/d





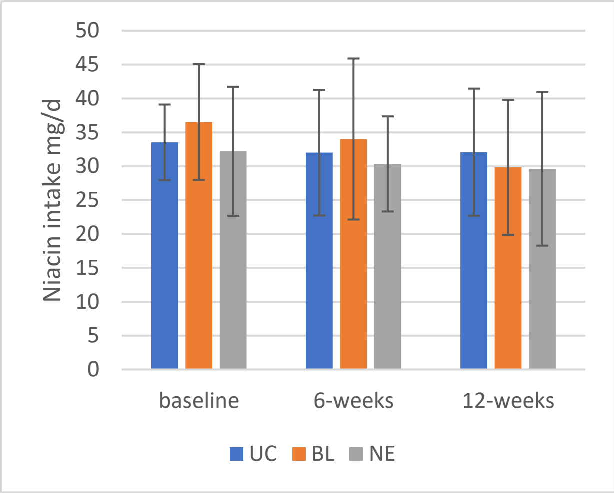


Figure 6.25 Thiamin intake (Mean ± SD) at each time point for each group.

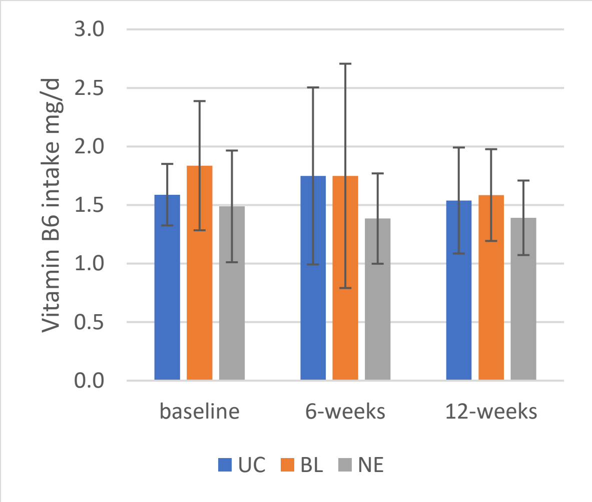
All group intakes were above the RNI of 0.9mg/d

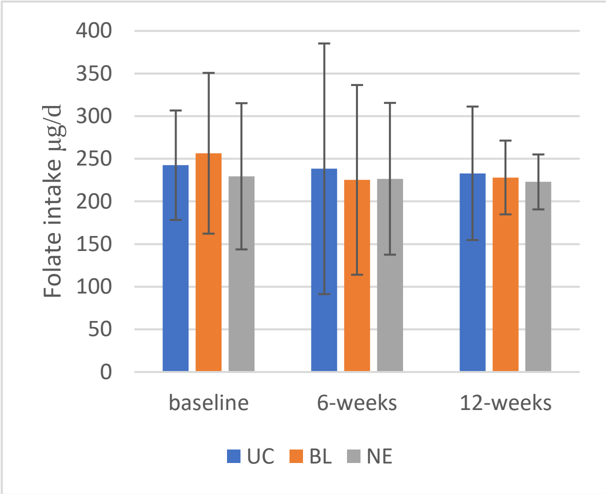
Figure 6.26 Riboflavin intake (Mean ± SD) at each time point for each group.

All intakes were above the RNI of 1.3mg/d

Figure 6.27 Niacin intake (Mean ± SD) at each time point for each group.

All intakes were above the RNI of 12mg/d





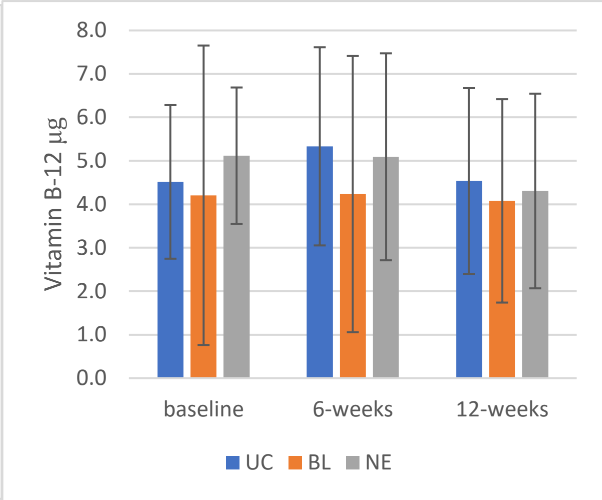


Figure 6.28 Vitamin B_6 intake (Mean ± SD) at each time point for each group.

Intakes for all groups are above RNI of 1.4µg/d

Figure 6.29 Folate intake (Mean ± SD) at each time point for each group.

Intakes for all groups are above RNI of 200µg/d

Figure 6.30 Vitamin B $_{12}$ intake (Mean ± SD) at each time point for each group.

Intakes for all groups are above RNI of 1.5µg/d

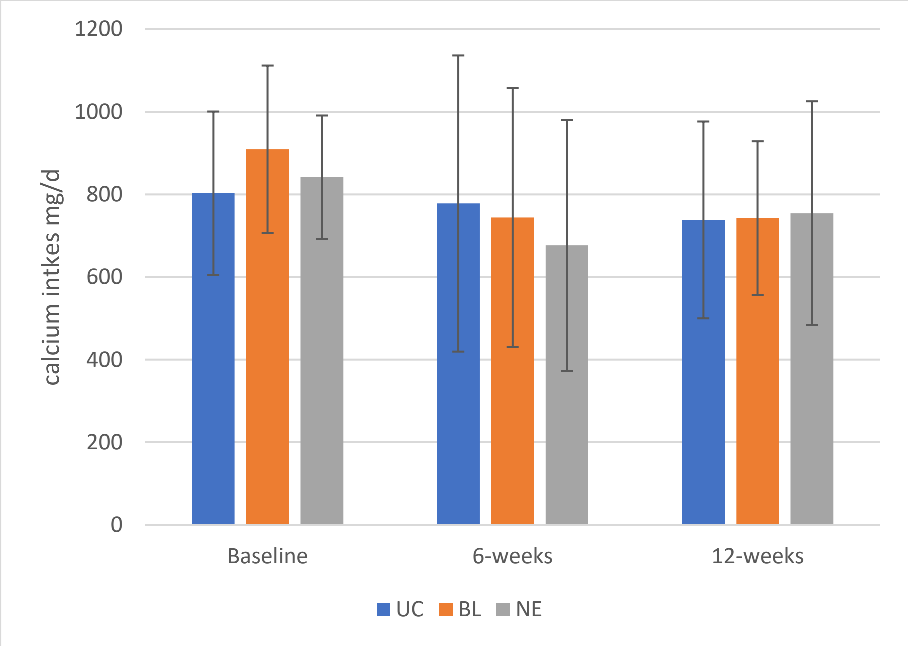


Figure 6.31 Calcium intake** (Mean ± SD) at each time point for each group.
Calcium intakes reduced over the intervention period for all groups, however remain within the RNI 700mg/d

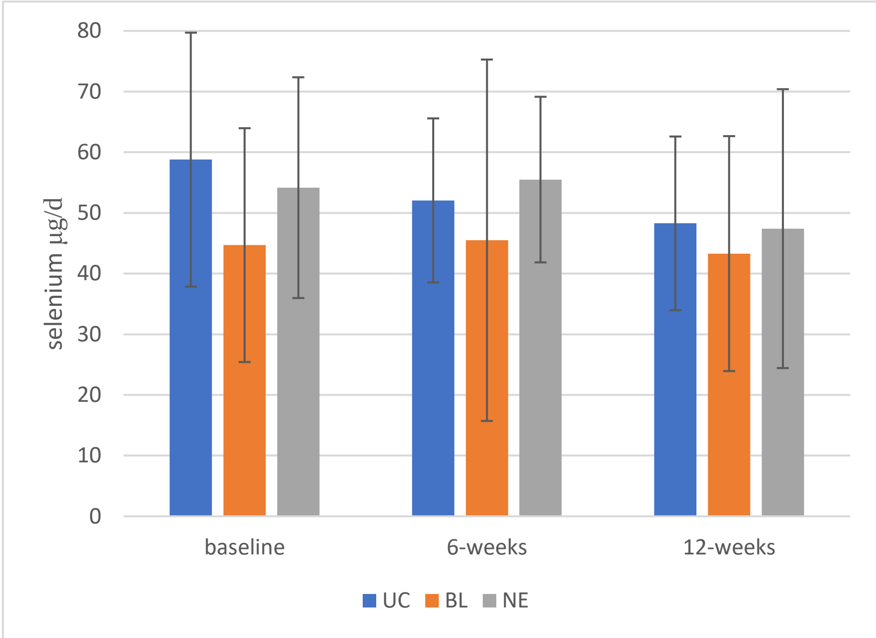
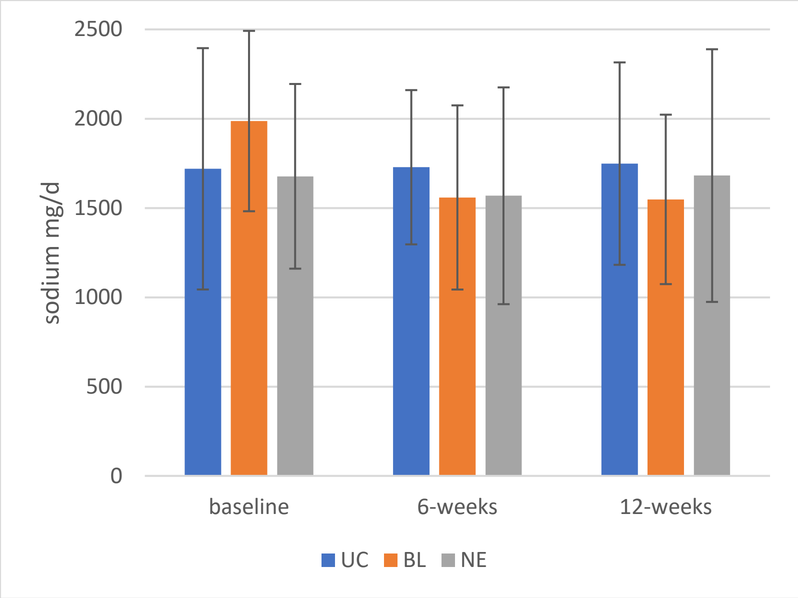


Figure 6.32 Selenium intake (Mean ± SD) at each time point for each group.
Intakes were below the RNI of 60µg/d in all groups



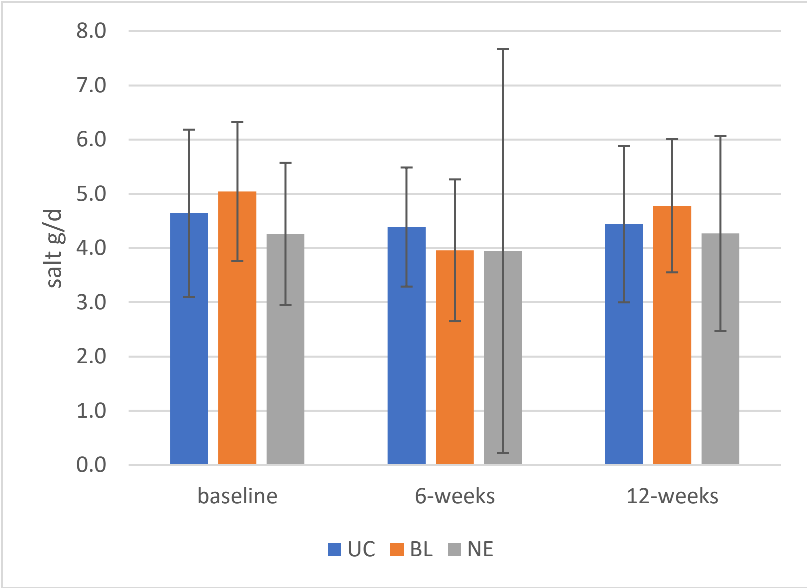


Figure 6.33 Sodium intake (Mean ± SD) at each time point for each group.

Mean intakes for all three groups puts them above the RNI for sodium 1,500mg/d

Figure 6.34Salt intake (Mean ± SD) at each time point for each group.

Mean intakes for all three groups was within the RNI of <5g/d

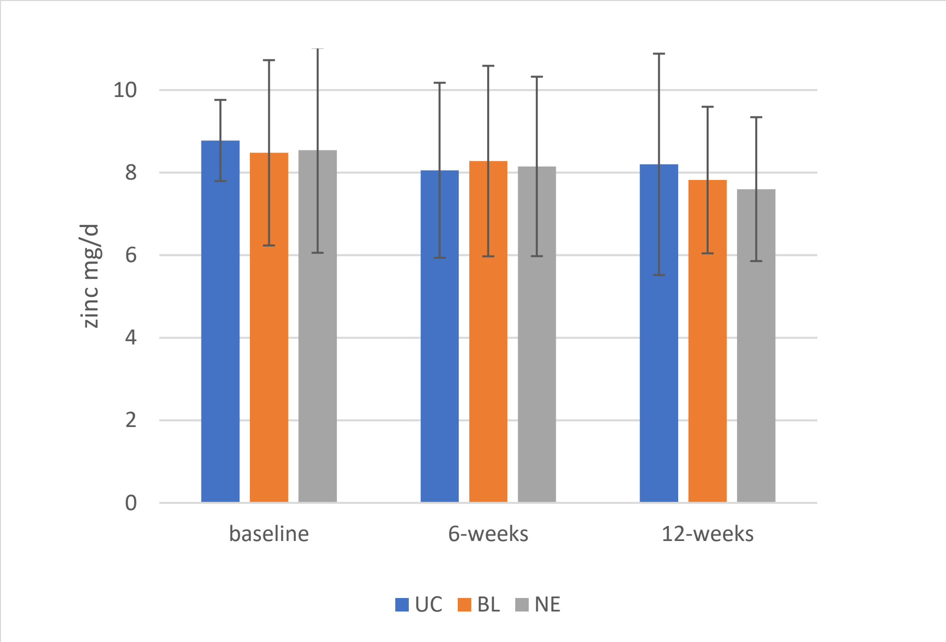


Figure 6.34 Zinc intake (Mean ± SD) at each time point for each group.

Mean intakes are slightly below the RNI of 9.5mg/d