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Holistic Evaluation of Lifestyle and Performance Diagnostics (HELP-D): A theoretical framework for screening and managing non-communicable diseases

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Abstract

Non-communicable diseases (NCDs) encompass a range of chronic conditions characterized by gradual transitions from health to disease and complex disruptions within the biological networks that underlie human pathologies. The cumulative impact of NCDs results in an estimated annual mortality of approximately 41 million individuals. Research has identified various modifiable risk factors associated with NCDs, which may act as behavioral precursors to these biological disruptions. Furthermore, lifestyle-based interventions have demonstrated effectiveness in managing or even reversing NCDs. Thus, our objective was to develop a theoretical framework for screening and managing NCDs within local gymnasiums, positioning these facilities as a critical interface between healthcare and lifestyle medicine. We conducted a narrative review employing predefined search terms combined with Boolean operators across three databases (Google Scholar, PubMed, and ProQuest) from December 1, 2024, to June 12, 2025. The literature search proceeded through three phases, beginning with initial search strings and evolving into 14 distinct keywords. Subsequently, we applied snowballing and forward citation strategies to align with the extensive scope of the review. A prioritization method was utilized to evaluate the relevance of included studies, and a modified feasibility assessment framework was employed to compare various screening modalities. This narrative review culminated in the development of the Holistic Evaluation of Lifestyle and Performance Diagnostics (HELP-D) framework.

The proposed framework includes a sociodemographic analysis, a prescreening tool, a lifestyle questionnaire, anthropometric measurements, an overhead squat assessment, handgrip strength testing, and a maximal oxygen uptake evaluation, along with assessments of potential confounding factors (e.g., caffeine intake). To demonstrate its diagnostic and inferential potential, we applied the model to the population of the State of Kuwait. Although the incorporated screening tools are based on empirical research, the model does present contemporary limitations that warrant a pilot study. Upon validation, the theoretical HELP-D framework shows promise for broad implementation.

Keywords: Non-communicable diseases, Screening, Lifestyle.

Introduction

Non-communicable diseases (NCDs) represent a group of chronic conditions characterized by gradual transitions from health to disease and intricate disturbances within the biological networks that underlie human pathologies.[1-3] These diseases, which are primarily non-infectious, fall into four major categories: cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes mellitus, alongside numerous additional subclassifications.[4] NCDs are responsible for over 70% of global deaths, with an estimated annual mortality of approximately 41 million individuals.[4] Their prevalence is particularly pronounced among individuals living in socially and economically disadvantaged circumstances, largely due to limited access to healthcare services and the lack of universal health coverage.[5,6]

The economic burden of NCDs is projected to escalate significantly in the coming decades, with global costs

expected to reach $13 trillion by 2030.[5] In the United States, the cumulative economic impact of NCDs on human capital between 2015 and 2050 is estimated to be $94.9 trillion, equating to approximately $265,000 per capita.[7] This financial strain is primarily attributed to disability-adjusted life years (DALYs), which combine years lost to premature mortality with years lived with disabilities associated with NCDs.[8] By 2019, NCDs accounted for 63.8% (95% UI, 61.4–66.0) of global DALYs, highlighting their significant societal impact.[8]

While the clinical symptoms of NCDs typically manifest between the fifth and seventh decades of life, evidence suggests that the transition from health to disease often begins much earlier, frequently during childhood or adolescence.[9] Research has identified several modifiable risk factors, such as physical inactivity[10] and the consumption of ultra-processed foods,[11] which are prevalent among adolescents[12,13] and tend to persist into adulthood.1 These behaviors contribute to low-grade inflammation, disrupting metabolic homeostasis and fostering dysmetabolic conditions.[14] Over time, these conditions create a biological environment that predisposes individuals to the onset of NCDs.15 The resultant synergistic effects involve disease-altered biological networks that trigger cascading failures in physiological systems, as evidenced by the high prevalence of multimorbidity among patients with NCDs.[16]

NCDs pose a complex medical and societal challenge[4] that can be addressed through various initiatives, including top-down government policies and individual lifestyle modifications.[17,18] Type 2 diabetes mellitus (T2DM) alone causes approximately 2 million deaths annually and contributes to the emergence of multimorbid states.[17] Nonetheless, research indicates that lifestyle modifications, such as carbohydrate restriction[19], may reverse T2DM. This evidence underscores the potential for proactive screening and subsequent lifestyle interventions to manage diabetes-related biological disruptions before further complications arise.[3,17]

Moreover, in addition to managing NCDs, identifying modifiable risk factors[10,11] prior to disease onset can facilitate prevention through the implementation of evidence-based lifestyle interventions.[19-21] These interventions should align with the six pillars of lifestyle medicine: balanced nutrition, regular physical activity, stress management, avoidance of harmful substances, restorative sleep, and fostering positive social connections.[20] However, early detection alone often fails to bring about sustained behavioral changes. Research indicates that population-level screenings for hypertension and T2DM typically do not result in significant improvements in health behaviors, despite the potential for reversibility through lifestyle medicine.[22-24] More favorable outcomes are observed when early detection is coupled with guided interventions from healthcare professionals.[25,26]

Given the constraints faced by overburdened medical facilities[5,6] and the necessity for expert guidance in screening and managing NCDs,[22-26] modern gyms could serve as a crucial link between healthcare and lifestyle medicine.[27] These facilities are client-centered and possess expertise in various aspects of lifestyle medicine.[20,27] Among these aspects is the provision of expert guidance in progressive resistance training modalities, which enhance musculoskeletal strength and cross-sectional area -factors associated with reduced NCD risk, lower all-cause mortality rates, and improved quality of life.[28-30] Collectively, the increasing pressures on healthcare systems,5,6 along with the inherent alignment of modern gyms with lifestyle medicine,[28-30] present a novel opportunity for the screening and management of NCDs, potentially alleviating their burden.[27]

Objectives

In light of these opportunities, we pose the following research question: Can an NCD screening and management tool be developed to inform tailored lifestyle medicine interventions, enabling modern gyms to function as a bridge between healthcare and lifestyle medicine? Our primary objective is to create a comprehensive framework for NCD screening and management while exploring its potential application within the context of the State of Kuwait. Additionally, the findings from our quasi-structured narrative review aim to provide an empirical foundation for a pilot study designed to gather essential information regarding its practical application.

Methods

We conducted a quasi-structured narrative review utilizing predefined search terms in conjunction with Boolean operators across three databases: Google Scholar, PubMed, and ProQuest. The review spanned from December 1, 2024, to June 12, 2025. The initial search strings included the following combinations: ((non-communicable diseases) AND (NCD)) AND (screening), ((non-communicable diseases) AND (NCD)) AND (risk factors), ((non-communicable diseases) AND (NCD)) AND (lifestyle medicine), and ((non-communicable diseases) AND (NCD)) AND (intervention). Subsequently, we employed individual keywords to identify additional pertinent literature, incorporating terms such as "physical activity," "lifestyle questionnaire," "health screening," "management," "blood pressure," "body composition," "body fat," "obesity," "circumference," "confounding factors," "circadian rhythm," "functional movement," "strength," and "maximal oxygen uptake." We also applied snowballing and forward citation strategies to ensure comprehensive coverage of relevant studies.

The title and abstract of each identified article were initially screened for relevance to determine whether a full-text review was warranted. Given the extensive volume of results retrieved through our quasi-structured narrative approach, we employed a prioritization method to assess the alignment of articles with the conceptual framework of this manuscript, as detailed in Table 1. Furthermore, the inclusion criteria for screening tools were established based on a modified feasibility assessment framework,[31] which facilitated comparisons between screening tools and alternative methodologies.

Table 1. Prioritization method for the quasi-structured narrative review

Category	Criteria
Inclusion criteria	- Manuscripts must be written in the English language.
Prioritization method	- High-quality systematic reviews, with or without meta-analysis, are prioritized over narrative reviews, individual empirical studies, or expert opinions. - Preference for studies with transcontinental sociodemographic inclusion over intracontinental sampling, except in sections focusing on the population of the State of Kuwait. - Studies with large sample sizes are favored over small-scale studies. - Contemporary research published within the past 10 years is prioritized over older literature. - Manuscripts thematically relevant to the screening and management of non-communicable diseases are prioritized. - Screening tools supported by empirical validation are favored over those based on anecdotal reports.

Results

1. Holistic Evaluation of Lifestyle and Performance Diagnostics (HELP-D)

1.1 Sociodemographic Characteristics

Evaluating the sociodemographic characteristics of target populations is essential for designing effective lifestyle interventions within the HELP-D framework. This information contextualizes the data collected in relation to normative or reference values reported in the literature, while also considering geographic-specific barriers and facilitators.[32-34] For instance, physical activity levels can vary significantly even among European countries,[32] reflecting environmental factors such as walkability[33] and cultural barriers that influence healthy lifestyle behaviors.[34] Additionally, dietary patterns are often influenced by population-specific characteristics shaped by cultural and religious contexts.[35-37]

Thus, understanding the sociodemographic characteristics of the target population -particularly in relation to modifiable NCD risk factors- enables professionals to develop individualized and culturally sensitive lifestyle interventions [Table-2]. When implementing the HELP-D framework for diverse populations, we recommend conducting a preliminary scientific review, similar to the approach taken by Kuijpers et al.,[37] in their study of the State of Kuwait. Their findings highlighted several population-specific modifiable risk factors, including poor nutritional habits, tobacco exposure, excess body weight, and inadequate sleep patterns.

Table 2. Sociodemographic influences on the application of the holistic evaluation of lifestyle and performance diagnostics (HELP-D) framework

Population	Sociodemographic Characteristic	Inferences
Global	- Income and socioeconomic status[5] - Education level[5] - Employment and occupation - Healthcare accessibility[5]	- Targeted educational initiatives are needed to enhance health literacy.[38] - Limited understanding of lifestyle as a modifiable risk factor for non-communicable diseases (NCDs) may hinder intervention uptake.[37] - Time constraints due to employment may limit adherence to lifestyle-based interventions. - Limited access to healthcare facilities and professionals may restrict guidance for lifestyle interventions in clinical populations.[6]
State of Kuwait	- Arid climate and limited infrastructure for physical activity[37] - Prevalence of fast-food chains and traditional diets low in plant-based foods[37] - Religious practices, including the Holy Month of Ramadan[39] - High obesity rates[37]	- Restricted outdoor mobility due to climate and infrastructure limits opportunities for physical activity, posing barriers to adopting active lifestyles.[33,37] - Limited availability of nutritious food options, coupled with abundant ultra-processed foods, may reduce willingness to adopt nutritional interventions.[37] - Daytime fasting, frequent family gatherings, mosque visits, and altered sleep schedules during Ramadan may necessitate tailored lifestyle interventions.[39] - Social acceptance of obesity and lower peer-driven encouragement may reduce motivation for lifestyle changes.[40]

1.2 Eligibility of Participants

Physical activity and exercise have been shown to reduce the risk of sudden cardiac death, challenging the common belief that exercise may be harmful to individuals with cardiac conditions.[41] These activities, whether structured or unstructured, serve as a primary prevention strategy against NCDs, functioning as a form of natural medicine for both clinical and non-clinical populations.[42,43]

Despite substantial evidence supporting the efficacy and safety of exercise in clinical settings,[42-44] the HELP-D framework incorporates pre-participation screening as part of the duty-of-care safety legislation recognized in various countries.[44] It is essential for allied healthcare professionals to minimize any potential risks associated with the services they provide. Consequently, many sports facilities implement the Physical Activity Readiness Questionnaire (PAR-Q) as a safety screening tool. However, this questionnaire has notable limitations, including age restrictions (15 to 69 years) and an overly conservative approach that may lead to unnecessary medical referrals.45 To address these issues, we recommend using the revised version known as the Physical Activity Readiness Questionnaire for Everyone (PAR-Q+), which alleviates some of the constraints of the original PAR-Q.[46]

Furthermore, we advocate for the administration of seven evidence-based questions designed to screen for medical contraindications.[46] Participants who respond 'yes' to any of the initial questions will advance to the follow-up section.[47] To prevent unnecessary medical referrals and barriers to engaging in physical activity, the HELP-D framework aligns with the current trend of granting allied healthcare professionals with advanced training in pathological conditions greater autonomy in determining exercise suitability.[48] Nonetheless, allied healthcare professionals lacking clinical training must refer individuals to a general health practitioner for further evaluation.

1.3 Lifestyle questionnaire, anthropometrics, and cardiometabolic parameters

1.3.1 Lifestyle questionnaire

A variety of screening tools have been developed to assess unhealthy lifestyle behaviors.[49-51] The Healthy Lifestyle and Personal Control Questionnaire (HLPCQ) introduces an innovative assessment tool targeting modifiable risk factors for NCDs. This questionnaire consists of 26 items organized into five distinct domains.[49] The questions are articulated in straightforward language and utilize a four-

point Likert scale for scoring, making the tool accessible to a broad demographic.[49] While the HLPCQ is comprehensive, it may be beneficial to include inquiries regarding current glycemic levels and serum total cholesterol, given their established connections to NCD development.[37,51] If individuals lack this information, allied healthcare practitioners should encourage them to undergo blood tests at local medical facilities to facilitate a more thorough assessment of NCD risk.

Although the HLPCQ is a practical tool for diverse populations, its application may be limited by language barriers and population-specific characteristics. For instance, when targeting young Arab children, the Arab Teens Lifestyle (ATLS) questionnaire may be preferred due to its cultural and geographic relevance.[52] Additionally, the HLPCQ does not address alcohol consumption,[49] despite its well-documented health risks.[51] The omission of substance-related questions may be viewed as a limitation in some contexts, although such inquiries may be deemed inappropriate in certain countries. The inclusion of substance-related questions should therefore be adapted to align with the cultural context in which the HELP-D framework is implemented.

1.3.2 Systolic blood pressure

Systolic blood pressure (SBP) serves as a critical objective measure of arterial pressure during cardiac contraction, reflecting the hemodynamic load imposed on vital organs such as the brain, heart, and kidneys. SBP is typically measured in millimeters of mercury (mmHg) using a sphygmomanometer. A diagnosis of hypertension is made when SBP readings are consistently ≥140 mmHg and/or diastolic blood pressure (DBP) readings are ≥90 mmHg. Over the past three decades, the global prevalence of hypertension has doubled,[53] establishing it as the most significant modifiable risk factor for cardiovascular diseases (CVDs).[54] Accurate assessment of SBP necessitates careful consideration of various confounding factors to ensure reliable readings. Essential considerations include avoiding caffeine for at least 30 minutes prior to measurement, providing reassurance to reduce anxiety, measuring while seated with the back supported and legs uncrossed, and taking multiple readings.[55] For a comprehensive discussion on ensuring valid and reliable blood pressure measurements, we refer readers to Rehman and Hashmi.[55]

Encouragingly, evidence indicates that hypertension can frequently be reversed through intensive lifestyle interventions.[53] Notably, a synergistic health benefit arises when a healthy dietary pattern is combined with regular moderate-to-high levels of physical activity,[56] highlighting the importance of multimodal lifestyle interventions as a fundamental component of hypertension management.

1.3.3 Body Mass Index

Body mass index (BMI) is a widely accepted anthropometric measure utilized in population-based research for the classification of body mass and the assessment of overall health status.[57] Its prevalence can be attributed to its simplicity, practicality, and the capacity to use self-reported data.[58] However, despite its advantages, BMI has notable limitations. Notably, it does not account for fat distribution across different body regions nor does it differentiate between visceral and subcutaneous fat accumulation, both of which have distinct metabolic implications and varying degrees of risk for NCDs.[58,59] While BMI serves as a useful preliminary indicator, a more comprehensive multi-metric body composition assessment is essential for nuanced NCD risk screening.[60]

To address the limitations of BMI, additional measures such as waist circumference and body fat percentage are recommended as part of a multi-metric assessment. These metrics can identify individuals who may not be classified as overweight or obese according to BMI but still face an elevated risk for NCDs due to increased waist circumference and/or body fat percentage.[58,59] This is particularly relevant for individuals with sarcopenic obesity, characterized by low muscle mass coupled with high fat mass.[61]

For individuals with elevated BMI, effective strategies for improvement include the adoption of a hypocaloric diet and regular engagement in resistance training exercises.[62] This multimodal approach offers complementary benefits; resistance training helps to preserve skeletal muscle mass during periods of negative energy balance, which is crucial for facilitating weight loss.[62] Consequently, metabolic health can be enhanced, and NCD risk can be effectively managed through the integration of various parameters.

1.3.4 Midabdominal Waist Circumference

Midabdominal waist circumference (WC) has been identified as a superior anthropometric measure for predicting central obesity when compared to BMI and waist-to-hip ratio (WHR).[63] This screening tool is instrumental in diagnosing central obesity and is associated with a cluster of metabolic risk factors, including hypertension, dyslipidemia, and diabetes mellitus.[64] One significant advantage of midabdominal WC over BMI is its heightened sensitivity in detecting both subcutaneous and visceral adipose tissue accumulation in the midabdominal region, which is linked to adverse metabolic outcomes.64 In contrast, individuals with a high BMI may exhibit a more uniform distribution of subcutaneous fat across various body regions, resulting in a comparatively lower risk profile than those with central obesity.[65]

Standardized thresholds for elevated WC are defined as ≥88 cm for females and ≥102 cm for males.[65] However, these thresholds may not adequately reflect variations across different BMI categories or ethnic groups. Research indicates that utilizing BMI-specific and ethnicity-specific midabdominal WC thresholds can provide more accurate predictions of central obesity and its associated health risks.[65] Therefore, practitioners are encouraged to apply population-specific thresholds whenever available to enhance the precision of central obesity risk assessments. In instances where ethnic-stratified data for the target population is lacking, adherence to international guidelines is recommended.[65]

Contemporary guidelines highlight two primary strategies for reducing midabdominal WC: the adoption of a hypocaloric diet and the engagement in one to two hours of physical activity daily.[66] Evidence suggests that even a modest reduction in midabdominal WC -approximately 3 cm- can lead to significant improvements in metabolic health, making it a practical and impactful goal for intervention strategies.[67]

1.3.5 Body fat percentage

The relationship between elevated body fat percentages and the risk of NCDs is well-established in the medical literature, demonstrating greater sensitivity compared to BMI.[68-69] This measurement is particularly relevant for diagnosing sarcopenic obesity, especially in older populations, which may not be adequately identified using BMI or midabdominal WC alone.[61] For example, individuals may present with normal BMI and midabdominal WC while having an elevated body fat percentage, suggesting the potential presence of sarcopenic obesity.[61] Regardless of the initial assessment, comprehensive screening is necessary to identify sarcopenic obesity, including evaluating skeletal muscle function through performance diagnostics.[61]

Furthermore, a correlational study involving 16,918 adults in the United States found that metabolic syndrome was absent in individuals with body fat percentages below 18% in men and 30% in women.[59] An inverse relationship was observed between body fat percentage and the prevalence of metabolic syndrome, indicating that higher body fat percentages correlate with increased prevalence rates.[59] Additional findings suggest cut-off points of 25.8% body fat for men and 37.1% for women, beyond which the likelihood of developing CVD rises significantly.[70] Collectively, these data imply that lower body fat percentages are beneficial for cardiovascular and overall health.[59,70]

Various techniques are available for assessing body fat percentage, encompassing both field-based and laboratory-based methods.[71] Each method has its own limitations. For instance, standard skinfold measurements may be affected by errors related to the measurement technique, the selection of anatomical landmarks, and the accuracy of predictive equations.[71] In our feasibility assessment, we considered factors such as cost-effectiveness and the required operational training, ultimately recommending bioelectrical impedance analysis (BIA) as a suitable technique.[72] Among the available options, the InBody 770® (InBody Co., Seoul, Korea) stands out as an affordable choice that delivers stable and reproducible measurements of body composition under controlled conditions.[72] To ensure standardized BIA measurements, it is essential to avoid water intake immediately before testing, maintain fasting for at least four hours prior to measurement, and refrain from physical activity for at least six hours before assessment.

Typical strategies for reducing body fat percentage align closely with those outlined in the sections on BMI and midabdominal waist circumference, particularly involving hypocaloric diets, physical activity, and resistance training.[62,66] Evidence indicates that multimodal interventions generally outperform monomodal approaches in effectiveness.

1.4 Performance Diagnostics

1.4.1 Pre-Testing Questionnaire

Human performance is influenced by various temporal factors, among which circadian rhythms are among the most extensively studied.[73] These rhythms affect numerous physiological systems, often resulting in peak performance during the late afternoon.[74] However, some research indicates no statistically significant differences in muscular performance metrics between morning and evening assessments, suggesting considerable variability in individual responses.[75] Given the time-dependent nature of performance, assessors must remain cognizant of these factors, as they may influence testing outcomes alongside other variables that affect the reliability of the collected data.

For instance, delayed-onset muscle soreness (DOMS), which arises from eccentric muscle contractions, can lead to strength deficits persisting for several days.[76] Similarly, plyometric training -characterized by rapid transitions from eccentric to concentric muscle contractions to trigger a stretch reflex- can result in significant peripheral fatigue[77] and diminish neuromuscular performance for several days following exercise.[78]

Nutritional status is another critical confounding variable. Depending on the metabolic demands of the assessment, low carbohydrate availability -an essential consideration in T2DM reversal programs[19]- can adversely affect muscular performance.[79] Conversely, pre-test caffeine consumption may induce an ergogenic effect, potentially skewing the results.[80] Additionally, sleep quality and duration are significant factors influencing human performance diagnostics. Sleep deprivation has been shown to impair muscle strength81, executive functions[82], and other performance metrics.[83] Even a single night of inadequate sleep can produce measurable changes in neurobehavioral function.[82]

Given the multitude of potential confounders -of which those discussed above are not exhaustive- it is crucial for assessors to manage these variables or at least acknowledge their probable impact. To facilitate this process, we recommend implementing a questionnaire to document relevant confounding factors [Table 3]. Standardizing testing conditions can enhance the reliability of performance diagnostics assessments and enable more accurate interpretations of data derived from lifestyle interventions.

1.4.2 Overhead Squat Assessment

The Overhead Squat Assessment (OHSA) is a dynamic movement evaluation within a closed kinetic chain, applicable to diverse populations, including field-based athletes and the general public.[84,85] This assessment is particularly valuable for screening fundamental movement patterns that are essential for everyday activities, such as sitting down or standing up from a chair. While the evidence may be limited due to statistical constraints,[86] the OHSA serves as a conceptual framework for enhancing physical functionality in active individuals. Additionally, it functions as an exercise modality aimed at improving lower extremity strength and endurance, which can contribute to a better quality of life and a reduced risk of NCDs.[28-29,87-88]

The OHSA effectively identifies deviations from optimal squat biomechanics, which are often compensatory strategies employed by the body in response to abnormal motor control patterns, muscular imbalances, or altered osteo- and anthropokinematics.[84] These deviations can be observed in both the frontal and sagittal planes of knee joint motion, with particular attention to the kinematics of the lumbar and thoracic spine.[89] For example, dynamic medial knee collapse is a compensatory strategy characterized by the inward movement of the knees toward the midline in the frontal plane.[90] This medial collapse increases compressive loads on the lateral structures of the knee, potentially compromising joint integrity and elevating the risk of lower extremity injuries, including anterior cruciate ligament (ACL) ruptures.[90-91]

Interventional strategies for addressing medial knee collapse typically include corrective exercises designed to

strengthen the hip abductor muscles, alongside implicit learning techniques aimed at fostering permanent neuromuscular adaptations.[91] One effective approach involves performing squat variations with an elastic band positioned around the distal thighs, which aids in activating hip abductor muscles such as the gluteus medius.[88] This technique promotes proper joint alignment, facilitates neuromuscular adaptations, and leads to biomechanical improvements.[91]

The scientific literature has examined the reliability of the OHSA, revealing acceptable levels of intra-rater and inter-rater reliability for detecting specific observable movement dysfunctions among experienced assessors.[92,93] However, the expertise and experience of the examiner are critical factors influencing this reliability. For example, Hernandez-Garcia et al.[92] found that not all individuals demonstrated acceptable intra-rater reliability, suggesting that variability in reliability scores may stem from differences in examiner experience. Previous studies on movement screening support this notion, highlighting the significance of education and practical experience in movement analysis for achieving valid and reliable outcomes.[94]

To enhance the accuracy of OHSA evaluations, we recommend employing the eleven-point scoring system outlined by Bischop et al.,[94] which provides a structured framework for documenting movement dysfunctions. In terms of administrative standardization, it is essential to maintain consistent footwear during assessments and to avoid warm-up exercises, allowing for the observation of natural movement patterns.[85] Additionally, utilizing cameras with a sampling rate of 120 Hz or higher can facilitate detailed movement recording. Two-dimensional camera analysis enhances evaluation accuracy and serves as a valuable tool for demonstrating biomechanical improvements over time to clients.[95-96] By combining examiner expertise with standardized scoring methods and advanced technologies, the reliability and overall utility of the OHSA within the HELP-D framework can be significantly improved.

1.4.2 Hand-Grip Strength

Body composition, particularly body fat percentage, serves as a critical biomarker associated with the risk of NCDs and all-cause mortality.[69] It is also a diagnostic parameter in sarcopenic obesity.[61] Despite the clinical importance of body composition metrics, emerging evidence indicates that low muscle strength is an independent risk factor for NCDs and all-cause mortality, regardless of muscle mass and other physiological or anthropometric factors.[29,43]

Hand-grip strength (HGS) assessment is widely utilized as a surrogate measure of overall body strength across diverse population cohorts.[97] However, the strength of the correlation between HGS and overall strength can vary based on demographic and methodological factors.[97] Vaishya et al.,[98] have proposed HGS as a novel health indicator due to its significant associations with NCDs, sarcopenia, and fragility fractures. One advantage of HGS assessment is the extensive normative data available; a recent systematic review that included 100 unique observational studies analyzed data from 2,405,863 adults, providing comprehensive reference values across various populations.[99]

Standardization of measurement protocols is crucial, as variations in HGS assessment methodology -including the device used, elbow positioning, and hand placement- can significantly affect data validity.[100] Based on feasibility assessments, we recommend the VALD Performance DynaMo Plus, which samples at 225 Hz. This device is noted for its validity, ease of use, and compatibility with the VALD Data Hub, facilitating streamlined data collection and analysis.[101]

For standardizing body positioning during HGS assessments, we recommend a seated posture with 90° hip flexion, shoulder adduction and neutral rotation, elbow flexed at 90°, and forearm in a neutral position. The wrist should remain straight and in a neutral position. HGS should be measured in the dominant hand over three trials, each lasting three seconds, to ensure data reliability.[100] Additionally, confounding variables outlined in Table 3 should be assessed prior to administering HGS. It is advisable to avoid caffeine intake for at least two hours before testing due to its potential ergogenic effects and to refrain from strenuous activities for 72 hours prior to assessment.[76-78,80]

Individuals exhibiting low muscle strength should

engage in a progressive whole-body resistance training program at least twice per week to reduce the risk of NCDs and all-cause mortality.[29] The benefits of resistance training on muscle hypertrophy and strength development demonstrate a dose-response relationship, indicating that higher training volumes (e.g., additional training sets) may further enhance physiological adaptations and subsequent health benefits.[102]

Table 3. Pre-Testing Questionnaire to Mitigate Confounding Factors in the Holistic Evaluation of Lifestyle and Performance Diagnostics (HELP-D) Framework

Potential Confounding Factor	Question in Pre-testing questionnaire	Practical example	Mitigation strategy
Circadian rhythm			
Time of day [74-75]	What time of day is the assessment being conducted?	Testing at 8 a.m. for the initial evaluation and at 6 p.m. for the retest may lead to false positives in performance diagnostic tests due to circadian rhythm variations.	Standardize administration times to ensure consistency across evaluations.
Physical training			
Delayed-onset muscle soreness (DOMS) [76]	Please rate your current level of muscle soreness on a scale of 1 to 10 (1 = no soreness, 10 = severe soreness).	Testing with a soreness score of 0 during the initial evaluation and 10 during the retest may result in false negatives in performance diagnostic tests.	Recommend that clients rest for at least 72 hours prior to testing to minimize DOMS.
Peripheral fatigue [77-78]	How many days have passed since your last physical training session (e.g., sports, resistance training, or other structured exercise)? 1) ≤ 24 hours, 2) 1–3 days, 3) ≥ 4 days	Testing with ≥ 4 days of rest before the initial evaluation and ≤ 24 hours after training for the retest may lead to false negatives in performance diagnostic tests.	Recommend that clients rest for at least 72 hours prior to testing to reduce peripheral fatigue.
Nutrition			
Carbohydrate availability [79]	What meal(s) did you consume today prior to testing? Please specify the type and approximate quantity.	Testing in a glycogen-depleted state during the initial evaluation and after carbohydrate loading for the retest may result in false positives in performance diagnostic tests.	Standardize pre-test food consumption to ensure consistent carbohydrate availability.
Caffeine intake [80]	Did you consume any caffeinated beverages or food products today? If yes, please specify the type and quantity (e.g., cups of coffee, energy drinks).	Testing without caffeine during the initial evaluation and after consuming two cups of espresso for the retest may result in false positives in performance diagnostic tests.	Standardize pre-test consumption of caffeinated products to ensure consistency.
Sleep			
Sleep duration [82,83]	How many hours of sleep did you get last night?	Testing at 6 a.m. after a short night of sleep for the initial evaluation and at 6 p.m. after restful sleep for the retest may result in false positives in performance diagnostic tests.	Schedule the HELP-D assessment at a time when the client is typically well-rested.

1.4.3 Maximal oxygen uptake

Maximal oxygen uptake (VO_2max) is defined as the maximum rate at which the body can consume and utilize oxygen during intense physical activity. This metric reflects the integrated performance of the cardiovascular and respiratory systems in delivering oxygen, as well as the skeletal muscles' ability to extract and utilize oxygen for oxidative metabolism. Beyond its significance for athletic populations, a recent systematic review encompassing 42 studies and 3.8 million observations has established a

dose-response relationship between VO_2max and a decreased risk of all-cause and cardiovascular-related mortality in adults.[103] Furthermore, low VO_2max levels may exacerbate health risks associated with obesity.[104] Notably, evidence indicates that enhancements in VO2max provide health benefits independently of body weight, a phenomenon referred to as the "fat-but-fit" paradox.[105] These findings underscore the importance of evaluating VO_2max as a critical health marker, separate from other physiological and anthropometric parameters.[103]

Various methodologies exist for assessing VO2max, each differing in terms of validity, reliability, and feasibility.[106] While estimation equations may introduce inherent biases, gold-standard laboratory assessments are often impractical for widespread use due to their high costs, extensive calibration time, and technical demands.[106] Therefore, we advocate for the Åstrand test (Å-test), a six-minute submaximal cycling protocol performed at a constant cadence of 50 RPM, based on our feasibility assessment.[106] In this test, VO_2max is estimated using a nomogram based on the steady-state heart rate recorded during the final minute of exercise, with participants aiming for a perceived exertion level of approximately 13 on the Borg CR20 scale.[107] The Å-test benefits from a comprehensive reference dataset derived from 263,374 Swedish adults.[106] However, empirical testing suggests that the Å-test may have a margin of error of ±10–15% when compared to gold-standard measures.[106] Despite this limitation, the Å-test is scalable and practical for routine implementation, although it may not fully capture more subtle training-induced adaptations.[107] The test requires only a cycling ergometer and a heart rate monitor capable of real-time data transmission, such as the Polar H10 sensor.[108]

Improvements in VO2max can be achieved through various exercise modalities and intensities.[109] Recent research highlights high-intensity interval training (HIIT) as an effective approach,[109] characterized by alternating periods of intense effort at 90% or greater of VO_2max with intervals of passive or active recovery.[39] Compared to lower-intensity alternatives, HIIT is associated with more significant cardiorespiratory adaptations.[107] For instance, three weekly HIIT sessions over an eight-week period resulted in a 7.2% increase in VO_2max among moderately trained individuals,[110] suggesting that reductions in all-cause and cardiovascular mortality risk can be achieved within a relatively short timeframe.[103]

Summary and Potential Applications of the Theoretical HELP-D Framework

The theoretical HELP-D framework's modular workflow has been summarized and contextualized for the State of Kuwait [Figure-1]. It begins with an initial scientific investigation aimed at assessing the sociodemographic characteristics of the target population and identifying modifiable risk factors associated with NCDs. The framework comprises three distinct phases: eligibility assessment, holistic lifestyle evaluation, and performance diagnostics. While the screening tools incorporated into the HELP-D framework have been evaluated for feasibility, we recognize that allied healthcare practitioners may face various constraints and facilitators during their implementation. To enhance the contextual adaptability of the HELP-D framework, alternative tools are provided for specific screening technologies [Table 4].

Data Integration

Although pilot research is still pending, the theoretical HELP-D framework shows potential as a tool for NCD screening and management, enabling the development of tailored interventions based on the principles of lifestyle medicine.20 We have illustrated fictitious data in Figure 2 to demonstrate the possible diagnostic and inferential significance derived from data collected through the HELP-D framework. Further applied research is necessary to explore whether this data can be aggregated into a risk-score algorithm.

Conclusions

NCDs represent a group of chronic conditions characterized by gradual transitions from health to disease and complex disturbances in the biological networks underlying human pathologies. The theoretical HELP-D framework offers a structured approach to screening and managing NCDs, positioning local gymnasiums as critical interfaces between healthcare and lifestyle medicine.

While the screening tools embedded within the HELP-D framework are based on empirical research, the model currently faces limitations regarding its accessibility, feasibility, and scalability. Pending ethical approval from the Ministry of Health, a pilot study is set to be conducted across seven branches of a privately-owned gymnasium center in Kuwait. This pilot study aims to collect essential information on the practical application of the HELP-D framework, including its cost-effectiveness, the duration required for practitioner training, challenges faced by clients, inter-rater reliability, and governance practices concerning sensitive client data. Therefore, contingent upon validation from pilot testing, the theoretical HELP-D framework has significant potential for widespread adoption in addressing the global burden of NCDs.

Table-4. Alternative screening technologies for the Holistic Evaluation of Lifestyle and Performance Diagnostics (HELP-D) framework

Screening Parameter	Technology/Methodology	Advantages	Disadvantages
Body Fat Percentage	Skinfold Caliper[111]	Cost-effective, portable, and easy to use	Prone to significant tester error, requires skilled application
	Bioelectrical Impedance Analysis (BIA)[72]	Requires minimal technical training, relatively affordable	Requires strict standardization for consistent and reliable readings
	Dual-Energy X-ray Absorptiometry (DEXA)[112]	Gold standard for accuracy and precision	Expensive, requires medical training, involves radiation exposure
Handgrip Strength	Jamar Dynamometer[113]	Cost-effective, portable, and widely accessible	Analog, measures only peak force (uni-metric)
	VALD Performance Dynamometer[101]	Cost-effective, provides cloud-based analytics, measures multiple metrics (e.g., peak force, rate of force development)	Less affordable than Jamar, requires charging and maintenance
Maximal Oxygen Uptake Capacity (VO_2max)	Åstrand Test[106]	Scalable, requires minimal operational expertise	±10–15% margin of error compared to metabolic systems
	Metabolic System[114]	Gold standard for accuracy in measuring VO_2max	High cost, requires operational expertise, time-intensive

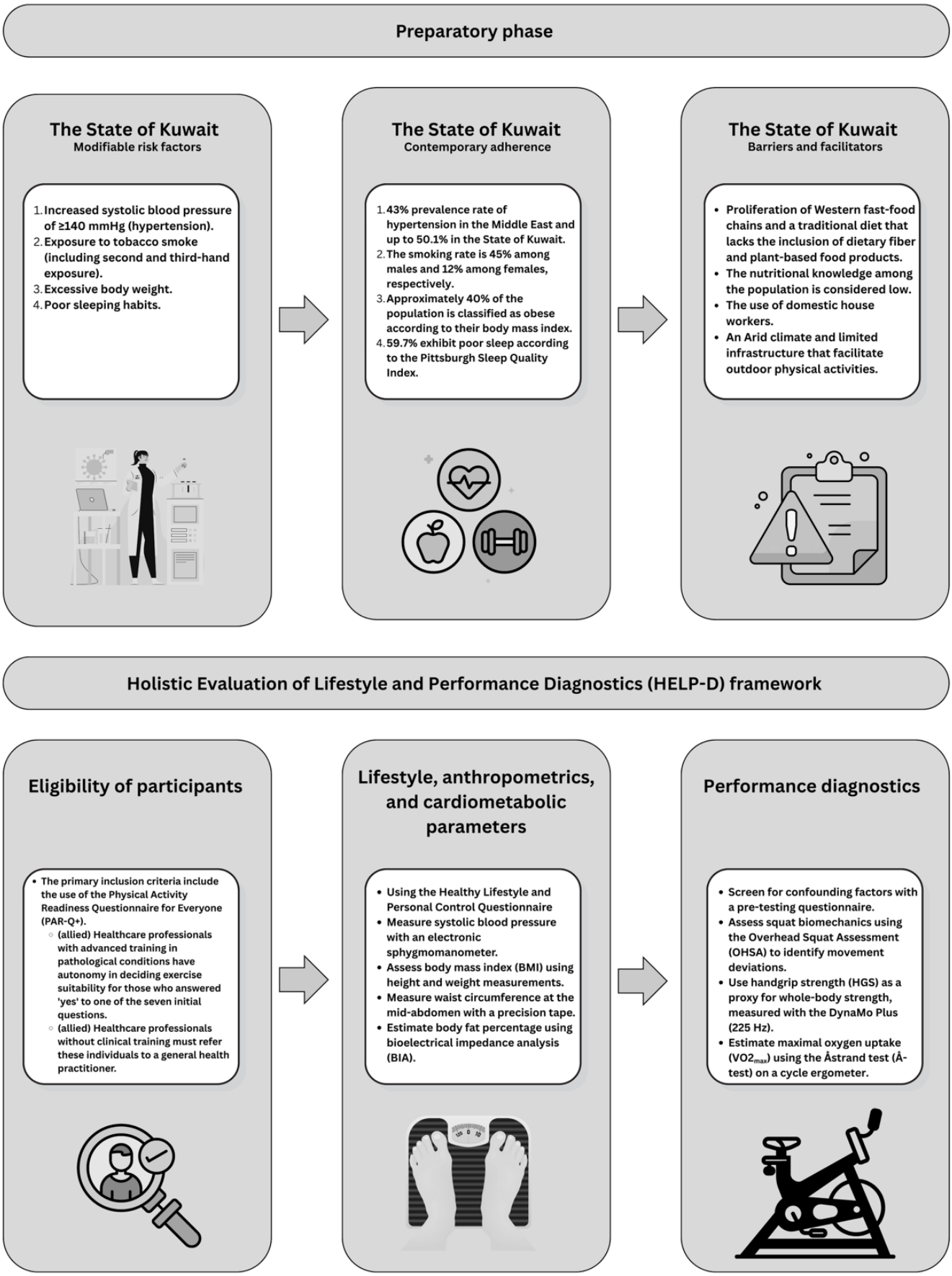

Figure 1. Holistic Evaluation of Lifestyle and Performance Diagnostics (HELP-D) framework tailored to the populace of the State of Kuwait.[36,46-49,54,57,63,69,84,97-98,101,115] Image created using Canva (www.canva.com). All graphic elements used under Canva Pro Content License.

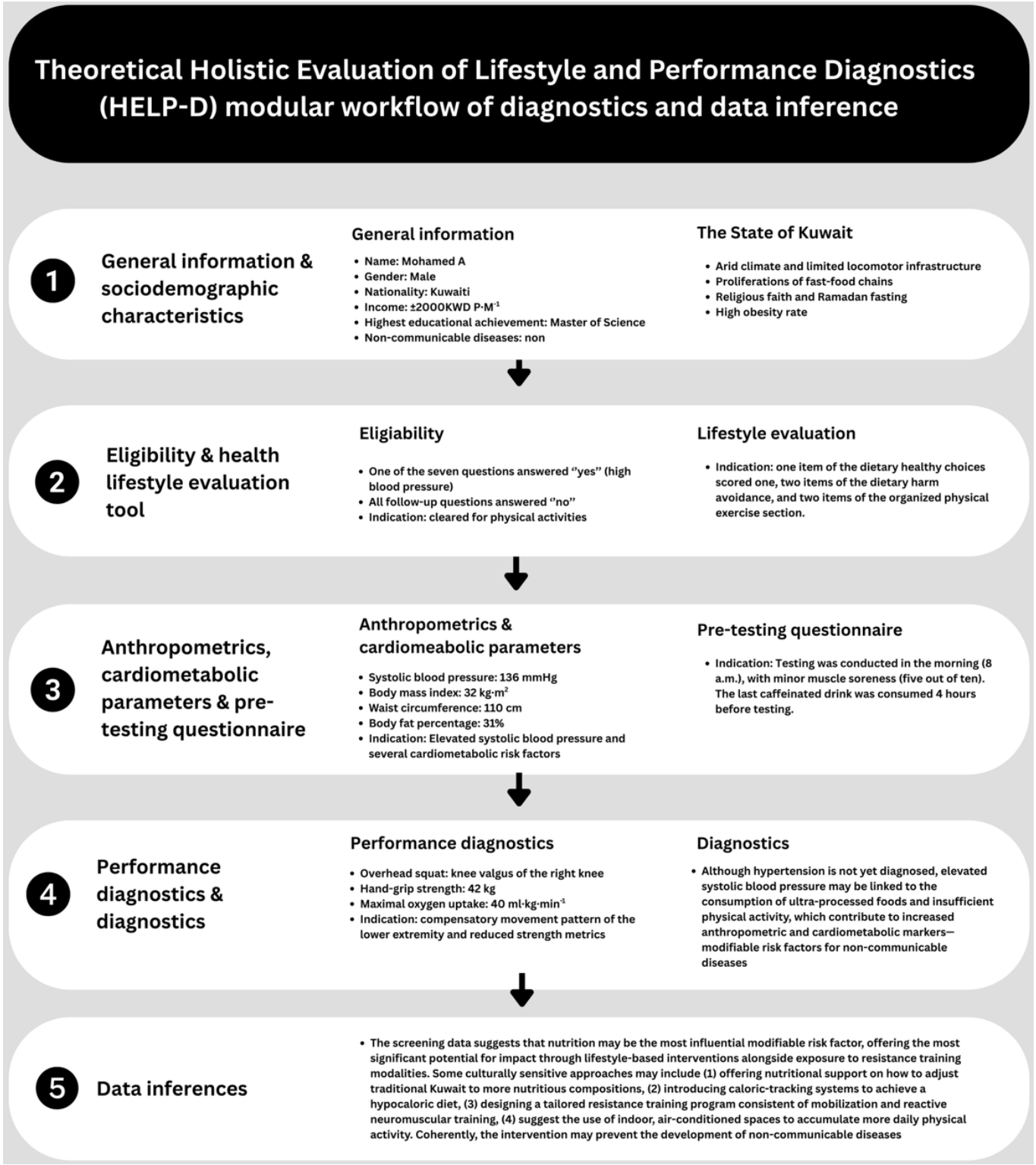

Figure 2. Modular workflow of the Holistic Evaluation of Lifestyle and Performance Diagnostics (HELP-D) framework based on a fictious data set. *Image created using Canva (www.canva.com). All graphic elements used under Canva Pro Content License.*

Practical point(s) in Preventive/Complementary Medicine:

► Gymnasiums can serve as a vital interface for NCDs screening and management, where a comprehensive framework that includes lifestyle questionnaires, anthropometric measurements, and physical assessments can be implemented to identify at-risk individuals and initiate lifestyle-based interventions.

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None.

Competing interests

The authors declare that they have no competing interests.

Abbreviations

Non-communicable diseases: NCDs; Holistic Evaluation of Lifestyle and Performance Diagnostics: HELP-D; disability-adjusted life years: DALYs; Type 2 diabetes mellitus: T2DM; Physical Activity Readiness Questionnaire: PAR-Q; Healthy Lifestyle and Personal Control Questionnaire: HLPCQ; Arab Teens Lifestyle: ATLS; Systolic blood pressure: SBP; diastolic blood pressure: DBP; cardiovascular diseases: CVDs; Body mass index: BMI; waist circumference: WC; waist-to-hip ratio: WHR; bioelectrical impedance analysis: BIA; delayed-onset muscle soreness: DOMS; Overhead Squat Assessment: OHSA; anterior cruciate ligament: ACL; Hand-grip strength: HGS; high-intensity interval training: HIIT; Dual-Energy X-ray Absorptiometry: DEXA.

Authors' contributions

All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

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Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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