An investigation of the relationship between breast kinematics and subjective ratings of breast support during treadmill activity

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Background: Numerical analogue scales are often used in breast biomechanics research to assess factors associated with an increase or decrease in perception of a variable. For example, correlations between breast comfort and breast kinematics have revealed a negative relationship (Scurr et al., 2010: Journal of Sports Sciences, 28(10), 1103–1109). Previous research calculated correlation coefficients between ratings of perceived breast support and vertical breast displacement during a variety of vigorous activities, showing significance in less than half of the bra conditions tested (Lawson & Lorentzen, 1990: Clothing and Textile Research Journal, 8(4), 55–60). It was suggested that perception of support is more multifaceted than merely a feeling of vertical motion. It was therefore hypothesised that subjective rating of support would show a stronger correlation with three dimensional breast kinematics than vertical displacement alone during treadmill activity.

Purpose: The aim of this investigation was to assess the relationship between participant’s subjective assessment of breast support and 3D breast kinematics during treadmill activity.

Methods: Following institutional ethical approval, 12 participants of bra size 34D, 36C and 38B took part in treadmill activity in a no bra and everyday bra condition. Breast kinematic data were recorded according to Scurr et al’s (2010) protocol. After each trial, participants rated their perceived breast support using a numerical analogue scale of 0 to 10. Spearman’s Rho correlation coefficients were calculated between subjective ratings and breast displacement, velocity and acceleration in a vertical, mediolateral and anteroposterior direction.

Results: A moderate relationship was found between subjective rating and; displacement in the anteroposterior ($r_s = -0.545, p = 0.000$) and vertical directions ($r_s = -0.430, p = 0.003$), velocity in all three dimensions ($r_s = -0.365, p = 0.012$; $r_s = -0.325, p = 0.026$; $r_s = -0.418, p = 0.003$ for anteroposterior, mediolateral and vertical respectively) and acceleration in the mediolateral ($r_s = -0.405, p = 0.005$) and vertical direction ($r_s = -0.484, p = 0.001$).

Discussion: In accordance with previous research, the results show that greater breast movement is associated with lower subjective ratings of support (Lawson & Lorentzen, 1990). In addition, the results show that subjective ratings of breast support are more closely correlated with 3D breast kinematics than just vertical displacement, as past research has assessed, which accepts the hypothesis. This indicates that women’s perception of breast movement is influenced by 3D breast kinematics. Sports bras should therefore be designed to limit breast movement in three dimensions, not only to improve women’s comfort but also to increase their perception of the support provided by the bra.

Conclusion: The results suggest that measures of perceived breast support may be used as an additional source of feedback on brassieres performance, alongside breast kinematic data. Use of this method of rating scale in breast biomechanics research is encouraged as a measure of perceived breast support due to the correlation with 3D breast kinematics.

BASES/PC9

The effect of Rating of Perceived Exertion (RPE) on the exercise-mood relationship

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Background: A considerable amount of literature attests to the benefits associated with regular exercise on physiological well being (Berlin & Colditz, 1990: Am J Epidemiol 32, 62–62). However despite this many people do not partake in the minimum recommended amount of exercise (30 minutes per day a minimum of five times per week) (ACSM, 2007: Guidelines for exercise testing and prescription). There is now recognition within exercise psychology literature of immediate improvements in mood state following aerobic exercise, which may bode well for attracting the sedentary population. Despite this there is scant research investigating the effects of perceived exertion on the mood changes associated with exercise.

Purpose: This study was designed to examine the effect of rating of perceived exertion (RPE) on the relationship between exercise and mood, in a natural exercise setting.

Method: Thirty participants consisting of 24 males and 6 females completed a one mile run, the positive and negative affect scale (PANAS) was administered before and after exercise to give pre and post scores for both positive and negative mood. Rating of perceived exertion was also reported after exercise using Borg’s perceived exertion scale and participants were separated into high, medium and
low groups based on their (RPE) score. $2 \times 3$
(Time $\times$ RPE group) mixed analysis of variance,
with repeated measures on the first factor, examined
the effects of exercise on positive mood subject to
(RPE) group.

**Results:** Overall participants reported significant
improvements in both positive and negative mood
state in response to exercise; the high (RPE) group
demonstrated the greatest improvements in positive
mood whereas the moderate (RPE) group demonstra-
ted the greatest improvements in negative mood.

**Discussion:** This study demonstrates that an
acute bout of aerobic exercise can facilitate improve-
ments in both positive and negative mood. The
findings have implications for the prescription of
exercise designed to maximize mood improvement
and thus capitalize on the improvement to subse-
quently improve exercise participation and adher-
ence. Exercise programs may wish to encourage
participants to work at a moderate to high level of
exertion.

**Conclusion:** The results also have implications
for clinical psychologists giving more support for
exercise as an effective treatment for depression.
Future research should focus on establishing a
relationship between people who experience improved mood in response to exercise and subsequent exercise adherence.

**BASES/PC10**

**The effect of breast support on ventilation and
breast comfort perception at the onset of
exercise**

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**Background:** Previous research has advocated the
use of a sports bra when exercising due to the
reduction in breast movement and discomfort they
provide, especially for larger-breasted women (Scurr
et al., 2010; Journal of Sport Sciences, 29(1), 55–
61). One study has investigated the effect of breast
size on respiratory function during sub-maximal
running (Bowles et al., 2005: Medicine & Science
in Sports & Exercise, 37(9), 1633–1640), yet it is not
known how different levels of breast support may
affect ventilation and comfort in larger-breasted
women during exercise.

**Purpose:** The purpose of this exploratory study
was to investigate the influence of breast support on
ventilation and breast comfort at the onset of
treadmill running.

**Methods:** Following institutional ethical approval,
9 larger-breasted (cup sizes D to E, mode 34 DD)
female participants were recruited (mean age 25,
s = 4 years, height 1.69, s = 0.03 m, mass 72.31,
s = 7.83 kg). Participants were required to run on a
treadmill (1) for two minutes (9.3 km $\cdot$ h$^{-1}$, 1%
incline) in three breast support conditions: no bra
(NB), everyday bra (EB) and sports bra (SB), in a
random order. An online gas analyser system (2)
recorded ventilatory variables breath-by-breath and
was averaged every 15 s. Ten minutes rest was given
between breast support conditions. Immediately
after each treadmill test breast comfort was rated
using a 0.1 m visual analog scale. Two-way repeated
measures ANOVAs were used to assess differences
in ventilatory variables across time points and
support conditions; Wilcoxon signed-ranks tests
were used to compare breast comfort data across
support conditions. The alpha level was 0.05 unless a
Bonferroni adjustment was applied.

**Results:** Breathing frequency (breaths $\cdot$ min$^{-1}$)
and the ventilatory equivalents for oxygen (VE/VO$\text{2}$)
were lower with no support (P $< 0.001$, $\eta^2 = 0.78$;
P = 0.002, $\eta^2 = 0.65$) compared with both supported
conditions. Tidal volume (L) was higher with no support (P $= 0.006$, $\eta^2 = 0.47$) compared with both
supported conditions. In contrast, these ventilatory
variables did not differ between bra conditions
(P $> 0.05$). Breast comfort was different between
all conditions (P = 0.007), with the SB rated as the
most comfortable (P = 0.017). Participant’s com-
ments on running bare-breasted included; “Some-
times I held my breath when thinking about the
discomfort” and “It felt harder to run...I felt my
body tense up”.

**Discussion:** Physiological results suggest that
when participants run bare-breasted breath-holding
may have occurred; this could be linked to the
greater amount of discomfort felt in this condition.
Comments from participants suggest that breath-
hold may be happening due to upper body muscle
tension; future research should investigate the effect
of breast support on muscle activity in the thoracic
region. Despite differences in breast comfort be-
tween the two bra conditions, bra type did not affect
ventilatory variables. As the sports bra did not have
an adverse effect on ventilation, the use of a sports
bra for sub-maximal running is promoted due to the
higher level of breast comfort experienced.

**Conclusion:** The results suggest that wearing
breast support changed ventilatory variables at the
onset of running, compared to bare-breasted run-
ing. This study utilised a 2 minute run as this was
the longest some participants could manage bare-
breasted. As this preliminary investigation did
identify ventilatory adaptations, but it is rare for
women to run with no breast support, future