

2735 Board #18 June 1 2:00 PM - 3:30 PM

Validity Of A High Incline VO_2max Walk Test

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Reported Relationships: D.E. Lankford: *Consulting Fee; Icon Health and Fitness.*

PURPOSE: The purpose of this study was to validate two high incline graded exercise VO_2max tests designed for individuals not accustomed to running on a treadmill.

METHODS: Participants consisted of 31 (18 men, 13 women) individuals aged 18-29 yrs. All participants completed a Bruce Protocol VO_2max test as well as two high incline graded exercise tests in a randomized order. The high incline VO_2max tests were performed at a constant speed of 3.6 mph and increased in incline 5% every 3-minutes until volitional exhaustion. The difference between the two high incline protocols (5-5, 10-5) was the starting incline following a 30-second warmup. The first stage of the 5-5 test was 5% grade and the first stage of the 10-5 test was 10% grade. A 1x3 repeated measures ANOVA was used to compare VO_2max data between tests. Pearson Correlation and Bland-Altman plots were used to analyze relationships between the two high incline tests (5-5, 10-5) and the Bruce Protocol individually.

RESULTS: There were no differences in VO_2max between tests (Bruce= 46.9 ± 7.7 , 5-5= 45.7 ± 7.9 , 10-5= 44.7 ± 78.3 , $p = 0.51$). VO_2max of the Bruce Protocol was strongly related to both 5-5 ($r = 0.96$) and 10-5 ($r = 0.90$) tests. Bland-Altman plots between 5-5 test and the Bruce Protocol revealed 93% of data falls within $\pm 4.5 \text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ and 100% fall within $5 \text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$.

CONCLUSIONS: These results suggest that both the 5-5, and 10-5 tests are valid alternatives to the Bruce Protocol. Additionally, these results demonstrate that a non-running VO_2max test is effective in determining VO_2max in a healthy population.

2736 Board #19 June 1 2:00 PM - 3:30 PM

Validity of Heart Rate Measurements for the Apple Watch and Fitbit Charge HR 2

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(No relevant relationships reported)

Only a few studies have examined the validity of heart rate (HR) measurements for the Apple Watch and Fitbit Charge HR devices.

PURPOSE: This study examined the validity of heart rate measurements for the Fitbit Charge HR 2 (Fitbit) and the Apple Watch devices.

METHODS: Thirty young adults (15 females, 15 males, age 23.5 ± 3.0) completed the Bruce Protocol while HR measurements were recorded from the electrocardiogram (ECG) and each device every minute. Average HR for each participant was calculated for very light, light, moderate, vigorous and very vigorous intensities based on ECG-measured HR. A concordance correlation coefficient (CCC, r_c) was conducted to examine the strength of the relationship between the ECG measured HR and the device measured HR. Relative error rates (RER) were calculated to indicate the difference in HR measurement between each device and ECG.

RESULTS: The HR from the Apple Watch was significantly lower compared to the ECG HR (122.78 ± 13.40 vs. 128.83 ± 9.46 BPM, $P < .01$) for moderate intensity. For very vigorous intensity, the Apple Watch HR was significantly lower compared to the ECG HR for females (174.47 ± 8.79 vs. 180.3 ± 9.13 BPM, $P < .05$). The HR measured by the Fitbit Charge HR 2 was significantly lower compared to the ECG measured HR for light intensity (100.25 ± 6.93 vs. 104.24 ± 9.09 BPM, $P < .01$), for moderate intensity (116.66 ± 23.74 vs. 127.79 ± 10.27 BPM, $P < .01$), for vigorous intensity for males (143.00 ± 13.61 vs. 159.39 ± 9.58 BPM, $P < .001$) and for females (137.24 ± 18.86 vs. 155.11 ± 9.86 BPM, $P < .05$) and for very vigorous intensity (157.47 ± 15.44 vs. 181.35 ± 9.44 BPM, $P < .001$). The Apple Watch also showed lower RER (2.4%-5.1%) compared with the Fitbit (3.9%-13.5%) for all exercise intensities. For both devices, the strongest relationship between the device measured HR and the ECG measured HR was found for very light intensity with a very high CCC ($r_c > .90$). The strength of the relationship declined as exercise intensity increased for both the Apple Watch and the Fitbit.

CONCLUSION: Our study indicated an inverse association between exercise intensity and HR measurement accuracy for the Apple Watch and the Fitbit Charge HR 2. The Apple Watch revealed lower error rates for all exercise intensities compared to the Fitbit Charge HR 2.

Keywords: heart rate measurement; wearable devices; validity

2737 Board #20 June 1 2:00 PM - 3:30 PM

Wingate Test-Retest Variability in Healthy Subjects

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(No relevant relationships reported)

Learning effects, biological changes, and motivation contribute to variability in performance on standardized exercise tests. Performance improvement on short-duration, high-intensity tests, such as a 30-second Wingate test of anaerobic power, may be more sensitive to motivational and learning changes in novice, healthy subjects.

PURPOSE: To examine performance changes during serial Wingate tests in healthy college-age students.

METHODS: Twenty college students were recruited to do three 30-second Wingate tests over three days. They were given identical instructions before each test. Sleep and nutrition were controlled. Standard Wingate parameters were collected. Multivariate analysis was used to examine changes in performance parameters; data are highlighted for the singular variable: peak power.

RESULTS: Eighteen subjects completed all three tests. The overall multivariate analysis for test number was not significant, and there were no significant differences across test days for peak power, power decline, average power, minimum power, power at max speed, or total energy expended. For peak power; averages for test 1 (1.72 ± 0.31 W/kg), test 2 (1.74 ± 0.28 W/kg), and test 3 (1.79 ± 0.32 W/kg) were similar, but examination of percent changes in performances illustrates why results appear homogenous. Thirteen of the subjects improved their performance with repeated trials. The average improvement in peak power for those subjects was $9.8 \pm 5.2\%$. Five subjects had performance declines from the first trial of $4.9 \pm 3.9\%$. One subject had no change in performance.

CONCLUSION: The fluctuation from zero to as high as 22% illustrates high variability of these power measurements (power decline ranged as much as 97% within one subject). This degree of variability is well outside what would normally be expected for biological variation and could be construed as problems with equipment calibration. Without application of criteria for subject effort, such as applied to cardiopulmonary exercise testing, it is difficult to make objective intra-group or intra-subject comparisons for Wingate testing.

2738 Board #21 June 1 2:00 PM - 3:30 PM

Bilateral Deficit: A Comparison Of Maximal Strength Between The Bilateral And Unilateral Leg Press Exercise

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(No relevant relationships reported)

The bilateral deficit (BLD) is a phenomenon in which the maximal strength of both limbs contracting simultaneously is less than the sum of the weight lifted by each limb contracting in isolation. The connection between the BLD and how it influences performance is unknown.

PURPOSE: To determine if the BLD is present during a dynamic leg press in trained participants.

METHODS: Thirty volunteers (19 male, 11 female; 19-37 years old) reported to the EMU Running Science Laboratory on three separate occasions 72 hours apart. On day 1, participants performed a movement screening consisting of 8-10 repetitions at 30% of one repetition maximum (1RM) for both the bilateral and unilateral dynamic leg press training conditions to ensure that all exercises were safely performed. On day 2, participants were randomly assigned to either the maximal bilateral or maximal unilateral condition. For both conditions, participants performed 6-8 repetitions at 50% 1RM, followed by a single repetition at 70% of 1RM. Afterwards, the amount of weight lifted was increased by 10% between each successful lift to ensure standardization. This process continued until participants could no longer increase weight for either testing condition. On day 3, participants completed