Heart Rate and Energy Expenditure Validity for the Fitbit Charge HR 2 and Apple Watch
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STUDY INTRODUCTION AND PURPOSE

- Wearable devices, such as the Fitbit Charge and Apple Watch, are convenient means of monitoring exercise heart rate and energy expenditure.
- Consumers may rely on wearable devices to adhere to exercise prescriptions, and measure energy balance.
- The accuracy of these devices, however, has come under scrutiny in recent years.
- The purpose, therefore, was to validate the heart rate and energy expenditure measurements in two popular consumer devices, the Fitbit Charge HR 2 (Fitbit) and the Apple Watch Series 1 (Apple Watch).

METHODS

- Thirty young adults (15 males and 15 females, age=23.5 ± 3.0 years) completed a health screening, and participants underwent assessment for weight, height, and blood pressure.
- The procedures were reviewed and approved by the Colorado State University Institutional Review Board before the start of the study.
- Participants were fitted for a mask for the metabolic cart, and prepped with a 12-lead electrocardiogram (ECG), the equipment for criterion heart rate measure.
- The Apple Watch device was placed on the participants’ right wrists and the Fitbit Charge was places on the left wrists.
- Participants began the Bruce Protocol maximal exercise test on a treadmill while investigators took heart rate readings from the ECG and each device per minute.
- At the conclusion of the exercise test, total energy expenditure (Kcals) was recorded from all of the wearable devices and calculated from data from the metabolic cart, the equipment for criterion energy expenditure measure.
- Means and standard deviations were calculated for heart rates and energy expenditure. Paired t-test analyses were performed and Cohen’s d effect sizes were calculated.
- Regression scatterplots and concordance correlation coefficient (rc) were used to depict the strength of the relationship of Apple Watch and measurements and criterion measurements

RESULTS

Heart Rate Data

- When measuring heart rate, the Fitbit had a relative error rate of 3.9%-13.5% compared to the ECG, across all exercise intensities.
- The Apple Watch had a relative error rate of 2.4%-5.1% when comparing heart rate measurements to the ECG, across all exercise intensities.
- Both devices had lower error rates when measuring heart rate at very low exercise intensities.

Energy Expenditure Data

- When calculating energy expenditure, the Fitbit overall error rate was 24.17%. For females, it was 16.72%, and for males, it was 24.17%.
- The Apple Watch energy expenditure calculations had an overall error rate of 24.25%, an error rate of 29.93% for females, and 18.58% for males.
- The Apple Watch revealed overestimated EE for females but underestimated EE for males. The Fitbit underestimated EE for both males and females.
- Researchers, practitioners, and personal users of wearable devices should consider these data when designing programs or training plans that use heart rate or energy expenditure targets as measured by these devices.

CONCLUSIONS

- Further research is required to determine the validity of heart rate measurements and energy expenditure calculations from wearable devices in the free living environment.
- Future studies should also include a variety of exercise modalities as the current study only utilized a treadmill running maximal exercise test.

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FUTURE DIRECTIONS

- Further research is required to determine the validity of heart rate measurements and energy expenditure calculations from wearable devices in the free living environment.
- Future studies should also include a variety of exercise modalities as the current study only utilized a treadmill running maximal exercise test.