Validation of the FitBit® for Physical Activity Quantification

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BACKGROUND

• An accelerometer is a device that measures movement and records data to characterize physical activity intensity levels to estimate calories expended[1].

• The ActiGraph GT1M (AG) is one of the oldest and most commonly used accelerometers[2].

• The FitBit® (FB) is a newer accelerometer that contains streamlined features and is a low cost alternative to the AG but there is limited research on the validity of this device[2,3].

PURPOSE

• The purpose of this pilot study was to validate the FB against the gold standard instrument, AG, for comparing minute by minute energy expenditure and step counts for activity levels that are representative of common activity levels of everyday life in healthy young adults.

METHODS

• Thirty-two (7 male, 25 female) adults, age 18-29 yrs (21.6 + 2.2 yrs) performed two thirty-minute phases of walking, slow and brisk, on a treadmill while wearing the FB and AG simultaneously. Heart rate (Polar Electro Inc., Lake Success, NY, USA) and metabolic (Ultima CPX Metabolic Cart, Medical Graphics Corporation, St. Paul, MN) data were collected during each phase.

• The respiratory exchange ratio (RER) was used to estimate energy expenditure (EE) by using the two min. averages of VO_2, RER, and energy expenditure/LO_2.

• Pearson's correlations were used to obtain the linear associations between the FB, AG, and EE. The Bland-Altman technique was utilized to determine agreement between the FB, AG, and EE.

• T-tests were used to determine statistical significance. Boxplots were utilized to compare variability.

1. Rothney et al. *Obesity* 2008;16:1946-1952.
2. Abel et al. *App Phys Nut Metab* 2008;33:1155-1164.
3. Montgomery-Downs et al. *Sleep Breath* 2011. DOI 10.1007/s11325-011-0575-y.

RESULTS

• *Energy Expenditure (kcals/min).* Sample correlations (r) between the AG and FB at slow and brisk speeds were 0.584 and 0.910 respectively, between the AG and EE were 0.811 and 0.918 respectively, and between the FB and EE were 0.689 and 0.942 respectively. All correlations indicated statistical significance. However, slow walking kcals/min illustrated a weak relationship nearing non-significance.

• Bland-Altman plots for energy expenditure for the AG and FB show average agreement but high variability. Poor agreement was displayed at slow speeds and average agreement was displayed at brisk speeds. Figure 1 shows a boxplot of the measured values of kcals at each exercise intensity for the AG, FB, and EE.

• The average energy expenditure for the slow walking phase for the AG, FB, and EE was 89.2+8.7, 88.0+3.9, and 100.9+5.8 kcals/min respectively. These means were not significantly different from each other at p = 0.05. Average energy expenditure for the brisk walking phase for the AG, FB, and EE was 122.6+11.6, 100.9+6.3, and 121.9+7.7 kcal/min respectively.

• *Step Counts (steps/min).* Sample correlation (r) at slow and brisk speeds between the AG and FB were 0.974 (p<0.001) and 0.996 (p<0.001) respectively, indicating statistical significance. Bland-Altman plots illustrated strong agreement for both slow and brisk walking speeds. However, six participants were excluded as their AG step counts were half the value of the FB step counts.

Table 1. Demographic Characteristics (Mean + SD)

VARIABLE	ALL (n=21)	MALE (n=3)	FEMALE (n=18)
Age (yrs)	21.2 + 1.7	21.3 + 3.5	21.2 + 1.4
Height (cm)	167.2 + 6.2	174.4 + 5.1	166.0 + 5.5
Weight (kg)	61.5 + 12.7	83.3 + 19.5	57.9 + 6.8
Slow Walking (kph)	4.0 + 0.4	4.3 + 0.5	3.9 + 0.4
Brisk Walking (kph)	4.9 + 0.6	5.3 + 0.5	4.8 + 0.6

Figure 1. Boxplot for Estimated Kilocalories by Device

Boxplot of Estimated Energy Expenditure by Device
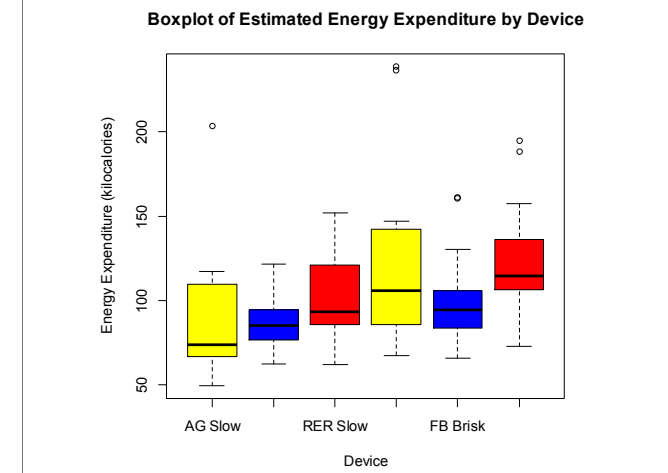
CONCLUSION

• While the FB and AG illustrated a strong correlation and a strong agreement for step counts, they only showed a moderate correlation and moderate agreement for energy expenditure. Thus, the devices should not be used interchangeably within the same study for a population of healthy young adults.

• At low intensities the FB may be superior to the AG in measuring activity but the FB's capabilities may be limited when estimating energy expenditure across different intensities. However, the FB can reliably estimate energy expenditure during two different exercise intensities. In comparison to the FB, the AG provides for greater accuracy in the assessment of varying intensity levels.

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