JOURNAL OF
Medical
Engineering
&Technology

http://informahealthcare.com/jmt
ISSN: 0309-1902 (print), 1464-522X (electronic)

J Med Eng Technol, Early Online: 1–7

DOI: 10.3109/03091902.2013.831135

informa
healthcare

INNOVATION

Comparison of steps and energy expenditure assessment in adults of Fitbit Tracker and Ultra to the Actical and indirect calorimetry

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Abstract

Epidemic levels of inactivity are associated with chronic diseases and rising healthcare costs. To address this, accelerometers have been used to track levels of activity. The Fitbit and Fitbit Ultra are some of the newest commercially available accelerometers. The purpose of this study was to determine the reliability and validity of the Fitbit and Fitbit Ultra. Twenty-three subjects were fitted with two Fitbit and Fitbit Ultra accelerometers, two industry-standard accelerometers and an indirect calorimetry device. Subjects participated in 6-min bouts of treadmill walking, jogging and stair stepping. Results indicate the Fitbit and Fitbit Ultra are reliable and valid for activity monitoring (step counts) and determining energy expenditure while walking and jogging without an incline. The Fitbit and standard accelerometers under-estimated energy expenditure compared to indirect calorimetry for inclined activities. These data suggest the Fitbit and Fitbit Ultra are reliable and valid for monitoring over-ground energy expenditure.

Keywords

Accelerometer, pedometer, physical activity

History

Received 13 February 2013
Revised 22 July 2013
Accepted 29 July 2013

1. Introduction

Despite established recommendations to increase daily physical activity among American adults, physical inactivity in the US is now considered an epidemic. Physical inactivity is a major contributing factor to the rising healthcare costs of obesity [1] and chronic disease [2]. A review by Blair and Brodney [3] suggests that inactivity is attributable to many of the health risks associated with being overweight or obesity. Normal weight individuals who are sedentary have a greater chance of morbidity and mortality than active obese individuals and research demonstrates that inactivity and low cardiorespiratory fitness are as important as overweight and obesity as mortality predictors [4,5]. Further, long-term sitting and its relative detriment is becoming a popular discussion in the scientific literature and may play a major role in heart disease and obesity [6–9].

To address the majority of the population who are still inactive, various devices to detect movement (accelerometers and pedometers) have been developed and marketed for commercial use. These devices may provide a more convenient way to account for daily physical activity in the battle to overcome inactivity. Devices of this kind are often small, unobtrusive and can be worn at the hip, wrist or chest. They can measure intensity, duration and frequency of steps, heart rate and total volume of physical activity. The more sophisticated accelerometer-based devices are usually worn attached via clip, patch or wristband and detect movements causing a piezo-electric crystal housed in the device to become deformed, creating a quantity of voltage. The voltage, commensurate with the degree of deformation, provides an indication of acceleration (movement through space), which can then be correlated to physical activity often quantified as 'steps', 'counts' or most recently 'fuel'. As acceleration requires force to move mass and force requires energy, the accelerometers provide an estimate (through calibration on study subjects and validity studies using gold-standard methods) of the amount of energy expended (kcal).

Various accelerometers have been developed and studied in the past decade for intra- and inter-device reliability and validity [10–28]. Previously, our lab conducted similar analyses comparing the Actical® and Actiheart® devices to indirect calorimetry [25]. Findings indicated that, across all activities studied, there was no difference in the ability of the Actical® and Actiheart® to predict energy expenditure. However, the Actiheart® provided better estimates than the Actical® for the activities in which acceleration of the pelvis was not closely related to energy expenditure (e.g. sweeping, lifting weights and card playing) and the Actical® provided better estimates for level walking and level jogging.

Recently, an accelerometry device, the Fitbit® Tracker, was introduced to the commercial market. This device is of

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particular interest because it is accessible to the public at a relatively low price point and the consumer can readily download and examine their physical activity with a user-friendly website and software. Furthermore, the Fitbit website provides an advanced programming interface (API) that can be leveraged by healthcare workers and researchers to observe daily activities and permits recommendations based on short- and long-term trends in behaviour. This potential for incorporating multiple types of inexpensive electronic devices for the consumer to monitor their health makes this instrument appealing.

To date, little research exists about the reliability and validity of the Fitbit [29,30]. An understanding of the accuracy of the Fitbit, a device marketed at a lower cost compared to devices that cost several hundred up to a thousand dollars, is warranted. Thus, the purpose of this study was to evaluate the accuracy, repeatability and validity of the Fitbit. The specific aims were to evaluate: (1) the repeatability of the Fitbit against itself, (2) the reliability of the Fitbit against the Actical® as the control accelerometer and (3) the validity of the Fitbit estimate of energy expenditure during ambulatory activities using indirect calorimetry as a gold standard.

2. Methods

2.1. Subjects

Subjects were recruited from a northeastern university in the US by word of mouth and by fliers. All subjects were free from cardiovascular, neuromuscular or orthopaedic conditions or other conditions that would preclude them from completing the tasks required. All participants signed an informed consent approved by the university Institutional Review Board.

2.2. Procedure

Subjects completed a consent form, medical history questionnaire and the International Physical Activity Questionnaire-short form (IPAQ) [31,32]. The short form IPAQ was developed as an instrument for monitoring of physical activity and inactivity and is considered to have acceptable criterion validity and reliability correlation for use in adults compared to accelerometer activity monitoring [33]. Individuals were included in the study if they participated at levels of physical activity considered moderate or vigorous (e.g. more that 150 min/week of moderate-intensity or 75-min/week of vigorous activity), based on their IPAQ scores.

Upon enrolment, subjects were instructed to wear appropriate exercise attire and sneakers. Prior to testing, subjects had their height and weight measured with a common scale and stadiometer (Detecto Inc., Webb City, MS). An explanation of the entire protocol was given to each subject and subjects were instructed to inform the testers if they felt discomfort or fatigue at any time during the testing.

For data collection, six devices; two Actical® (Philips Respironics, Inc., Andover, MA) and four Fitbit devices (Fitbit, Inc., San Francisco, CA) were clipped onto an elastic waistband (provided by Phillips Respironics), with one of each on the left (Fitbit-a, Ultra Fitbit-a and Actical-a) and right pelvis (Fitbit-b, Ultra Fitbit-b and Actical-b) at the anterior superior iliac spine as per manufacturer's instructions. Both the Fitbit, Fitbit Ultra and Actical accelerometers were initialized to collect data using 1-min epochs. Subjects were also instrumented with a chest strap heart rate monitor (Polar, Inc., Lake Success, NY) adhered to the skin with hypoallergenic electrode gel (S&W Healthcare, Inc., Brookesville, FL).

To collect indirect calorimetry data subjects were outfitted with a telemetric gas analysis system ($K4b^2$ Cosmed Inc., Rome, Italy) comprised of a small metabolic analyser, battery pack and face-mask. The face-mask, attached to a turbine flowmeter, allows for real-time collection of VO_2 values. The $K4b^2$ unit (∼925 g) was strapped to the participant's shoulders and torso using the manufacturer's harness throughout the protocol. The $K4b^2$ has been validated for measurement of energy expenditure [34–36] and is well suited for measurements involving free-living conditions. During testing, metabolic values of oxygen consumption (VO_2 mL kg^{-1} min^{-1}), Ventilation (V_E L min^{-1}) and the ratio of oxygen and carbon dioxide production were collected (RER) and monitored continuously through breath-by-breath analysis. The $K4b^2$ was calibrated according to the manufacturer's instructions prior to each testing session. Termination of all testing was implemented if subjects meet any two of these criteria: heart rate (HR) $>$ 95% of predicted maximal HR (based on the formula: 220 – age), RER $>$ 1.0 for three consecutive readings or volitional signs of fatigue [37].

Activity trials consisted of four exercise bouts and required an approximate total of 30 min to complete all test sequences. All activities were performed in one testing session and in the same order for each subject. Subjects began with 6 min of resting, sitting in a chair quietly. This was followed by walking and running on a motor-driven treadmill (Trackmaster®, TMX425C, Newton, KA) for 6 min bouts of each of the following: 3.5 miles h^{-1} (5.63 km h^{-1}) at 0% incline (*walk*), 3.5 miles h^{-1} (5.63 km h^{-1}) at 5% incline (*walk-incline*) and 5.5 miles h^{-1} (8.85 km h^{-1}) at 0% incline (*jog*). Each bout was interspersed with 1 min of rest. The purpose of the rest bout was to afford clear demarcation between trials so that the Actical® and Fitbit could be accurately compared. Subsequent to the treadmill bouts, subjects were asked to rest for 6 min, followed by 6 min of stair stepping (30.5 cm Reebok step) at 96 beats min^{-1} (*step*). Throughout, the subjects were asked to provide feedback regarding their comfort wearing the mask and performing the activity and to tell the tester if they felt discomfort, fatigue or shortness of breath. All subjects completed all four activities.

Midway through our study, Fitbit, Inc. released a hardware upgrade called the Fitbit Ultra. Therefore, we also incorporated two Fitbit Ultra accelerometers into our concurrent data collection on a sub-group of the subjects.

2.3. Data management and analyses

Data recorded from the $K4b^2$, Fitbit, Fitbit Ultra and Actical were downloaded through their respective software and exported as .csv test files into Microsoft Excel 2010 for subject and group analyses. Both the Fitbit Tracker, Fitbit Ultra and Actical provide step counts and estimate energy expenditure (kcal) based on subject parameters and their own proprietary algorithms. Energy expenditure (kcal) based on the indirect calorimetry measurement was obtained from the K4b^2.

For each subject the mean steps and energy expenditure (kcal) for minutes 2, 3, 4 and 5 was calculated for each activity for each device, discarding the first and last minutes. Comparisons were made of the instruments using Intraclass Correlation Coefficients (ICC 3,k) (SPSS 16.0) calculated with analysis of variance (ANOVA) ($p<0.05$). Analyses included: (1) intra-instrument concurrent repeatability of steps and calories in the four activities for Fitbit-a and Fitbit-b, Actical-a and Actical-b, FitbitUltra-a and Fitbit Ultra-b, (2) inter-instrument concurrent reliability of steps in mean Fitbit (Fitbit-a and Fitbit-b), mean Actical (Actical-a and Actical-b) and mean Fitbit Ultra (Fitbit Ultra-a and Fitbit Ultra-b), (3) inter-instrument concurrent validity of kcal in mean Fitbit (Fitbit-a and Fitbit-b), mean Actical (Actical-a and Actical-b) and mean Fitbit Ultra (Fitbit Ultra-a and Fitbit Ultra-b) compared to the K4b^2 and (4) accuracy of steps and kcal.

3. Results

Twenty-three subjects, 10 women and 13 men (mean age 26.65 ± 7.55 years, height 170.57 ± 11.12 cm, mass 69.56 ± 13.76 kg), participated in the testing. A sub-group of 16 subjects, six women and 10 men, also wore the Fitbit Ultra during data collection. Steps taken and kcal estimations were compared between two Fitbit Trackers, two Fitbit Ultras and two Acticals for each activity and are reported in Table 1. All intra-device ICC values were very high (0.86–0.99) for all devices with the exception of mean steps taken for Fitbit Ultra jogging ($r=0.76$), Actical stepping ($r=0.51$) and kcal for Fitbit jogging ($r=0.74$). No intra-device differences were found with respect to steps or kcal.

To conduct inter-device comparisons, the mean of Fitbit-a and b were compared to the mean of Actical-a and b and mean of Fitbit Ultra-a and b. For steps taken, there were high correlations between devices for all activities (ICC = 0.80–0.99) (Table 2). There were no differences in mean steps taken between the Fitbit and Fitbit Ultra devices. There were no differences between the Fitbit and Actical devices with the exception of the jog activity, [$F(22,1)=10.133$, $p=0.004$]. There were also differences between the Fitbit Ultra and Actical devices for the incline walk and jogging [$F(15,1)=7.595$, $p=0.015$ and $F(15,1)=8.853$, $p=0.009$, respectively].

Inter-device comparisons of the Fitbit and Fitbit Ultra found that ICC values for average kcal expended were high ($r=0.94$–0.97), with the exception of the jog activity ($r=0.48$) (Table 3). While mean Fitbit kcal were 10.91, Fitbit Ultra were significantly higher at 14.34 [$F(15,1)=10.129$, $p=0.006$]. Fitbit and Actical correlations of energy expenditure estimation were high ($r=0.89$–0.97) for all activities.

Energy expenditure in kcal for the Fitbits and Actical were also compared to the K4b^2 to determine device validity. Correlation values were lower, ranging from $r=0.56$–0.73 for walking, incline walking and jogging (Table 3). Neither device was valid when compared to K4b^2 energy expenditure during the stepping activity (Fitbit and K4b^2 $r=0.18$ and

Table 1. Intra-device step and energy expenditure correlations.

			ICC	*p*
Steps	Fitbit-a	Fitbit-b		
Walk-level	118.48 ± 8.29	118.57 ± 9.00	0.86	ns
Walk-incline	119.3 ± 9.28	118.00 ± 6.99	0.91	ns
Jog	152.57 ± 10.34	153.61 ± 11.08	0.86	ns
Stepping	81.65 ± 9.80	80.65 ± 8.55	0.88	ns
	Fitbit Ultra-a	Fitbit Ultra-b		
Walk-level	117.22 ± 9.95	118.18 ± 6.75	0.90	ns
Walk-incline	116.96 ± 6.80	117.00 ± 7.00	0.99	ns
Jog	151.28 ± 11.61	154.36 ± 8.23	0.76	ns
Stepping	80.39 ± 9.35	79.25 ± 9.90	0.88	ns
	Actical-a	Actical-b		
Walk-level	119.48 ± 6.70	119.52 ± 6.72	0.99	ns
Walk-incline	118.52 ± 7.04	118.52 ± 6.98	0.99	ns
Jog	158.70 ± 9.47	158.65 ± 9.48	0.99	ns
Stepping	77.70 ± 13.76	82.70 ± 12.74	0.51	ns
kcal	Fitbit-a	Fitbit-b		
Walk-level	5.52 ± 1.41	5.43 ± 1.27	0.91	ns
Walk-incline	6.43 ± 1.31	6.61 ± 1.67	0.90	ns
Jog	10.65 ± 2.50	11.74 ± 3.43	0.74	ns
Stepping	4.91 ± 1.31	4.87 ± 1.46	0.92	ns
	Actical-a	Actical-b		
Walk-level	4.39 ± 0.99	4.48 ± 1.04	0.98	ns
Walk-incline	5.09 ± 1.16	4.91 ± 1.28	0.96	ns
Jog	11.30 ± 1.72	11.04 ± 1.89	0.91	ns
Stepping	3.65 ± 1.11	3.57 ± 0.99	0.98	ns
	Fitbit Ultra-a	Fitbit Ultra-b		
Walk-level	5.56 ± 1.16	5.55 ± 1.44	0.91	ns
Walk-incline	6.77 ± 1.91	6.71 ± 2.31	0.95	ns
Jog	14.20 ± 4.90	14.48 ± 4.56	0.97	ns
Stepping	4.64 ± 1.40	4.63 ± 1.14	0.91	ns

kcal, kilocalories.

Table 2. Inter-device step correlations.

			ICC	*p*	
Steps	Fitbit	Fitbit Ultra			*F*(15,1)
Walk-level	117.28 ± 8.77	117.712 ± 8.19	0.98	ns	
Walk-incline	117.50 ± 8.19	116.96 ± 6.85	0.96	ns	
Jog	150.659 ± 10.25	152.82 ± 9.04	0.94	ns	
Stepping	80.38 ± 9.48	79.82 ± 9.09	0.98	ns	
Steps	Fitbit	Actical			*F*(22,1)
Walk-level	118.52 ± 8.29	119.02 ± 7.66	0.98	ns	
Walk-incline	118.65 ± 7.88	118.26 ± 7.00	0.98	ns	
Jog	153.09 ± 10.02	156.15 ± 9.42	0.94	0.004	10.133
Stepping	81.16 ± 8.68	79.17 ± 8.31	0.82	ns	
Steps	Fitbit Ultra	Actical			*F*(15,1)
Walk-level	117.71 ± 8.10	117.91 ± 8.23	0.99	ns	
Walk-incline	116.96 ± 6.85	117.22 ± 6.83	0.99	0.015	7.595
Jog	152.82 ± 9.04	154.00 ± 9.07	0.99	0.009	8.853
Stepping	79.82 ±	78.00 ± 8.18	0.80	ns	

Kcal, kilocalories.

Actical and K4b^2 $r=0.30$). Mean kcal were significantly different for the devices across all activities ($p<0.006$). The results suggest that both Fitbit and Actical devices underestimate energy expenditure for all tested activities when compared to data recorded by the Cosmed K4b^2.

The Fitbit Ultra and Actical ICC values for estimation of kcal were very high ($r=0.90$–0.96) with the exception of jogging ($r=0.57$), with Fitbit Ultra mean kcal values

Table 3. Inter-device energy expenditure correlations.

				p	
kcal	Fitbit	Fitbit Ultra	ICC		$F(15,1)$
Walk-level	5.50 ± 1.14	5.56 ± 1.26	0.94	ns	
Walk-incline	6.66 ± 1.60	6.74 ± 2.07	0.96	ns	
Jog	10.91 ± 2.30	14.34 ± 4.67	0.48	0.006	10.129
Stepping	4.56 ± 1.20	4.63 ± 1.22	0.97	ns	
kcal	Fitbit	Actical	K4		
Walk-level	5.48 ± 1.28	4.91 ± 1.04	6.09 ± 1.47		
Walk-incline	6.52 ± 1.43	5.85 ± 1.32	11.13 ± 3.03		
Jog	11.20 ± 2.67	11.52 ± 2.21	12.65 ± 2.82		
Stepping	4.89 ± 1.33	4.26 ± 1.22	8.22 ± 2.11		
kcal ICC	Fit versus Act	Fit versus K4	Act versus K4		$F(66,2)$
Walk-level	0.95	0.70	0.73	0	19.957
Walk-incline	0.97	0.72	0.73	0	111.696
Jog	0.89	0.56	0.68	0.004	6.43
Stepping	0.97	0.18	0.30	0	64.151
kcal	Fitbit Ultra	Actical	K4		
Walk-level	5.56 ± 1.26	4.97 ± 1.01	6.25 ± 1.39		
Walk-incline	6.74 ± 2.07	5.88 ± 1.41	11.44 ± 2.87		
Jog	14.34 ± 4.67	11.28 ± 1.47	13.06 ± 2.54		
Stepping	4.63 ± 1.22	4.00 ± 1.11	8.31 ± 1.82		
kcal ICC	Fit Ultra versus Act	Fit Ultra versus K4	Act versus K4		$F(46,2)$
Walk-level	0.90	0.83	0.89	0	27.925
Walk-incline	0.96	0.81	0.82	0	119.349
Jog	0.57	0.87	0.67	0.001	8.229
Stepping	0.96	0.58	0.65	0	121.909

Kcal, kilocalories; Fit, Fitbit; Act, Actical, K4, $K4b^2$.

exceeding those of the Actical. Correlations between the Fitbit Ultra and $K4b^2$ were high ($r = 0.81$–0.87), with the exception of energy expenditure during stepping ($r = 0.58$). Again, mean kcal were significantly different for the devices across all activities ($p < 0.001$).

4. Discussion

The goal of this study was to determine the reliability and validity of the Fitbit activity tracker compared to a similar validated activity tracker, the Actical, and a gold-standard indirect calometric expenditure device, the Cosmed $K4b^2$. During data collection, the newer Fitbit Ultra was released and as such it was incorporated into the data collection protocol. The results suggest that both the Fitbit and Fitbit Ultra are generally reliable and valid when compared to these standard research-grade devices, suitable for monitoring and reporting energy expenditure and activity results in research that would typically utilize more expensive activity trackers.

One of our reasons for conducting this study was to develop a long-term methodology for incentivizing increased daily activity for multiple populations. The potential for a researcher or clinician to provide real-time and long-term feedback based on activity tracking provided through the Fitbit and its website holds an advantage over the previous generation of activity tracking devices such as the Actical where the interface is not as user-friendly.

Our validity data suggests that both types of Fitbits are accurate activity monitoring devices for activities where no incline is incorporated. This is particularly the case for step counting. When estimating energy expenditure, whether walking or jogging, the Fitbit Tracker accuracy was within 90 and 88%, respectively, of energy expenditure calculations of the $K4b^2$ (Figure 1). The Fitbit Ultra accuracy was 91–113% of the $K4b^2$ calculations. The two Fitbit devices were more accurate for level walking but slightly less for jogging compared to the Actical (81 and 91% of $K4b^2$ kcal, respectively). Incline walking and stepping were less accurate in terms of energy expenditure when comparing the Fitbit and Actical to the $K4b^2$. All accelerometry devices were off by 40% or more for non-level activity (e.g. incline walking and stepping). In general, $K4b^2$ kcal calculations were twice that estimated for the Fitbit and Actical for incline walking and stepping. This was also the case for the $K4b^2$ and Fitbit Ultra calculations during these non-level activities. However, the Fitbit Ultra kcal calculations were higher than those of the Fitbit and Actical, suggesting that, in addition to a hardware upgrade, adjustments of the proprietary energy expenditure calculations may have been made. Although the Fitbit Ultra has incorporated an altimeter into the device and correlations with the kcals recorded by the $K4b^2$ for stepping were improved from those of the Fitbit and Actical, it still produces low estimations of kcal compared to the $K4b^2$.

All accelerometers under-estimated the energy expenditure necessary to perform these activities. Under-estimation is preferred in order to help people monitor their ratio of caloric intake vs caloric expenditure. Thus, the accuracy for non-level ground behaviours needs to be improved for specific types of activities and workouts. For example, individuals that live in mountainous areas, where levels of inactivity and obesity are high, such as in Appalachia, under-estimations may prove to

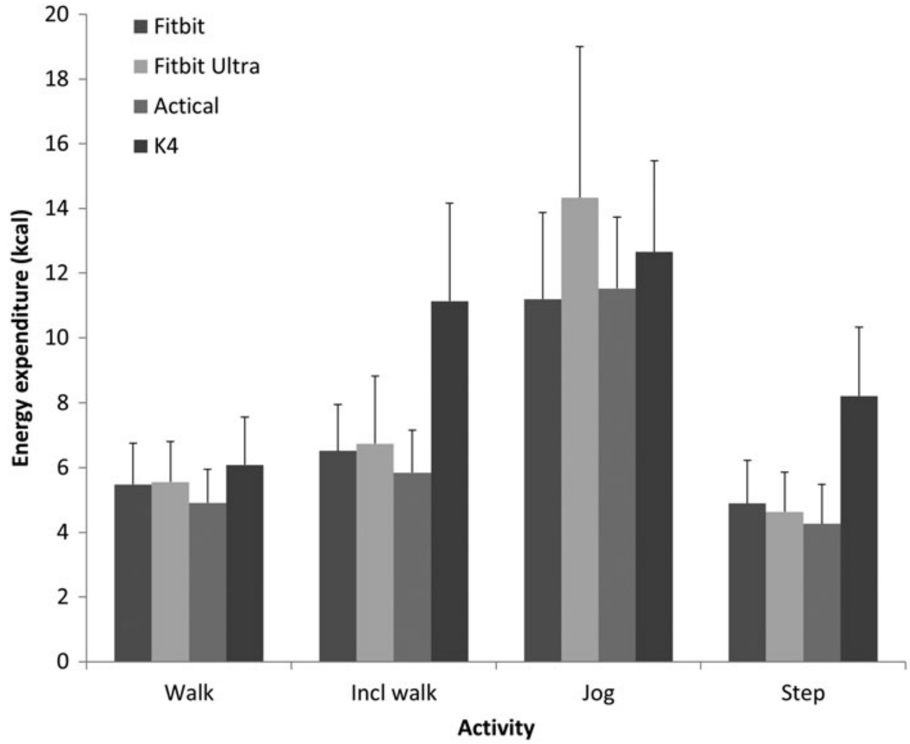

Figure 1. Energy expenditure (kcal) for the three accelerometer and indirect calorimetry devices. kcal, kilocalories; K4, K4b^2; incl walk, inclined walk.

be frustrating and ineffective. The incentive to climb hills on a regular basis may prove to be significantly different than that for walking or running on level ground.

The design of the Fitbit requires that it be worn on a belt or a waistband at the pelvis. Instructions also indicate that it can be worn in a pant leg pocket. Aside from the clip design, which is most common among accelerometer devices, bracelet style devices are now available for the same purpose. Bracelet devices are worn on the wrist (like a watch) and obtain information from arm swing. These devices, although bolstered by several claims, do not have supportive literature related to their reliability or validity.

One major advantage of bracelet style devices is that their design may encourage user compliance. While the data from the current study suggest that the Fitbit is reliable and valid, the clip design requires the user to remember to do it every day. Forgetting to wear the Fitbit negates its effectiveness as an activity incentivizer. Further, the Fitbit can fall off a pant's waistband if the user is standing and sitting with any regular frequency. In contrast, the bracelet-style accelerometers can be worn all the time and, because these devices are waterproof, users can shower and swim with the devices. Additional to this, compliance in reporting activity tracking may be improved through the Fitbit's ANT+ automated communications with the website. Other than an initial set-up process, there is no user intervention necessary to report activity data to the website for subsequent viewing or analysis.

Another advantage of these new 'connected' activity monitors is that they have a backend data collection system that allows for feedback to be provided to the user. The current Fitbit website allows a user to log-in and easily view their short-term and long-term activity data. One of the benefits of this database and the semi-real-time nature of the data transmission is that incentive programmes can be developed to provide either positive or negative feedback to users depending on their behaviour. For example, the API of the Fitbit website allows a 3rd party, such as a researcher or health professional, to monitor their subject's/patient's data and provide encouragement in the form of SMS or email messages when activity is not being performed at or above the level of an 'exercise prescription'. If users are not performing at the prescribed level, they can be contacted either by an automated message or by a real person to discuss why progress or goals are not being met. This ability to monitor and contact and intervene in individuals' progress or regression in real-time was not possible with previous generations of activity monitors and, thus, the validity and reliability of these activity trackers could help determine the effectiveness of an incentivized activity programme.

There are some limitations to this study. First, we only tested a sub-set of many behaviours that could be considered to be healthy activities. Most accelerometers are designed to measure locomotor activities such as walking or running. While the Fitbit is generally reliable and valid for these types of activities, the device also claims to be able to monitor other behaviours such as weight lifting and sleep patterns with a specific armband when using upper limb activities. We did not test the reliability and validity of these behaviours, but will compare these measurements in future studies with other bracelet-based activity monitors and indirect calorimetry. One other limitation of this study is the relatively short duration of activities we measured. The 6-min epochs are useful measures for general activities of daily life, but the validity for longer duration (e.g. running a 10 K) and free ranging field activities still need to explored.

5. Conclusion

We conclude that the Fitbit is a valid, reliable and inexpensive alternative device for activity monitoring specific to level-ground locomotor behaviours. The device is generally as accurate, if not more so than comparable research grade accelerometers for level and inclined locomotion as well as stair climbing activities. The internet connection provided by the Fitbit and the API provided to third party developers to parse the data collected can undoubtedly be exploited to develop incentivized activity programmes for a number of specific subject types. Even though the Fitbit is under-estimating level-ground energy expenditure, it provides valid activity data on a day-by-day basis. It is now necessary to test activity programmes and further develop specific targeted feedback mechanisms to decrease the inactivity epidemic which is contributing to obesity, heart disease and other healthcare issues.

Acknowledgements

Thanks to the students at the ADAM Center and the Exercise Science Human Performance Laboratory for their assistance in data collection.

Declaration of interest

The authors report no conlicts of interest. The authors alone are responsible for the content and writing of the paper.

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