**Title:** Comparison of Three Models of Actigraph Accelerometers During Free Living and Controlled Laboratory Conditions

**Keywords:** accelerometry, comparability, physical activity, activity counts, step counts

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## Abstract

The aim of this study was to compare the outputs of three commonly-used uniaxial Actigraph models (Actitrainer, 7164 and GT1M) under both free-living and controlled laboratory conditions. Ten adults (mean age = 24.7±1.1 years) wore the three Actigraph models simultaneously during one of day free-living and during a progressive exercise protocol on a treadmill at the speeds between 1.5 and 5.5 miles per hour (mph). During free-living the three Actigraph models produced comparable outputs in moderate, vigorous and moderate-to-vigorous physical activity (MVPA) with effect sizes typically <0.2, but lower comparability was seen in sedentary and light categories, as well as in total step counts (effect sizes often >0.30). In controlled conditions, acceptable comparability between the three models was seen at all treadmill speeds, the exception being walking at 1.5 mph (mean effect size = 0.48). It is concluded that care should be taken if different Actigraph models are to be used to measure and compare light physical activity, step counts and walking at very low speeds. However, using any of these three different Actigraph models to measure and compare levels of MVPA in free-living adults seems appropriate.


## Introduction

Accelerometry-based activity monitors have been widely used to objectively assess physical activity levels over recent decades, with the Actigraph models being some of the most commonly used research devices for this purpose (Alhassan & Robinson, 2008; Brage et al., 2004; Peters et al., 2010). Over the past decade, Actigraph has introduced several different models, starting with uniaxial models, which only measure vertical acceleration, to the present triaxial models (e.g., GT3X and 3D-Actitrainer), that can measure acceleration in three dimensions and simultaneously obtain heart rate and inclinometer measurements. The well-known Actigraph 7164 was introduced in the 1990s (John, Tyo, & Bassett, 2010), and was superseded by the smaller and lighter GT1M model in the 2000s (Kozey, Staudenmayer, Troiano, & Freedson, 2010). Both were uniaxial models that have been extensively used in physical activity research (Owen, Bauman, & Brown, 2009; Trost, Sirard, Dowda, Pfeiffer, & Pate, 2003). The uniaxial Actitrainer was introduced in 2007 and had features similar to the GT1M except the Actitrainer is larger and permits simultaneous heart rate measurement.

The introduction of updated Actigraph models raises the question regarding the inter-model compatibility of their outputs, especially for researchers involved in longitudinal studies that may have used different Actigraph models, or for those who may wish to compare or collate studies undertaken with two or more Actigraph models. Ensuring adequate inter-model comparability is also critical for those wishing to undertake meta-analysis of data from these widely-used accelerometers. Several recent studies have examined the comparability between some Actigraph models. Five studies examined only the 7164 and GT1M models (Corder et al., 2007; Fudge et al., 2007; John et al., 2010; Kozey et al., 2010; Rothney, Apker, Song, & Chen, 2008), yet inconsistent findings were presented. In a study where the participants were required to wear the 7164 and GT1M during self–paced locomotion, Kozey and colleagues (Kozey et al., 2010) found that both the step and activity counts were not comparable between the models. However, when the activity counts were classified into respective activity intensity categories based on published cut-points, there were no significant differences observed. John and colleagues (John et al., 2010) found no significant differences in the activity counts between the two models during walking and running on the treadmill, whilst the results of Fudge and colleagues (Fudge et al., 2007) showed small differences during walking, but some marked differences especially during fast running, although they did not statistically test for differences between these models. Corder and colleagues (Corder et al., 2007) even concluded that a correction factor was needed to be applied when using the GT1M since there were significant differences observed for the time spent in sedentary and light activities between the two models during free-living conditions. The study by Rothney and colleagues (Rothney et al., 2008) also found that the activity counts generated by the 7164 differed from the GT1M, even when movements were delimited to a highly reproducible mechanical oscillation system.

Despite the claim from the manufacturer that the outputs between different models should be comparable (personal communication June 2010), these recent studies, mentioned above, show inconsistent findings between the outputs of Actigraph models during walking and running (which has been suggested to be possibly due to small variations in band-pass filtering and/or amplitude range between models, or even in the manufacturing process (John et al., 2010)), and most studies have focused only on comparing the 7164 and GT1M models. Moreover, most of these detailed studies have been conducted only under controlled laboratory conditions (Fudge et al., 2007; John et al., 2010; Kozey et al., 2010; Rothney et al., 2008), with no studies to date reporting comparisons between Actigraph models used during free-living conditions with adult participants. The unique contributions of this current paper to the accelerometry literature it that no comparison data have been reported on the research-oriented version of the Actitrainer, nor any data simultaneously examining the comparability between all three Actigraph models, nor under both free-living and controlled laboratory conditions. We hypothesized that there would be no differences between the Actitrainer and GT1M models across all activities, but that these two models would both differ significantly, mainly at sedentary and light activities, to the 7164 model.

## Methods

The three uniaxial instruments were (a) the 7164, (b) the GT1M, and (c) the Actitrainer.

(a) The 7164 (5.1 x 4.1 x 1.5cm, 37.8g) has a sampling rate of 10 Hz using an 8-bit analog/digital (A/D) converter to measure activity counts and steps counts, but requires calibration and uses a non-rechargeable battery. Prior to use in this project, all 7164 models had their battery replaced and their calibration checked using the manufacturer-designed hardware and software calibration system.

(b) Of the three versions of the GT1M (John et al., 2010), the version #3 was used here (4.0 x 3.9 x 1.8cm, 26.7g) that samples at 30 Hz, has a rechargeable battery, and uses a 12-bit A/D converter to measure activity counts and step counts.

(c) The research-oriented version of the Actitrainer, (8.6 x 3.3 x 1.5cm, 51.0g), also uses a sampling rate of 30 Hz, has a rechargeable battery, and uses a 12-bit A/D converter to measure activity counts and step counts, but also has the ability to monitor heart rate. Like the GT1M, calibration of the Actitrainer was not required due to improved solid-state circuitry and firmware digital filtering.

Eight male and two female university students who were apparently healthy and moderately active were recruited (mean age = 24.7±1.1 years; height = 170.3±6.5 cm; mass = 57.9±4.9 kg); informed consent was obtained from each participant after ethical approval for the study was obtained from the University Research Ethics Committee. Participants were from a convenience sample, and included if they understood the requirements of the study and considered they could complete all stages (including moderately fast running on a treadmill, with some prior experience of running on a treadmill at the University recreation centre). Each participant simultaneously wore all three Actigraph models under two conditions: (a) during a working day (free-living condition), and (b) during a progressive exercise protocol on a motorized treadmill (laboratory condition). The three accelerometers were initialized by the same computer using Actigraph software version 4.1.0, using an epoch length of 60 s and tied together to form a single unit by an inelastic band. The unit was threaded onto a belt and placed at the mid-axillary line at the right hip. The order of the three models was rotated between participants using a 10 x 3 (participant x accelerometer) Latin-square design to avoid any positional bias.

The participants wore the accelerometers for the entire waking day (weekday, for at least 10 hours of valid data recording), excluding showering/bathing or water-activities. The participants were given clear instructions on how to attach the belt and correctly position the packet of accelerometers. The next day they returned the accelerometers to the laboratory and proceeded to the second part of the research where they wore athletic clothing and re-attached the accelerometers in the earlier standardized position. Prior to the exercise protocol, the participants stood stationary on the treadmill for three minutes ('baseline' output), then walked for 3 minutes at the speed of 1.5, 2.5 and 3.5 miles per hour (mph), and jogged at 4.0, 4.5, 5.0 and 5.5 mph.

***Data analysis****:* After the accelerometry data were downloaded to a personal computer the accelerometry counts per minute (cpm) and step counts per minute were obtained. Although the use of cut-points is widely debated (Ridgers & Fairclough, 2011), the time spent in different physical activity categories was determined using a well-cited set of adult cut-points (Freedson, Melanson, & Sirard, 1998) (light activity = 100-1951 cpm; moderate activity = 1952-5724 cpm; vigorous activity = > 5725 cpm); moderate and vigorous physical activity were also combined as MVPA, as they represent an intensity of physical activity often recommended for enhancing health (American College of Sports Medicine, 2010; World Health Organization, 2011). Sedentary time (<100 cpm) was also determined (Matthews et al., 2008). During the free-living condition, the main outcome variables were the mean overall activity counts (cpm), the step counts, and the minutes spent in different activity categories, whereas the main outcome variables analysed during the laboratory test were the mean activity levels (cpm) at each speed during each 3-minute increment of the 21-minute-exercise protocol. Any period of continuous zero-counts for 30 or more minutes during daily activity that was seen simultaneously across all three acclerometers was taken as being indicative of that group of monitors not being worn and these periods were not included in the subsequent analysis.

Each set of data was examined for normality using the Shapiro-Wilks test, with data from only one of fourteen (7%) grouping variables (vigorous activity) showing non-normal distributions (these data were log-transformed). The outputs from the three Actigraph models across the 7 treadmill speeds and the 7 activity categories during free-living were compared using paired t-tests with the Holms sequential Bonferroni adjustment (Holm, 1979) to reduce the risk of a Type I error. Effect sizes comparing each pair of tests were also calculated and interpreted (Saunders, Pyne, Telford, & Hawley, 2004), along with Spearman rank order correlations due to the small sample size. A statistical significance level was set at $P<0.05$.



## Results

Data from the first part of the study that involved comparing the accelerometers during free-living conditions over a working day is shown in Table 1. Five of the ten participants had periods of non-wear detected during the day, resulting in an overall average non-wear period of 90.1 min; the average time over the day that the accelerometers were worn by all participants was 733.4 min. Over the weekday, the mean activity level (cpm) from the Actitrainer was significantly 4% lower ($P=0.025$) than the 7164 and 3% lower ($P<0.001$) than the GT1M. Similarly, the total step counts from the Actitrainer and GT1M were significantly 12% ($P<0.001$) and 11% ($P<0.001$) lower than those measured by the 7164 (effect sizes both above 0.40), whilst the step counts from the Actitrainer were also 2%

significantly lower (P<0.001) than those measured by the GT1M, although the effect size was trivial (0.07).

Table 1 near here

The Actitrainer recorded the highest mean minutes in sedentary activity, with the GT1M 2% significantly lower (P=0.011). In contrast, during light activity the Actitrainer recorded the lowest output, with the 7164 and GT1M significantly 12% (P=0.003) and 5% (P=0.037) higher respectively. The output of the GT1M for light activity was also significantly 6% lower (P=0.001) than that measured by the 7164. Only in this light activity did the differences between each pair of instruments result in effect sizes consistently at 0.30 or higher. During moderate, vigorous and the combined moderate-to-vigorous physical activity (MVPA), no significant differences between models were seen in the t-tests. When vigorous activity data was log-transformed, small significant differences were seen between the Actitrainer-GT1M pair (P<0.004) and the Actitrainer-7164 pair (P=0.036), but in each case the effect sizes were small (<0.30). All Spearman correlations between the pairs of data were 0.85 or higher (P<0.01).

The second part of the study involved controlled-laboratory comparisons using a progressive treadmill protocol, with summary data shown in Table 2. The only significant differences between the models were seen during the slowest walking speed (1.5 mph), with the outputs from the Actitrainer and GT1M being respectively 26% (P<0.001) and 16% (P<0.001) lower than the 7164 (effect sizes of 0.71 and 0.49 respectively), and the output of the Actitrainer also 12% lower (P=0.002) than that of the GT1M (effect size of 0.25). At 2.5, 3.5, 4.0, 4.5, 5.0 and 5.5 mph the outputs from the Actitrainer were a consistently the lowest and the 7164 consistently the highest, yet the differences between the models were not significant. At all speeds above 1.5 mph the effect sizes between pairs remained trivial or small (<0.5), with Spearman correlations all significant ($P < 0.05$) at, or above, 0.70.

Table 2 near here

Figure 1 shows that the activity counts increased with increasing speed in a linear manner until the speed reached a walking speed of 4 mph, after which the running stage started. Despite the relatively small, but significant differences shown at 1.5 mph (Table 2), the visual data in Figure 1 shows a considerable degree of commonality across all three monitors, with only the 7164 showing visible, but not statistically significantly different values, at higher speeds.

Figure 1 near here

## Discussion

The main finding of this study was that when activity counts taken from free-living adults during daily activity were classified using published cut-points into time spent in different intensity categories, significant differences between the three Actigraph models were seen in sedentary and light activities. The absence of significant differences for moderate, vigorous and MVPA are consistent with the findings of Corder and colleagues (Corder et al., 2007) who showed the 7164 and GT1M models generated comparable outputs in these categories. Consequently, we believe that using any of these three different Actigraph models to measure levels of MVPA in free-living adults would be appropriate and the measured variables across each model should be consistent.

However, based on the findings in this study, the three Actigraph models were unable to generate comparable outputs at lower activity levels. Our findings are similar to one study (Corder et al., 2007) that found the 7164 recorded significantly more time in light activity than the GTIM, whereas our unique findings on the Actitrainer show it also recorded significantly less time in light activity compared to the GT1M and 7164. In contrast to the findings of Corder and colleagues (Corder et al., 2007) who found the GT1M significantly recorded more time in sedentary activity than the 7164, the difference between the two models was not significant in our study. However, we found that the Actitrainer recorded significantly more sedentary activity than the GT1M. The relatively inconsistent results across the three Actigraph models, especially in measuring sedentary and light activities, highlights the need for care when attempting to compare data from free-living adults across different Actigraph models.

Obtaining valid and reliable (both intra- and inter-machine) measurements of both sedentary and light activity remains important due to the their significant associations with conditions that can raise our metabolic risk (Healy et al., 2008; Laaksonen et al., 2002), and also because some of the biggest improvements in public health are likely to be gained from moving the large numbers of sedentary individuals into some form of light activity (Blair, Cheng, & Holder, 2001; Blair, LaMonte, & Nichaman, 2004; Warburton, Nicol, & Bredin, 2006). That no differences were seen in the moderate, vigorous and MVPA categories across all three Actigraph models is gratifying considering these categories are the primary focus of most surveillance and clinical studies (Kozey et al., 2010), and with health professionals encouraging the population to accrue $150 \text{min} \cdot \text{wk}^{-1}$ of MVPA due to its well recognized benefits to health and fitness (American College of Sports Medicine, 2010; World Health Organization, 2011). Yet accurately monitoring humans over the entire range of activity intensities during free-living using objective instruments remains an important goal for health professionals.

The overall mean counts per minute (cpm) during free-living conditions in our study showed the GT1M was a non-significant 1% lower than the 7164, which is inconsistent with a significant 9% difference reported by one study (Corder et al., 2007) and an opposite result found by another group (Kozey et al., 2010) where the cpm outputs of the GT1M were significantly higher than the 7164, but only by 2.7%. It is not particularly clear why there were opposite findings to those of Kozey and colleagues (Kozey et al., 2010) although the larger discrepancy found by Corder and colleagues (Corder et al., 2007) could be explained by a change in the Actigraph filtering process and the different patterns of physical activity across age groups. An increase in the lower filtering range from 0.21Hz (7164) to 0.25Hz (GT1M) is likely to have required greater accelerations for a non-zero count in the GT1M (Rothney et al., 2008) which may have resulted in it providing lower estimates of light activity than the 7164 (Kozey et al., 2010). Furthermore, Corder and colleagues (Corder et al., 2007) recruited younger adolescents who spent more time in light physical activity than the adults in our study and this could have possibly led to the higher (9%) difference between the 7164 and GT1M when compared to the current study.

Our findings also showed that the three Actigraph models were not able to generate consistent step counts under free-living conditions. These findings extend the results of a previous study (Kozey et al., 2010), which showed the 7164 and GT1M models generated remarkably different (>50%) step counts, but only during slow walking speeds. Kozey and colleagues (Kozey et al., 2010) explained that the differences observed were due to the different low filtering range between the 7164 and GT1M (as mentioned above), and this could also be applied in our study. Compared to the 7164, Kozey and colleagues (Kozey et al., 2010) reported 20% lower overall step counts by the GT1M; their 20% exceeded the 11%

and 12% lower total step counts recorded by the GT1M and Actitrainer respectively in our study. The greater variations in step counts reported by their study (Kozey et al., 2010) is likely to reflect the different experimental design (3 self-paced speeds around a track), compared to the free-living condition of our study. However, we could not explain the small, but significant 2% difference in step counts we observed between the Actitrainer and GT1M, as we understand these models use the same filtering process, hence researchers should interpret these step counts data cautiously.

Only at the lowest walking speed (1.5 mph) were there significant differences in activity counts between all three models (Table 2), with greater comparability across models seen at higher treadmill speeds. These findings were consistent with those under the free-living condition, where the comparability across models increased at higher activity intensities (Table 1). Similar to previous findings (Kozey et al., 2010), the 7164 in our study consistently produced the highest activity counts at all treadmill speeds, whilst the Actitrainer consistently produced the lowest counts at all treadmill speeds (Fig 1). This indicates a difference exists between these models under controlled conditions, especially during slow speeds, and that care needs to be taken when attempting to compare outputs from these models if measuring slow body movements (e.g. slow walking at, or below, 1.5 mph) was of interest. The lack of significant differences within the 2.5 – 5.5 mph speeds between the 7164 and GT1M in our treadmill test agrees with the findings of John and colleagues (John et al., 2010), but contrasts with the results from a study using a mechanical shaker (Rothney et al., 2008). However, due to the different research designs between the studies (treadmill test versus mechanical shaker test), such contrasts should be interpreted in caution.

Our study contains some limitations. A small sample size (n = 10) and short duration of wearing the accelerometers during the free-living condition (one working day) may be construed as limitations of our study. However, our sample size of 10 was identical to three other comparison studies using an Actigraph accelerometer (John et al., 2010; McClain, Craig, Sisson, & Tudor-Locke, 2007; McClain, Sisson, & Tudor-Locke, 2007). Although our single day was longer than the 120 minutes of free-living reported by Bernsten and colleagues (Berntsen et al., 2010), it was not used to report data on normal habitual activity, but only to compare how the three instruments compared when analyzing data from free-living individuals, rather than under strictly-controlled laboratory conditions. Thus one-day of free-living measurement in the field, as also used by McClain and colleagues (McClain, Sisson, et al., 2007), is as justified as undertaking three different speed trials in a controlled laboratory over a single day (Kozey et al., 2010). It should be noted that the small sample size and repeat t-test comparisons with Bonferroni adjustment may increase the chance of Type II errors, and the absence of a significant t-test alone does not imply that each data-pair is similar (only that the means are not significantly different). For this reason we also provided in Table 2 and Table 3 the Spearman rho correlations that help examine the similarity between the sets of data.

Our convenience sample was an unbalanced mixture of gender (8 male and 2 female). Although males are often reported to be more active than females (Lin, Yeh, Chen, & Huang, 2010), there were no significant differences between Actigraph models observed between genders in a similar previous study (Kozey et al., 2010), thus we believe that the gender imbalance in our study would not cause a significant impact on our findings. Also, the treadmill speed range used here, 1.5- 5.5 mph (2.4 – 8.8 km/h) contrasts to the 3 - 20 km/h used in two studies (Fudge et al., 2007; John et al., 2010) on endurance-trained athletes, as we aimed to cover those speeds typically managed by reasonably-active healthy individuals commonly found in larger surveillance studies, but not the higher speeds associated with competitive athletes. Finally, we are aware that since we did not attempt to include a criterion measure of activity, it is not possible to determine which monitor provides the best estimates of activity. However, determining the most accurate device was not our aim, rather our primary focus was to determine if data collected from a mixture of these three devices (possibly from a variety of studies), could be faithfully compared (e.g., meta-analysis or systematic review).

The strengths of this study is that it is the first to simultaneously compare the outputs of three different research-oriented Actigraph models, including data from free-living and laboratory conditions. It is important to compare the outcomes in both conditions, as this could provide a more comprehensive evaluation on the spectrum of activities being measured, from sedentary and light activities that typically dominate during free-living conditions, to moderate-to-vigorous activity that were tested on the treadmill. If the participants were predominantly inactive, the findings would potentially underestimate any differences in MVPA if these measures were only taken during free-living conditions. Similarly, the findings would not truly reflect the typical variability of the models when measuring sedentary and light activities if the research was only conducted under controlled laboratory conditions. A further cautionary note should be considered when analyzing accelerometry data, since the epoch length, cut-point thresholds, and the duration of zeros needed to define periods of non-wear can all affect the partitioning of accelerometry-determined activity into the different intensity bouts (sedentary, light, moderate, vigorous). For example, using a 60s epoch may incorrectly classify a single 60s bout of intermittent activity as being "light", whilst using a 5s epoch to analyze the same 60s of activity may reveal that in fact 50s of the measured 60s was actually "sedentary", with a small 10s burst of "moderate" activity. A detailed discussion of these influences is beyond the scope of this paper, with the reader referred to other reviews on this area (Ridgers & Fairclough, 2011; Trost, McIver, & Pate, 2005). Given the limitations of our study, we would recommend that future studies comparing the outputs of different physical activity monitors should utilize a longer sampling period as well as a substantially larger group of participants that would permit additional sub-sample analyses (e.g., gender, weight status, etc), in both controlled laboratory and free-living conditions.

## Conclusion

We found that during free-living the three Actigraph models (Actitrainer, 7164 and GT1M), all generated comparable outputs in moderate, vigorous and MVPA, but not in less active categories, nor in total step-counts. During laboratory-controlled treadmill activity, poor comparability was seen among all three models at very slow walking (1.5 mph), but at higher speeds improved similarity was seen.

## Conflict of interest

All authors declare no conflict of interest with the Actigraph company or its products.

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**Figure Captions:**

Figure 1. Mean activity counts for each device against speed during the exercise protocol on a treadmill

**Table 1.** Time spent in different activity categories, mean counts per minute (cpm) and step counts for the Actitrainer, 7164 and GT1M during free-living conditions. Paired comparisons: Pair a) Actitrainer-7164 ; Pair b) Actitrainer-GT1M ; Pair c) 7164-GT1M.

| Condition | Model | Mean ± SD (min) | Mean Difference ± SD (min) | 95% CI | Effect size | Spearman rho^ |
|---|---|---|---|---|---|---|
| Sedentary | Actitrainer | 491.1 ± 85.0 | a) -15.2 ± 19.0 | a) -28.8, -1.59 | a) 0.18 | a) 0.98 |
| | 7164 | 475.9 ± 75.9 | b) -8.3 ± 8.2 | b) -14.2, -2.4 * | b) 0.10 | b) 1.00 |
| | GT1M | 482.8 ± 81.1 | c) 6.9 ± 13.8 | c) -3.0, 16.8 | c) 0.08 | c) 0.98 |
| Light | Actitrainer | 153.2 ± 19.8 | a) 18.2 ± 14.2 | a) 8.1, 28.3 * | a) 0.68 | a) 0.85 |
| | 7164 | 171.4 ± 31.1 | b) 7.2 ± 9.3 | b) 0.53, 13.9 * | b) 0.30 | b) 0.95 |
| | GT1M | 160.4 ± 25.9 | c) -11.0 ± 7.2 | c) -16.1, -5.9 * | c) 0.39 | c) 0.94 |
| Moderate | Actitrainer | 77.9 ± 24.2 | a) -2.1 ± 2.8 | a) -4.1, -0.12 | a) 0.11 | a) 0.98 |
| | 7164 | 75.8 ± 25.7 | b) 0 ± 1.2 | b) -0.89, 0.89 | b) 0.00 | b) 0.99 |
| | GT1M | 77.9 ± 24.1 | c) 2.1 ± 2.8 | c) 0.12, 4.08 | c) 0.11 | c) 0.97 |
| Vigorous | Actitrainer | 7.7 ± 15.9 | a) 2.5 ± 2.8 | a) 0.47, 4.53 # | a) 0.29 | a) 0.98 |
| | 7164 | 10.2 ± 18.2 | b) 0.9 ± 1.1 | b) 0.11, 1.7 # | b) 0.12 | b) 0.98 |
| | GT1M | 8.6 ± 15.7 | c) -1.6 ± 2.7 | c) -3.5, 0.31 | c) 0.17 | c) 0.97 |
| MVPA | Actitrainer | 85.6 ± 27.0 | a) 0.4 ± 3.2 | a) -1.9, 2.7 | a) 0.01 | a) 1.00 |
| | 7164 | 86.0 ± 28.8 | b) 0.9 ± 1.5 | b) -0.19, 2.0 | b) 0.03 | b) 0.99 |
| | GT1M | 86.5 ± 27.3 | c) 0.5 ± 3.0 | c) -1.6, 2.6 | c) 0.04 | c) 0.98 |
| Mean cpm | Actitrainer | 299.6 ± 100.8 | a) 12.3 ± 14.5 | a) 1.9, 22.7 * | a) 0.11 | a) 0.99 |
| | 7164 | 311.9 ± 108.9 | b) 8.6 ± 4.8 | b) 5.1, 12.1 * | b) 0.08 | b) 1.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | GT1M | 308.2 ± 104.9 | c) -3.7 ± 12.0 | c) -12.3, 4.9 | c) 0.03 | c) 0.99 |
| Steps (n) | Actitrainer | 10611 ± 3102 | a) 1491 ± 457 | a) 1164, 1817* | a) 0.44 | a) 0.98 |
| | 7164 | 12103 ± 3072 | b) 212 ± 56.6 | b) 171.8, 252.8 * | b) 0.07 | b) 0.99 |
| | GT1M | 10824 ± 3095 | c) -1279 ± 429 | c) -1585, -972.2* | c) 0.38 | c) 0.99 |

* Significantly different using Holms sequential Bonferroni adjustments.

# Significantly different using Paired t-test, with Holms sequential Bonferroni adjustments, on log-transformed data (performed on Vigorous activity only).

^ All Spearman rho correlations were significant at P < 0.01

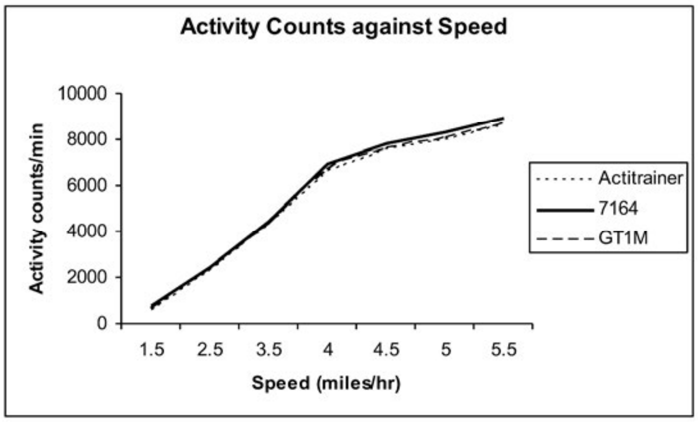
**Table 2.** Activity counts for the Actitrainer, 7164 and GT1M at various speeds on the treadmill. Paired comparisons: Pair a) Actitrainer-7164; Pair b) Actitrainer-GT1M; Pair c) 7164-GT1M.

| Treadmill speed | Model | Mean ± SD (counts) | Mean Difference ± SD (counts) | 95% CI | Effect size | Spearman rho^ |
|---|---|---|---|---|---|---|
| 1.5 mph walk | Actitrainer | 541.4 ± 321.2 | a) 190.1 ± 51.3 | a) 153.4, 226.8* | a) 0.71 | a) 0.90 |
| | 7164 | 731.5 ± 299.7 | b) 71.4 ± 50.6 | b) 35.2, 107.6 * | b) 0.25 | b) 0.96 |
| | GT1M | 612.8 ± 339.9 | c) -118.7 ± 66.8 | c) -166.5, -70.9* | c) 0.49 | c) 0.95 |
| 2.5 mph walk | Actitrainer | 2321 ± 274.8 | a) 117.5 ± 179.2 | a) -10.7, 245.7 | a) 0.36 | a) 0.92 |
| | 7164 | 2439 ± 358.4 | b) 55.7 ± 61.1 | b) 12.0, 99.4 | b) 0.19 | b) 0.95 |
| | GT1M | 2377 ± 310.2 | c) -61.8 ± 167.6 | c) -181.7, 58.1 | c) 0.18 | c) 0.89 |
| 3.5 mph walk | Actitrainer | 4324 ± 345.7 | a) 131.3 ± 259.7 | a) -54.5, 317.1 | a) 0.32 | a) 0.93 |
| | 7164 | 4455 ± 453.4 | b) 9.3 ± 50.3 | b) -26.6, 45.2 | b) 0.02 | b) 0.96 |
| | GT1M | 4333 ± 361.2 | c) -122.0 ± 248.1 | c) -299.5, 55.5 | c) 0.29 | c) 0.93 |
| 4.0 mph run | Actitrainer | 6630 ± 1010 | a) 307.0 ± 363.5 | a) 46.9, 567.1 | a) 0.32 | a) 0.93 |
| | 7164 | 6937 ± 1035 | b) 78.2 ± 140.2 | b) -22.1, 178.5 | b) 0.08 | b) 0.91 |
| | GT1M | 6709 ± 1095 | c) -228.8 ± 408.1 | c) -520.7, 63.1 | c) 0.25 | c) 0.78 |
| 4.5 mph run | Actitrainer | 7583 ± 936.0 | a) 212.0 ± 292.1 | a) 3.0, 421.0 | a) 0.25 | a) 0.88 |
| | 7164 | 7795 ± 928.8 | b) 57.5 ± 162.9 | b) -59.0, 174.0 | b) 0.06 | b) 0.88 |
| | GT1M | 7641 ± 1038 | c) 154.5 ± 338.3 | c) -396.5, 87.5 | c) 0.19 | c) 0.87 |
| 5.0 mph run | Actitrainer | 8002 ± 809.7 | a) 333.6 ± 385.7 | a) 57.7, 609.5 | a) 0.44 | a) 0.70 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 7164 | 8335 ± 781.3 | b) 62.6 ± 178.7 | b) -65.2, 190.4 | b) 0.07 | b) 0.92 |
| | GT1M | 8064 ± 921.1 | c) -271.0 ± 395.3 | c) -553.8, 11.8 | c) 0.35 | c) 0.83 |
| 5.5 mph run | Actitrainer | 8622 ± 634.5 | a) 325.5 ± 469.5 | a) -10.3, 661.3 | a) 0.50 | a) 0.71 |
| | 7164 | 8948 ± 647.5 | b) 69.1 ± 196.1 | b) -71.2, 209.4 | b) 0.10 | b) 0.97 |
| | GT1M | 8691 ± 727.1 | c) -256.4 ± 484.5 | c) -603.0, 90.2 | c) 0.38 | c) 0.85 |

* Significantly different using Holms sequential Bonferroni adjustments.

^ All Spearman rho correlations were significant at $P < 0.05$

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279x361mm (300 x 300 DPI)