Concurrent validity of ActiGraph-determined sedentary time against the activPAL under free-living conditions in a sample of bus drivers

Running head: SEDENTARY BEHAVIOUR MEASUREMENT
Abstract

This study explored the validity of ActiGraph-determined sedentary time (<50cpm, <100cpm, <150cpm, <200cpm, <250cpm) compared with the activPAL in a free-living sample of bus drivers. 28 participants were recruited between November 2013 and February 2014. Participants wore an activPAL3 and ActiGraph GT3X+ concurrently for 7 days and completed a daily diary. Time spent sedentary during waking hours on workdays, non-workdays, during working-hours and non-working hours were compared between instruments. During working hours, all ActiGraph cut-points significantly underestimated sedentary time (p<0.05), whereas during non-working hours the <50 cpm cut-point demonstrated the closest agreement (ActiGraph sedentary time: 250±75 minutes vs activPAL sedentary time: 236±65 minutes). ROC analyses revealed that on workdays and non-workdays the ActiGraph cut-points exhibited relatively low sensitivity (all <0.62) and specificity (all <0.49) values. The use of the ActiGraph to measure sedentary time in this understudied, highly sedentary and at risk occupational group is not recommended.

Key words: Bus drivers, sedentary behaviour, validation, ActiGraph, activPAL.
Introduction

Sedentary behaviour, described as any sitting or reclining posture with an energy expenditure ≤1.5 MET’s during waking hours (SBRN, 2012), has been linked to numerous adverse health outcomes, including obesity, type 2 diabetes, metabolic syndrome, some cancers and mortality from all causes and cardiovascular disease (Wilmot et al., 2012; Biswas et al., 2015). High levels (between 50- 60% of waking hours) of sedentary time have been identified in office workers (Thorp et al., 2012; Brown et al., 2013; Clemes et al., 2015) and bus drivers (Wong et al., 2014; Varela-Mato et al., 2015), which put them at greater risk of co-morbidities and mortality in comparison to other occupational groups (John et al., 2006; Katzmarzyk et al., 2009; Dunstan et al., 2013).

Accelerometers have been used to overcome the limitations of self-report instruments and are commonly used in surveillance studies and interventions to quantify both physical activity and sedentary time. In addition, studies have shown a robust relationship between accelerometer-determined sedentary time and health outcomes (Healy et al., 2008; Kozey-Keadle et al., 2011). The use of accelerometry to provide an objective estimate of sedentary time, in addition to physical activity, has been widespread, with the ActiGraph being one of the most popular measurement tools within the literature (Kozey-Keadle et al., 2011; Hart et al., 2011; Berendensen et al., 2014). The ActiGraph is a small lightweight device that traditionally has been worn on an elastic belt on the hip. This device measures raw acceleration data by capturing the frequency and amplitude of the acceleration of the body segment to which it is attached (Atkin et al. 2012). Once the monitoring period is finished, these data can be clustered into sedentary, light, moderate and vigorous activities during the post-processing analysis (Atkin et al. 2012). However,
ActiGraphs do not measure posture and instead sedentary time is estimated using a lack of movement counts. Several different thresholds (cut-points) have been applied to predominantly the vertical axis of the ActiGraph accelerometer, to estimate sedentary time (Kozey-Keadle et al., 2011; Hart et al., 2011; Ridgers et al., 2012). A cut-point of less than 100 counts per minute (cpm) has been the most widely adopted to define sedentary time (Atkin et al., 2012) in studies ranging from clinical interventions to large scale epidemiological studies (Matthews et al., 2008; Healy et al., 2011). However, this cut-point was not empirically derived.

The activPAL is a lightweight device that is attached to the anterior aspect of the thigh. This contains a uni-axial accelerometer which responds to signals related to gravitational forces and provides information on thigh inclination (Kozey-Keadle et al., 2011). The activPAL has been shown to be a highly sensitive and valid measure of posture (Kozey-Keadle et al., 2011; Grant et al., 2006; Hart et al., 2011), overcoming the limitations of other accelerometers used to estimate sedentary time (e.g. the ActiGraph). However, literature studying the agreement between the ActiGraph and activPAL when measuring sitting time in a free-living environment is limited (Ridgers et al., 2012; Decker et al., 2013).

As sedentary behaviours are ubiquitous in most adults’ day to day lives, accurately measuring sedentary time is important to establish dose-response relationships with health, to determine sedentary behaviour levels and patterns, and to identify behaviour domains to target in interventions. It is therefore important to assess the outputs from available instruments to measure sedentary time (ActiGraph and activPAL) taking into account different characteristics of each occupational group; as different job-related behaviours and working-environments might have an impact on the monitors’ ability to correctly identify
sedentary time. Most validation studies (comparing the ActiGraph against the activPAL) in adults have been conducted under controlled laboratory conditions, which have typically simulated computer-based working environments (Kozey-Keadle et al., 2011; Hart et al., 2011; Berendsen et al., 2014). No validation studies have been conducted in occupational drivers such as bus drivers, whereby the continuous vehicle accelerations and decelerations may have an impact on the accelerometers sensitivity to identify true sedentary time.

Indeed, of the limited research available examining bus drivers’ sedentary time using accelerometry, vast differences in sedentary time have been reported across studies using different measurement tools. For example, using the ActiGraph accelerometer, Wong et al (2014) reported that bus drivers accumulated 8 hours/day of sedentary time on workdays (using a cut-point of <150 counts/minute (cpm)), whereas Varela-Mato et al (2016) reported that bus drivers accumulated 12 hours/day of sitting on workdays, using the activPAL. The largest differences in sedentary time observed between studies appeared to occur during working hours, with bus drivers reportedly spending up to 4 hours whilst at work sedentary in the study by Wong et al. (2014), whereas in the study by Varela-Mato et al. (2016), bus drivers spent approximately 7 hours sitting whilst at work. Whilst information on the drivers work pattern, in terms of hours spent driving, the number of breaks, and distance between stops is not available for a detailed comparison between studies, the large differences in sedentary times observed between these studies warrants further investigation into any potential differences between the measurement tools.

Despite the ActiGraph being used to assess sedentary time in bus drivers (Wong et al., 2014), no evidence currently exists on the validity of this measurement tool in this specific population. Due to the nature of their occupation which typically promotes
prolonged periods of sitting, and their higher levels of disease risk (John et al., 2006; Joshi et al., 2013; Wong et al., 2014) bus drivers are an important group to study in sedentary behaviour research. This study therefore aims to explore the validity of ActiGraph-determined sedentary time (<50cpm, <100 cpm, <150cpm, <200cpm, <250cpm) in comparison to the activPAL in a free-living sample of bus drivers. This study will further our understanding of the validity of the ActiGraph as a sedentary behaviour measurement tool in a different occupational group, considering their working environment.

Methods

Participants

A convenience sample of bus drivers was recruited from a bus company within the East Midlands, UK, via leaflets and personal approaches by the researcher. Participants were recruited at their place of work during their breaks, with the manager’s consent, between November 2013 and February 2014. Participants drove single-decker buses travelling local routes with an average of 20 stops per route. Participants breaks varied in number between 1 and 4 depending on the route and their shift (average shift duration: 9 hours/day). Written consent was obtained from 35 eligible full-time bus drivers (42% of the driving workforce). Ethical approval was granted from the Loughborough University Ethical Advisory Committee.

Demographic measures
Participants self-reported their age. Height was measured without shoes using a portable stadiometer (Seca 206, Oxford, UK). Body composition and weight were assessed using a Tanita BC-418 MA Segmental Body Composition Analyzer (Tanita, UK Ltd). BMI was calculated as kg/m².

Measurement of Sedentary Behaviour

The activPAL was initialised and downloaded using activPAL Professional v.7.2.29 software (device firmware version 3.107). It was attached directly to the skin on the midline of the anterior aspect of the right thigh using a hypoallergenic medical dressing (BSN Hypafix). The activPAL3 determines posture using information derived from accelerations of the thigh, including the gravitational component, using a triaxial accelerometer (Atkin et al., 2012). Due to its precision to differentiate between postures during free-living activities (Godfrey et al., 2007), the activPAL3 has been shown to be a valid measure of time spent sitting/lying, standing and walking in adults (Kozey-Keadle et al., 2011; Grant et al., 2006; Hart et al., 2011). This monitor has been used as the criterion measure in studies investigating the validity of waist-worn accelerometers for estimating sedentary time (Oliver et al., 2010; Ridgers et al., 2012). The activPAL3 was therefore used as the criterion measure in this study.

The ActiGraph GT3X+ was worn on an elasticated belt on the waist above the midline of the right thigh. The device was initialised at a frequency of 100HZ and downloaded using ActiLife software v6.11.8 and firmware version 2.0.0. Several sedentary behaviour cut-points ranging from 0 to 500 cpm, applied to the vertical axis, have been proposed in the literature (Atkin et al., 2012; Kozey-Keadle et al., 2011), with the <100 cpm cut-point being the most commonly used (Atkin et al., 2012; Healy et al., 2008; Broklebank et al., 2015). In
this study ActiGraph data were downloaded in 60-seconds epochs and sedentary time was defined as the sum of minutes where the monitor output (from the vertical axis) was <50cpm, <100cpm, <150cpm, <200cpm, <250cpm and <300cpm.

Participants were advised to wear both devices concurrently and continuously over a seven-day period, except during water-based activities. In addition, participants were asked to complete a daily log book where they recorded their waking hours. On workdays, participants recorded the times they started and finished work, along with the times of their breaks during the day. Information about any non-wear time was also recorded in the daily log. At the end of the seven days the devices and diary were collected from the participants.

Data processing

Downloaded data from the activPAL were processed manually using a customized Microsoft Excel macro. The activPAL data which are downloaded into 15-sec epochs were re-integrated and summarized (using the Microsoft Excel macro) over 60-sec epochs (to match the ActiGraph data) and time spent sitting, standing and stepping, including number of steps and average cadence and sit-to-stand transitions were extracted. Sleeping time was identified as the last transition from standing to sitting/lying and the first transition from sitting/lying to standing during the time that best matched the participants’ daily log. For each identified sleeping bout, data were explored 60 minutes before and after and included as sleeping time if sitting/lying time was ≥30 minutes and <20 steps were recorded. If any standing time with <20 steps was found during sleeping hours, this was considered as sleeping time. Non-wear time was considered as time spent in either a sitting/lying or standing position for ≥3 hours, with no transitions.
Using the ActiGraph data, the time spent sedentary for each participant was determined by summing the minutes spent below the 6-different cut-points defined above. Sleep time was interpreted as the consecutive strings of sedentary minutes during the night time that best matched the activPAL data. Sleep time was excluded from the analysis. Non-wear time data (continuous strings of zero counts) that best matched the activPAL data was removed from the analysis.

To be included in the analyses participants were required to have worn both devices concurrently for at least 600 minutes on at least 4 days, including three work days and one non-work day. For each participant, time matched total minutes spent sedentary during working hours and outside of working hours on workdays, and total sedentary and non-sedentary time on non-workdays were extracted based on times derived from participant’s logs. Timed-matched data for waking hours during work and non-workdays and during working and non-working hours were retrieved from the activPAL and ActiGraph. These were analysed for each participant using a Microsoft Excel macro which summarised total activPAL and ActiGraph-determined sedentary time for each domain.

**Data analysis**

Sedentary times determined by the activPAL and ActiGraph during waking hours on workdays and non-workdays, and during working-hours and non-working-hours on workdays were analysed using SPSS version 22. These variables were tested for normality using the Shapiro-Wilk Test, which confirmed that all data were normally distributed. Paired-samples t-tests were used to compare the time (in minutes) spent sedentary between instruments on workdays and non-workdays and during working hours and non-
working hours on workdays. The Cohen’s d statistic has been reported to provide a further insight into the magnitude of the differences between the activPAL and ActiGraph, by providing information on the standardised difference between the means. An effect size calculator (UCCS Lee Becker) was used to determine the effect sizes. A small effect is classified as 0.2, a medium effect as 0.5 and a large effect is classified as 0.8 (Cohen, 1988). The coefficient of variation was used to assess the variability of the standard deviation with respect to the mean.

The mean difference in time spent sedentary within the different domains, along with the 95% limits of agreement, were calculated using Bland-Altman plots (Bland and Altman, 1986). In addition, to assess the agreement of total sedentary time between the outputs of the two devices, two-way mixed Intraclass Correlation Coefficients (ICC) were calculated. ICC results were interpreted as follows: 0-0.39 indicates poor agreement; 0.4-0.59 indicates fair agreement; 0.6-0.74 indicates moderate agreement; and >0.75 indicates excellent agreement (Cicchetti, 1994). Receiver operating characteristic (ROC) curve analyses (95%CI) (Jago et al., 2007) were conducted to explore the sensitivity and specificity of each of the cut-points applied to the ActiGraph data to determine sedentary time. The area under the curve value (AUC; representing the percentage of time that the ActiGraph correctly identified sedentary time) was used to determine the accuracy of the diagnostic ability of the ActiGraph compared with the activPAL. These tests were used to examine if the ActiGraph cut-points correctly identify sedentary and non-sedentary time compared to the activPAL during workdays and non-workdays (Jago et al., 2007). Statistical significance was set at p<0.05. Results are presented as mean (SD) unless stated otherwise. The ActiGraph and activPAL outputs were plotted against each other as a Figure for one person.
during a workday and a non-workday to illustrate the level of agreement between both devices.

Results

Of the 35 drivers enrolled in the study, 28 (100% male; mean age 43.9 (27) years; mean BMI 28.5 (3.9) kg/m²) provided at least 4 days of valid data for both monitors. The average wear times during waking hours for the activPAL and ActiGraph for workdays were 1014(57) minutes/day (working-hours: 604(85) minutes/day) and 869(295) minutes/day for non-workdays.

Levels of agreement between sedentary times determined by the ActiGraph and activPAL

Sedentary times recorded (mean minutes/day) by the activPAL and different ActiGraph cut-points during each of the different domains over the monitoring period are shown in Table 1. Bland-Altman plots depicting the mean differences and 95% limits of agreement between sedentary times measured using the different ActiGraph cut-points and the activPAL on workdays and non-workdays, and during working hours and non-working hours on workdays are shown in Figures 1 and 2.

Relative to the activPAL, the ActiGraph significantly underestimated total daily sedentary time during workdays when using the <50 cpm, <100 cpm and the <150 cpm cut-points. All ActiGraph cut-points significantly underestimated sedentary time during working hours (Table 1). Outside of working hours on workdays, and during non-workdays, no
significant differences were observed between sedentary times estimated using the <50 cpm cut-point in comparison to the activPAL. All other ActiGraph cut-points significantly overestimated sedentary time, relative to the activPAL on non-workdays, and during non-working hours on workdays. Effects sizes (Cohen’s d) for the differences in sedentary times between the devices ranged from small (0.1) to large (0.8), depending on the cut-point (Table 1). The strength of the associations, as determined by the ICC, between ActiGraph-determined sedentary time and sitting time measured using the activPAL were stronger on non-workdays, and during non-working hours on workdays, across all cut-points in comparison to workdays and working hours on workdays (Table 1).

Sensitivity and specificity of ActiGraph-determined sedentary time

Figure 3 shows the area under the ROC curve for the ActiGraph during workdays, which showed poor discrimination of sedentary time compared with the activPAL (ROC=.617). Despite the different cut-points generally showing better sensitivity than specificity, the sensitivity and specificity values across all cut-points were low (Table 2). Figure 4 shows the area under the ROC curve for the ActiGraph during non-workdays, which showed better discrimination of sedentary time compared to workdays (ROC=.706 versus ROC=.617). As with the workday data, the sensitivity and specificity values across all cut-points were low (Table 3).

Illustration of activity patterns on a typical workday and non-workday for a bus driver

Figure 5 shows the ActiGraph output illustrating activity patterns on a typical workday and non-workday for a bus driver compared with the activPAL. Sedentary time
identified by the activPAL is represented by a straight line. ActiGraph and activPAL outputs are superposed and time-matched for waking hours during a typical workday and non-workday.

Discussion

The aim of this study was to explore the validity of accelerometer-determined free-living sedentary time (assessed using <50 cpm, <100 cpm, <150 cpm, <200 cpm, <250 cpm and <300 cpm cut-points) during and outside working hours in comparison to the activPAL in a sample of bus drivers. All ActiGraph cut-points assessed in this study significantly underestimated sedentary time during working hours, which led to weak associations between accelerometer-determined sedentary time and activPAL determined sitting time on workdays. Whilst closer agreements were observed between accelerometer-determined sedentary time and the activPAL on non-workdays, ROC analyses revealed that the ActiGraph generally showed poor discrimination of sedentary time compared with the activPAL on both workdays and non-workdays. These findings suggest that the ActiGraph is not a valid tool to assess sedentary time in bus drivers, particularly during workdays.

Kozey-Keadle and colleagues identified in 2011 significant differences in ActiGraph-determined sedentary time depending on which cut-point was applied to the data (ranging from <50 cpm to <250 cpm) over a 6-hour direct observation period. In their study, which involved simulated office work, the authors reported that the cut-point with the lowest bias was the <150 cpm cut-point, which overestimated sedentary time by 1.8%. In contrast, the most commonly used <100 cpm cut-point underestimated sedentary time by 4.9%. In a different study which compared sedentary time estimated by different ActiGraph cut-points...
to activPAL-determined sitting time in free-living adults, Hart et al. (2011). observed an
ActiGraph cut-point of <50 cpm had the closest agreement with the activPAL.

In contrast to the above studies, the present paper examined the validity of different
ActiGraph cut-points in a different occupational group comprising bus drivers. In the present
study, discrepancies in the most accurate ActiGraph cut-point for detecting sedentary time,
relative to the activPAL, existed between workdays and non-workdays. On workdays, the
<250 cpm cut-point provided the closest estimate of total daily sedentary time compared to
the activPAL (mean difference +17 minutes/day). However, on non-workdays total daily
sedentary time was best estimated using the <50 cpm cut-point, which underestimated
sedentary time by 34 minutes/day. During working hours, all cut-points underestimated
sedentary time relative to the activPAL, with the <300 cpm cut-point providing the closest
estimate (underestimating by 33 mins/day).

Wong et al. (2014) used the ActiGraph-accelerometer (<150 cpm) to measure
sedentary time in a sample of bus drivers in Australia. In this study, they showed that,
despite the sedentary nature of a driving occupation, bus drivers accumulated less
sedentary time during workdays in comparison to non-workdays (7.8 hours/day versus
8.9 hours/day, respectively) and during working hours compared to non-working hours (3.7
hours/day versus 4.1 hours/day, respectively). These results are contrary to those presented
in this study, which revealed that drivers spent 715 minutes (~12 hours/day) sitting on
workdays and 536 minutes (8.8 hours/day) sitting on non-workdays, and 478 minutes (7.9
hours/day) sitting during working hours. Taking into account any potential cultural or
weather-related (UK and Australia) differences between these studies; these results suggest
that using accelerometer-applied cut-points to determine sedentary time (as done by Wong
and colleagues, 2014) may result in the underestimation of sedentary time, possibly due to
the misclassification of sedentary time as light physical activity in this occupational group,
due to the movement of the bus.

The ActiGraph accelerometer records the intensity of the body’s movements and
sedentary time is estimated through a lack of movement counts (Chen et al., 2005). Any
motion over any of the cut-points applied within this sample of drivers will therefore be
considered as non-sedentary activity and clustered as light-activity, as indicated by the
findings of the current paper. Discrepancies between the activPAL and the ActiGraph could
therefore be due to the vibrations experienced during vehicle motion. Figure 5 illustrates
the ActiGraph output activity patterns on a typical workday and non-workday for a bus
driver, compared to the activPAL. This figure indicates that continuous accelerations during
working-hours are detected by the ActiGraph and classified as non-sedentary time, whilst
the time-matched activPAL output clustered this time as sitting based on the body’s
posture. Therefore, it is plausible that the discrepancies detected between the activPAL and
the ActiGraph are aggravated by the vibrations experienced during vehicle motion by the
bus driver, leading to an underestimation of sedentary time by the ActiGraph, as the vertical
vibrations travel through the body. Resulting in tipping the classification over the sedentary
threshold, despite the driver being seated (Patterson et al., 1993).

This study provides novel information on sedentary behaviour measurement and
how sedentary time is accumulated during and outside working hours using two different
tools in a sample of bus drivers. This study is not without limitations however. One
limitation is that the bus vibrations were not objectively quantified and it is difficult
therefore to assess their impact on the monitor’s sensitivity to accurately detecting
sedentary time. Moreover, the sample size of this study was relatively small and included participants who were overweight or obese, which may have exacerbated the impact of the vehicle vibrations on the monitor’s performance. This issue should be investigated further in larger samples and in other driving occupations.

Conclusions

The present paper highlights that the ActiGraph accelerometer, relative to the activPAL, misclassifies sedentary time in bus drivers, particularly during working hours. When the use of the activPAL is not possible in such occupational groups, further research should explore a correction formula to apply to ActiGraph data for defining sedentary time in occupational drivers. Overall, sedentary behaviour measurement techniques should be improved in this understudied, highly sedentary and at risk occupational group.

References


<table>
<thead>
<tr>
<th>Domains</th>
<th>ActiGraph cut-points (cpm)</th>
<th>ActiGraph-determined sedentary time (min/day)</th>
<th>activPAL-determined sedentary time (min/day)</th>
<th>ICC between devices</th>
<th>CV (%)</th>
<th>p value (t-test)</th>
<th>95% CI (t-test)</th>
<th>Cohen’s d (effect size)</th>
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<tbody>
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<td>29.5</td>
<td>&lt;.001</td>
<td>54.7, 97.1</td>
<td>-0.4</td>
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<tr>
<td></td>
<td>&lt;300</td>
<td>323(84)</td>
<td></td>
<td>.764</td>
<td>28.8</td>
<td>&lt;.001</td>
<td>66.3, 107.1</td>
<td>-0.5</td>
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</tbody>
</table>

Abbreviations: ICC, intraclass correlation coefficient. CI, confidence interval; CV, coefficient of variation.
Figure 1. Bland-Altman plots showing the mean difference and the 95% limits of agreement in time spent sedentary on workdays and non-workdays, between the ActiGraph GT3X+ (using different cut points) and the activPAL. The straight lines represent the mean difference in minutes between the activPAL and the ActiGraph and the dotted lines represent the 95% confidence intervals of the agreement between the measures. The x axis represents the mean sedentary time calculated between devices and the y axis is the difference in sedentary time (in minutes) between the ActiGraph and the activPAL.
Mean activPAL and ActiGraph determined sitting time
Figure 2. Bland-Altman plots showing the mean difference and the 95% limits of agreement in time spent sedentary during working-hours and non-working-hours on workdays, between the ActGraph GT3X+ (using different cut-points) and the activPAL. The straight lines represent the mean difference in minutes between the activPAL and the ActiGraph and the dotted lines represent the 95% confidence intervals of the agreement between the measures. The x axis represents the mean sedentary time between devices and the y axis is the difference in sedentary time (in minutes) between the ActiGraph and the activPAL.

Figure 3. ROC curve for ActiGraph-determined sedentary time during workdays
Table 2. Sensitivity and specificity values calculated across participants for each ActiGraph cut-point. The performance of each cut-point was compared to activPAL-determined total daily sitting time on workdays. The area under the ROC curve value to assess the accuracy of the ActiGraph to detect sitting time compared with the activPAL.

<table>
<thead>
<tr>
<th>Area under the ROC curve (95% CI)</th>
<th>.617 (.613-.621)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ActiGraph-determined sedentary cut points</td>
<td>Sensitivity</td>
</tr>
<tr>
<td>&lt;50cpm</td>
<td>.620</td>
</tr>
<tr>
<td>&lt;100cpm</td>
<td>.549</td>
</tr>
<tr>
<td>&lt;150cpm</td>
<td>.498</td>
</tr>
<tr>
<td>&lt;200cpm</td>
<td>.453</td>
</tr>
<tr>
<td>&lt;250cpm</td>
<td>.413</td>
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<tr>
<td>&lt;300cpm</td>
<td>.380</td>
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</tbody>
</table>

Figure 4. ROC curve for ActiGraph-determined sedentary time during non-workdays
Table 3. Sensitivity and specificity values calculated across participants for each ActiGraph cut-point. The performance of each cut-point was compared to activPAL-determined total daily sitting time on non-workdays. The area under the ROC curve value to assess the accuracy of the ActiGraph to detect sitting time compared with the activPAL.

<table>
<thead>
<tr>
<th>ActiGraph-determined sedentary cut points</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50cpm</td>
<td>.602</td>
<td>.278</td>
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<tr>
<td>&lt;100cpm</td>
<td>.532</td>
<td>.219</td>
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<tr>
<td>&lt;150cpm</td>
<td>.478</td>
<td>.182</td>
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<td>&lt;200cpm</td>
<td>.437</td>
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<td>&lt;250cpm</td>
<td>.401</td>
<td>.139</td>
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<tr>
<td>&lt;300cpm</td>
<td>.372</td>
<td>.124</td>
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</tbody>
</table>

Area under the ROC curve (95% CI) .706 (.701-.712)
Figure 5. ActiGraph output illustrating activity patterns on a typical workday and non-workday for a bus driver, compared to the activPAL.