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Effects of epoch duration on estimated moderate and vigorous physical activity time among adults workers using the GT3X+ Accelerometer

Efeitos da duração do *epoch* sobre o tempo estimado de atividade física moderada e vigorosa entre adultos trabalhadores usando o acelerômetro GT3X+

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ABSTRACT

Introduction: Epoch length may influence physical activity estimates derived from accelerometers. Objective: To compare the effects of different epoch lengths on the average time spent in moderate-to-vigorous physical activity (MVPA) among adults using the GT3X+ accelerometer. Methods: This methodological study used data from the Longitudinal Study of Determinants of Physical Activity, a cohort of administrative staff and faculty members from a university in the state of Rio de Janeiro, Brazil. Physical activity data were collected using an accelerometer (ActiGraph GT3X+) worn on the non-dominant wrist for seven consecutive days. MVPA time was calculated using epoch lengths of 1s, 5s, 10s, 15s, 30s, and 60s. Analysis of variance was used to compare mean physical activity values across epoch lengths, followed by Bonferroni post hoc tests for pairwise comparisons. Bland–Altman plots were used to assess agreement. Accelerometer data processing and all statistical analyses were performed using R software. Results: A total of 255 participants were included (mean age: 44.0 ± 10.7 years; 55.3% men). Mean MVPA time was higher when calculated using shorter epochs compared with longer epochs ($p < 0.001$). MVPA estimated using a 1-second epoch was 94.8 minutes (95% CI: 90.6; 99.0), whereas the 60-second epoch yielded 67.4 minutes (95% CI: 62.8; 72.1), representing a significant mean difference of 27.7 minutes ($p < 0.05$). Conclusion: The observed differences indicate that substantially different epoch lengths may produce estimates that are difficult to compare and may lead to inaccurate conclusions. To improve comparability across studies using accelerometers, reporting the epoch length employed is essential.

Keywords: Physical activity assessment; Accelerometry; Methods.

RESUMO

Introdução: A duração do epoch pode influenciar as estimativas obtidas por acelerômetros. Objetivo: Comparar os efeitos de diferentes durações de epoch no tempo médio de atividade física moderada a vigorosa (AFMV) de adultos que utilizaram o acelerômetro GT3X+. Métodos: Estudo metodológico com dados do Estudo Longitudinal dos Determinantes da Atividade Física, uma coorte de técnicos administrativos e professores de uma universidade no estado do Rio de Janeiro. Os dados de atividade física foram capturados usando um acelerômetro (ActiGraph, GT3X+), usado no pulso não dominante por 7 dias. O tempo de AFMV foi calculado para epochs de 1s, 5s, 10s, 15s, 30s e 60s. Testes de variância foram propostos para as médias de atividade física em cada epoch, teste post-hoc de Bonferroni para análise pareada e gráficos de Bland-Altman para análise de concordância. O processamento dos dados do acelerômetro e todas as análises estatísticas foram realizados no software R. Resultados: Compuseram a amostra 255 participantes (média de idade: 44,0 (± 10,7); 55,3% homens). O tempo médio de AFMV foi maior em epochs de menor duração do que naquelas de maior duração (p < 0,001). A AFMV avaliada com epochs de 1s resultou em 94,8 minutos (95% IC: 90,6; 99,0), enquanto o de 60s resultou em 67,4 minutos (95% IC: 62,8; 72,1), uma diferença média significativa de 27,7 minutos (p < 0,05). Conclusão: As diferenças encontradas mostram que epochs com durações muito diferentes podem produzir estimativas mais difíceis de comparar e levar a conclusões imprecisas. Para aumentar a comparabilidade entre estudos que utilizam acelerômetros, é essencial informar a duração do epoch utilizado.

Palavras-chave: *Avaliação da atividade física; Acelerometria; Métodos.*

Introduction

Wearable technologies for assessing physical behavior have become increasingly prevalent in the health field[1]. Typically attached to the body, these devices measure and store various health-related parameters[1]. Among these, accelerometers represent a widely used form of wearable technology. These small devices capture and record the acceleration of body movements using sensors, which are translated by algorithms into health-related indicators, such as step count, energy expenditure, and physical activity (PA) parameters. Given their ability to continuously capture behavioral data, several studies have used accelerometers to investigate the implications of specific physical behaviors on health outcomes[2–4].

When using an accelerometer to assess behavioral profiles, the protocol for methodological decision-making must be well-defined to ensure that the collected data are as accurate and reliable as possible[5,6]. The validity of results is highly dependent on the methodology framework employed. Decisions regarding the selection of equipment, data processing techniques, and location sensor placement can significantly impact study outcomes. In this sense, some methodological research has sought to establish standardized criteria for accelerometer use, aiming to enhance data accuracy, reliability, and comparability across studies[7–10].

Accelerometers collect and record acceleration data. An epoch represents the duration during which the sensor aggregates a series of acceleration readings at consistent time intervals determined during data processing. During data processing, these intervals can range from a few seconds to several minutes[11]. The selection of an appropriate epoch duration is a critical methodological consideration, as research suggests that certain epoch durations may affect the accuracy and sensitivity of PA measurement at different intensities[7,12].

Studies conducted with children have observed that shorter epoch durations, such as 1s and 5s intervals, more accurately capture PA due to their ability to detect rapid changes in movement, which are characteristic of this age group[13–15]. Similar results have been reported in studies investigating specific groups, such as pregnant women and individuals with arterial dysfunction[16].

Among adults, some studies recommend using an epoch of the 60s[17], as adults typically sustain a given level of acceleration for longer durations. In addition, shorter epoch durations require greater data storage capacity, posing limitations for older device models with restricted memory resources[18,19]. Both systematic reviews and original observational studies indicate that epoch duration can influence the estimation of PA levels in adults. However, despite consistent evidence that different epoch durations yield different estimates, the current body of research is largely limited to specific populations - such as young adults (e.g., Skinner et al.[20], who studied 220 Americans aged 17 to 23) - or studies that rely on proprietary accelerometer software with limited data transparency, such as the cross-sectional study by Haddadj et al.[21], which included 181 adults residing in France[20–22].

To date, evidence regarding the influence of epoch duration on measuring time spent at different intensities of PA is limited to specific populations, and we found no data for Brazilian adults. Furthermore, there is no consensus on the ideal epoch duration, especially in studies that use raw data analysis over a full day and a complete week. Therefore, this study aimed to compare the effects of different epoch durations on the mean time of moderate-to-vigorous physical activity (MVPA) of adults who used the GT3X+ accelerometer.

Methods

Study Design

This is a cross-sectional study based on baseline data from the Longitudinal Study of Determinants of Physical Activity "*Estudo Longitudinal dos Determinantes da Atividade Física*". The study is a population-based cohort of university employees, designed to investigate the psychosocial determinants of PA among administrative and teaching staff at a university in Rio de Janeiro, Brazil.

Ethical considerations

The project was submitted to and approved by the Ethics Committee of the Salgado de Oliveira University - UNIVERSO (opinion 5.378.946). All the research procedures were thoroughly explained, and participation was voluntary, with informed consent obtained through the signing of the Informed Consent Form. Participants retained the right to withdraw from the study at any stage. This did, however, not occur.

Participants and data collection

The sample included men and women aged 18 years or older who held one of the aforementioned positions and who were working at the time the researcher visited their site. A second site visit was scheduled, and if the individual was not there, they were not included. Employees on leave (vacation, leave) were excluded from the study, as they were not actively working at the time of data collection.

The data collection phase was carried out by a team of trained volunteer researchers and was divided into two stages. In the first stage, the researchers visited employees at their workplaces, introduced the research, and collected general and psychosocial data. At this stage, the researchers explained the study procedures and instruments and invited participants to take part in the second phase, which involved the objective assessment of PA using the ActiGraph GT3X+ accelerometer. If a participant agreed to participate, an additional appointment was scheduled to distribute the accelerometer and provide instructions on its proper use. This scheduling was necessary to ensure that the device was configured according to study specifications before use.

Accelerometer measurements

Participants were instructed to wear a triaxial accelerometer (ActiGraph GT3X+, ActiGraph LLC, Pensacola, FL, USA) on their non-dominant wrist for 7 consecutive days. This device has demonstrated high validity and reliability in assessing PA among adults[23]. The sampling rate was set at 100 Hz. During the monitoring period, participants were advised to avoid water-based activities (swimming and diving), although routine bathing was permitted.

All usage instructions were provided by a trained researcher at the time of device distribution (verbally and with an information leaflet), and the same researcher was responsible for retrieving the device after the monitoring period. Additionally, the data collection team-maintained contact with participants during the measurement period to answer any questions and provide necessary support (email, call, and message).

Processing

No equipment was lost or experienced technical problems during the measurement period. A day of use was defined as starting at midnight and ending at midnight the following day ("MM"). To be considered valid, a recorded day had to include at least 16 hours of wear time. Each participant was required to have at least three valid weekdays and one valid weekend day for their data to be included in the analysis. Some individuals (n = 5) did not meet the minimum wear-time requirement and were not allowed to repeat the measurement. Calibration settings were configured following the Euclidean Norm Minus One (ENMO) method. No data imputation was performed.

After applying all validity criteria, 18 individuals were excluded due to inconsistent PA parameters (Accelerometer permanently removed or presented data inconsistent with signal capture reports). Consequently, the final analytical sample consisted of 255 adults with valid data. Raw accelerometer data were processed using the GGIR package (version 3.1-2) in R software (Rstudio 2024.04.2+764)[5,23]. To achieve the study objectives, epochs of 1s, 5s, 10s, 15s, 30s, and 60s were analyzed. Given that the accelerometer was worn on the wrist, acceleration thresholds for classifying inactivity, light physical activity (LPA), moderate physical activity (MPA), and vigorous physical activity (VPA) were based on the thresholds proposed and validated by Hildebrand et al.[24] Acceleration above the 100 mg threshold was classified as MVPA.

Covariates

Several variables were used to describe the characteristics of the sample. Gender was categorized as men and women. Race/ethnicity was classified as White, Brown, Black, or Asian. Educational level was grouped into completed primary education, secondary education, higher education, and postgraduate. Marital status was categorized as married, single, or widowed. Income was categorized into three levels (low, middle, and high) based on the distribution of the sample to ensure adequate sample size within each category. Low income included participants earning up to 4,212 BRL, middle income ranged from 4,213 to 8,212 BRL, and high income included those earning above 8,213 BRL.

Statistical analysis

Descriptive analyses were conducted for the total sample and stratified by gender (means, standard deviation, Confidence Interval (CI), and proportions). To compare MVPA across different epoch lengths (1s, 5s, 15s, 30s, and 60s), a repeated-measures analysis of variance (ANOVA) was performed, considering epoch as a within-subject factor. As the same individuals were measured under all epoch conditions, this approach accounted for the non-independence of observations. The assumption of sphericity was assessed using Mauchly's test. When violated, Greenhouse–Geisser corrections were applied to adjust the degrees of freedom (supplementary data). If a statistically significant difference was identified ($p < 0.05$) in the ANOVA, Bonferroni-adjusted pairwise comparisons were conducted to examine differences between epoch lengths.

The Bland-Altman method was employed to assess agreement between epoch durations for the mean times of MVPA. Statistical significance was set at $p < 0.05$. All PA results are reported in minutes per day. Statistical analyses were conducted using R software (2023.0.3.0). Differences between the analytical sample and the remaining participants from the total sample were assessed using chi-square tests. Also, differences in continuous variables between the analytical sample and the remaining participants were assessed using independent t-tests. Non-parametric tests were considered when appropriate.

Results

The university's staff comprises 2,200 individuals, including technical-administrative personnel and permanent faculty members. The data collection phase occurred between August 2022 and December 2023, covering a sample of 1,060 participants, recruited through a convenience sampling strategy. Of the 1,060 individuals who participated in the initial data collection, 278 agreed to wear the accelerometer. After applying the validity criteria for accelerometer use, 23 participants were excluded, resulting in a final sample of 255 participants. Figure 1 presents a flowchart illustrating this process in detail.

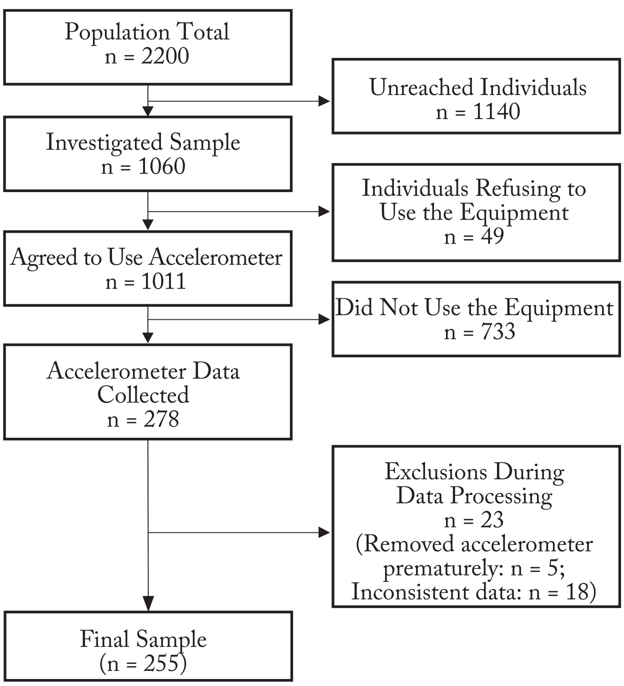

Figure 1 – Flowchart with the number of participants included and excluded.

The sample had an average age of 44.0 (± 10.7) years and consisted of slightly more than half male participants (55.3%). Additionally, half of the participants self-identified as White. In terms of educational level, the majority of the sample had a high level of education, with 71.2% reporting postgraduate education, and only 1.5% had completed primary education. Most participants were married (61.1%), while 37.9% were single and 1.0% were widowed. Regarding income, 41.9% of participants were classified as high income, 24.2% as middle income, and 33.8% as low income. Detailed sample characteristics are provided in Table 1.

Table 1 – Demographic characteristics of the analytic sample

Total	n (%) 255 (100)
Gender	
Men	141 (55.3)
Women	114 (44.7)
Race/ethnicity	
White	142 (55.7)
Brown	75 (29.4)
Black	26 (10.2)
Asian	1 (0.4)
Not reported	11 (4.3)
Educational level	
Completed primary education	4 (1.5)
Secondary education	28 (11.1)
Higher education	41 (16.2)
Postgraduate	182 (71.2)
Marital stage	
Married	156 (61.1)
Singles	97 (37.9)
Widowed	2 (1.0)
Income	
Low	86 (33.8)
Middle	62 (24.2)
High	107 (41.9)
	Mean (sd)
Age (years)	44.0 (10.7)
Height (m)	1.70 (0.1)
Weight (kg)	78.5 (17.7)
Body mass index (kg/m²)	26.9 (4.8)

The data are absolute and relative frequencies for categorical variables and means and standard deviations for continuous variables. Income: Income was categorized into low (≤ 4,212 BRL), middle (4,213 – 8,212 BRL), and high (≥ 8,213 BRL) based on the sample distribution.

Each epoch duration was used to estimate the mean time spent in MVPA and its corresponding confidence intervals: 1s (94.8 min, 95% CI: 90.6; 99.0); 5s (86.9

min, 95% CI: 82.4; 91.4); 10s (82.6 min, 95% CI: 78.0; 87.2); 15s (79.5 min, 95% CI: 74.9; 84.1); 30s (74.1 min, 95% CI: 69.4; 78.7); and 60s (67.4 min, 95% CI: 62.8; 72.1). The results indicate that shorter epoch durations yielded higher MVPA estimates. The ANOVA across the epoch groups revealed a significant difference in MVPA times ($p < 0.05$). Bonferroni's post hoc test showed statistically significant differences in MVPA time for the following epoch groups comparisons: 1s vs. 10s, 1s vs. 15s, 1s vs. 30s, 1s vs. 60s, 5s vs. 30s, 5s vs. 60s, 10s vs. 60s, and 15s vs. 60s. Specifically, the 1s epoch group had a mean difference of 21.7 minutes compared to the 30s epoch ($p < 0.05$) and 27.7 minutes ($p < 0.001$) compared to the 60s epoch, this is the largest difference. Conversely, no other statistically significant differences were found between some of the closest comparisons (e.g., 30s vs 60s). Additional comparisons across different epoch durations can be found in Figure 2.

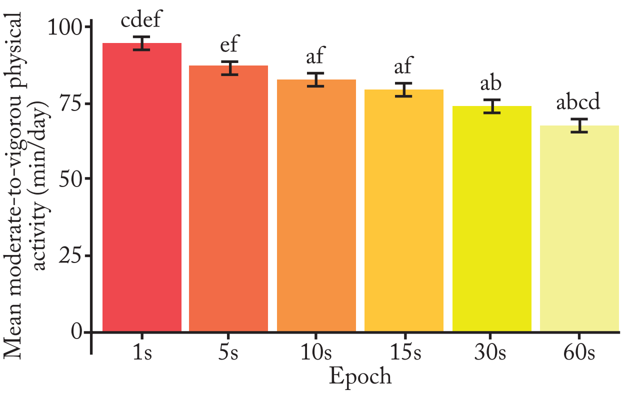

Figure 2 – Moderate to vigorous physical activity time averages for each epoch duration, as well as the 95% confidence interval. a: Significant difference for the 1s epoch with $p < 0.001$; b: Significant difference for the 5s epoch with $p < 0.001$; c: Significant difference for the 10s epoch with $p < 0.001$; d: Significant difference for the 15s epoch with $p < 0.001$; e: Significant difference for the 30s epoch with $p<0.001$; f: Significant difference for the 60s epoch with $p < 0.001$.

Figure 3 illustrates the agreement between epoch groups for MVPA estimates. The Bland-Altman plots show an increasing linear trend in the values near zero, with greater data dispersion as mean MVPA levels increase. This suggests a significant difference between 1s vs. 10s, 15s, 30s and 60s epochs durations. Specifically, shorter epochs capture more time spent in MVPA, and as epoch duration increases, the discrepancy between estimates widens.

Discussion

This study aimed to compare the effects of different epoch durations on the average time spent in MVPA among adults using the GT3X+ accelerometer. The findings indicate that shorter epochs, on average, captured greater amounts of MVPA time compared to longer epochs. Moreover, some differences in average activity time across each group were statistically significant. These results suggest a statistically significant difference in methodological disagreement between the durations of the epochs, although some exceptions have been observed. Specifically, statistically significant differences were found in certain comparisons between epoch durations (1s vs. 10s, 15s, 30s, and 60s). These findings underscore the potential influence of epoch selection on PA estimates, highlighting the importance of considering epoch duration as a methodological factor when analyzing accelerometer-derived data. In practice, the decision on the interval used should be related to the intended nature of the sample and the activities to be assessed.

The differences in MVPA time across epoch durations can be explained by the way PA is recorded over time. Shorter epochs capture rapid fluctuations in PA with greater precision, whereas longer epochs tend to smooth out these variations, resulting in lower average activity times at a given intensity[7,25].

Some studies conducted with children corroborate these findings[14,26]. However, other studies examining populations within the same age group have reported an inverse relationship, wherein longer epoch duration was associated with greater MVPA time[27,28]. These findings suggest that the relationship between epoch duration and MVPA time is not always linear, highlighting the complexity of methodological choices in accelerometer-based assessments.

To better understand the relationship between decreased MVPA time with longer epochs, Fabre et al.[19] proposed a study involving ten students aged 28.4 ± 9.9 years. The study employed a controlled treadmill-based running and walking protocol designed to elicit MVPA levels in a standardized environment. The experiment consisted of four sessions, each lasting five minutes. During these sessions, participants alternated between 15 seconds of PA (either running or walking) and 15 seconds of passive recovery, during which they remained standing. This cycle was repeated continuously until the end of each session. The results showed that, for the walking protocol, MPA time decreased as epoch duration increased. This finding suggests a potential misclassification of MPA as LPA, which

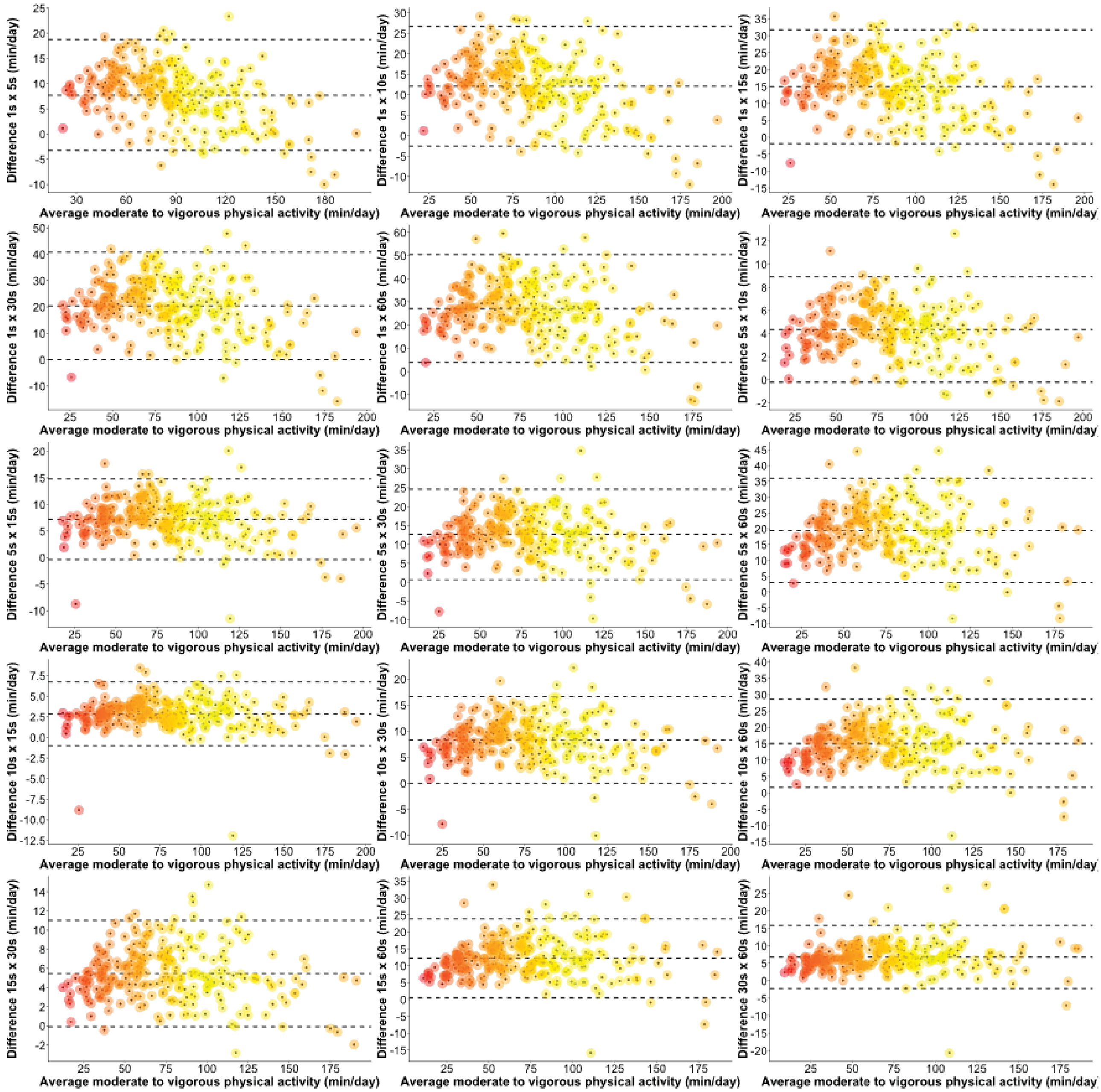

Figure 3 – Bland-Altman plots were used to represent the agreement between the groups of epochs, for the averages of mean moderate to vigorous physical activity time. The central dashed line represents the average bias, while the upper and lower dashed lines represent the 95% CI of the differences in the averages.

may also explain the patterns observed in our study. The authors emphasized that intermittent PA exhibits substantial variation patterns, meaning that as epoch duration increases, the accuracy of PA classification is compromised[19].

The findings presented in this study align with previous research, which primarily focused on specific conditions and limited time periods. In contrast, our study assessed PA continuously over an entire day for a full week[7,14,17,25,28–30]. For example, Gabriel et al.[31] compared MPA and VPA time using 10s and 60s epoch durations in overweight and postmenopausal women and found significant differences between these epoch groups[31]. Similarly, another study identified significant differences between epoch groups comparable to those found in our study. However, in this case, participants were assessed in a controlled laboratory context during a specific test[19].

Some of the epoch durations comparisons carried out in this study did not show statistically significant differences for either MVPA. This finding contrasts with certain studies, particularly those focused on determining MVPA time[19]. These results reinforce the importance of adopting more tailored approaches to accelerometer data processing, considering the specific characteristics of the PA pattern being assessed, while also ensuring comparability with other studies. For the assessment of MVPA, some comparisons between durations of adjacent periods did not reveal significant differences (e.g., 5s vs. 10s, 10s vs. 15s, 30s vs. 60s). This suggests that adjacent epochs may capture similar patterns and body movement times, indicating that even small variations in epoch durations may not always lead to substantially different estimates of MVPA.

This study has both limitations and strengths that warrant consideration. Although some studies use a 5s or 60s epoch[5], no universally recognized reference epoch has been established as the most accurate duration for assessing PA, making direct comparisons with a definitive standard impossible. Another limitation concerns the epoch duration range used for validation wear time during data processing, which was set at 5s. It is likely that if a 1s or 60s epoch had been adopted, different PA estimates would have been generated. Furthermore, this study focused exclusively on the MPA and VPA, omitting sedentary time and LPA, since these behaviors presented a broader threshold for movement classification. As a result, the study does not account for potential variations and compensations in the overall behavioral profile over time. Additionally, the use of a convenience sampling strategy and the evaluation of only workers from a single university may limit the generalizability of our results to the adult population in general.

On the other hand, most studies in this area have utilized cut-off points derived from count-based data, whereas this study processed raw accelerometer data using the GGIR package in R software, a methodological approach that distinguishes it from previous research. The GGIR package analyzes raw acceleration data and generates outputs in the same unit of measurement as the input data, eliminating the need to convert to a different unit. In contrast, proprietary software from different manufacturers commonly reports PA in "counts", a derived metric whose transformation process from raw data remains undisclosed for proprietary and marketing reasons[5], and both ways seem to produce different results[10]. However, even studies that compare the epoch durations using count-based data have reported significant differences[16,27]. Another methodological strength of this study was the continuous use of the accelerometer for 7 consecutive days, without requiring removal for daily activities such as sleeping or other non-water-based activities. This approach ensured comprehensive capture of all PA performed, thereby enhancing the robustness of the collected and processed data.

In conclusion, our findings, based on the processing of raw accelerometer data, demonstrate that recorded MVPA time can vary depending on the specified epoch duration. These variations may represent limitations or challenges when comparing studies that assess PA using GT3X+ accelerometers. This issue is particularly relevant when epoch durations differ substantially, such as between 1s and 60s epochs. However, it is important to note that comparisons between adjacent epoch durations, such as 30s and 60s, may not exhibit the same degree of variation and could instead represent PA comparable values. Given these findings, it is essential for studies utilizing accelerometers to report epoch duration explicitly to facilitate comparability across research. Furthermore, studies evaluating different epochs in controlled environments and specific activities can be produced to further this interpretation. Advancing this discussion will enhance the comparability of findings across studies and contribute to a deeper understanding of PA measurement using accelerometry.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

Garcia: MC Conceptualization; Methodology; Software; Validation; Formal analysis; Investigation; Resources; Data curation; Supervision; Project administration; Visualization; Funding acquisition; Writing – original draft; Writing – review & editing; Approval of the final version. Soares AMG: Conceptualization; Methodology; Software; Validation; Formal analysis; Investigation; Resources; Project administration; Visualization; Writing – original draft; Writing – review & editing; Approval of the final version. Moura B and Crochemore-Silva I: Supervision; Writing – original draft; Writing – review & editing; Approval of the final version. Oliveira AJ: Conceptualization; Methodology; Software; Validation; Formal analysis; Investigation; Resources; Data curation; Supervision; Project administration; Funding acquisition; Writing – original draft; Writing – review & editing; Approval of the final version.

Declaration regarding the use of artificial intelligence tools in the article writing process

The authors did not use artificial intelligence tools for preparation of the manuscript.

Availability of research data and other materials

Data is avaliable upon request.

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Supplementary material

Supplementary Table 1 – Characteristics of the analytical and total samples and comparison between groups

	Analitic sample	Total sample	p value
	n (%)	n (%)	
Total	255 (100)	1011 (100)	
Gender			
Men	141 (55.3)	563 (55.7)	0.740
Women	114 (44.7)	448 (44.3)	
Race/ethnicity			
White	142 (55.7)	565 (55.9)	0.508
Brown	75 (29.4)	313 (31.0)	
Black	26 (10.2)	106 (10.5)	
Asian	1 (0.4)	3 (0.3)	
Not reported	11 (4.3)	23 (2.3)	
Educational Level			
Completed primary education	4 (1.5)	17 (1.7)	0.264
Secondary education	28 (11.1)	92 (9.1)	
Higher education	41 (16.2)	120 (11.9)	
Postgraduate	182 (71.2)	787 (77.9)	
Marital stage			
Married	156 (61.1)	647 (64.0)	0.659
Singles	97 (37.9)	349 (34.5)	
Widowed	2 (1.0)	16 (1.6)	
Income			
Low	86 (33.8)	170 (16.8)	0.001
Middle	62 (24.2)	322 (31.8)	
High	107 (41.9)	519 (51.4)	
	Mean (sd)		
Age (Years)	44.0 (10.7)	46.7 (11.1)	0.002
Height (m)	1.70 (0.1)	1.71 (0.4)	0.576
Weight (Kg)	78.5 (17.7)	78.2 (16.6)	0.762

Total (n = 255). The data are absolute and relative frequencies for categorical variables and means and standard deviations for continuous variables. Income: Income was categorized into low (≤4,212 BRL), middle (4,213–8,212 BRL), and high (≥8,213 BRL) based on the sample distribution. Differences between the analytical sample and the oth-er participants were analyzed using chi-square tests and indepen-dent t-tests for continuous variables.

Supplementary Table 2 – Pairwise comparisons of moderate-to-vigorous physical activity across epoch lengths

Comparison	p-value (Bonferroni-adjusted)	Significant
X1s vs X5s	<0.001	Yes
X1s vs X10s	<0.001	Yes
X1s vs X15s	<0.001	Yes
X1s vs X30s	<0.001	Yes
X1s vs X60s	<0.001	Yes
X5s vs X10s	<0.001	Yes
X5s vs X15s	<0.001	Yes
X5s vs X30s	<0.001	Yes
X5s vs X60s	<0.001	Yes
X10s vs X15s	<0.001	Yes
X10s vs X30s	<0.001	Yes
X10s vs X60s	<0.001	Yes
X15s vs X30s	<0.001	Yes
X15s vs X60s	<0.001	Yes
X30s vs X60s	<0.001	Yes

Supplementary Table 3 – Shapiro-Wilk normality tests moderate-to-vigorous physical activity and Levene's Test for Homogeneity of Variance

Epoch	p-value
X1s	0.009
X5s	<0.001
X10s	<0.001
X15s	<0.001
X30s	<0.001
X60s	<0.001
Levene's Test for Homogeneity of Variance	0.6978

Reviewers' assessment

The reviews of this article were originally conducted in Portuguese. This version has been translated using ChatGPT and subsequently reviewed by the Chief Editors.

Section Editor

- We thank you for submitting your manuscript and for your interest in publishing in the journal. After editorial evaluation, we request that the revisions and suggestions outlined below be considered before resubmitting a revised version.
- First, we recommend that physical activity be presented as MVPA (moderate-to-vigorous physical activity), rather than separately as MPA and VPA. This approach is widely used in epidemiological studies, facilitates interpretation of the results, and enhances the applicability of the study findings.
- The authors report the use of ANOVA in the statistical analyses; however, no evidence was provided to demonstrate that the assumptions required for this test were met. We ask that tests for data normality, homogeneity of variances, and sphericity be reported, as these are prerequisites for conducting ANOVA.
- We also request that the discussion more clearly highlight the practical applicability of the results. In addition, please remove the conclusion section from the manuscript. In RBAFS, article structure follows the format: Introduction, Methods, Results, and Discussion.
- Regarding Table 1, we ask that the unit of measurement be presented in the row corresponding to each variable, rather than in the table legend. We also note the need to further characterize the sample. Please include additional demographic information, as well as health-related data that may contribute to describing the study population, such as the presence of comorbidities (in percentage).

Reviewer A

Anonymous

General comments

- This is a very interesting study aimed at comparing PA estimates according to different epoch lengths in adults. Although the research question is relevant and timely, several aspects require clarification and improvement. The comments below are organized according to each section of the manuscript.

Introduction

- Page 4, lines 82, 86. The authors acknowledge the existing evidence suggesting that epoch duration can influence PA estimation, while also mentioning potential limitations and gaps in the literature. However, a more detailed description of the individual studies, including their main findings and limitations, would better contextualize the current evidence and more clearly justify the need for the present study.
- Page 4, lines 87, 88. The statement "To date, there is a limited body of evidence on the extent to which epoch duration influences the measurement of time spent in different PA intensities in adult populations" appears to contradict the information presented in the preceding paragraph. As suggested above, the available evidence should be described in greater detail so that the specific gaps the current study intends to address are more clearly articulated.

Methods

- For the analyses, the authors considered only MPA and VPA, excluding LPA. Please clarify the rationale for this decision.

Results and Discussion

- Was there any difference in the general characteristics between the total study sample and the analytic sample? Presenting this comparison, at least as supplementary material, is important to ensure that no selection bias occurred due to data inclusion/
- The authors state that the results for VPA were similar to those observed for MPA. However, this interpretation is not fully supported by the post-hoc analyses. Specifically, there was a clear trend toward greater MPA with increasing epoch length (except for the lack of difference between 1 s and 5 s), whereas time spent in VPA did not differ from 10 s onward. As shown in figure 4, VPA estimates were similar across 10 s, 15 s, 30 s, and 60 s epochs. The authors should revise both the presentation and interpretation of these results, particularly because

the discussion relies heavily on overall ANOVA findings without adequately considering similarities revealed in the post-hoc comparisons.
- I strongly recommend the inclusion of MVPA estimates, not as a substitute but in addition to MPA and VPA analyzed separately. In adult populations, MVPA is the most commonly reported accelerometer-derived PA outcome, and its inclusion would enhance the comparability of the present findings with the existing literature.
- Reinforcing the previous point, the authors discuss studies showing greater MVPA estimates with longer epoch durations in adults. Although the authors state that MVPA was not analyzed in the current study, this variable could, and should, be derived from the available data. The discussion would benefit from a more in-depth consideration of this issue.
- Page 11, lines 239, 250. The authors discuss the potential misclassification of MPA as LPA. This discussion could be strengthened by elaborating on the differences between free-living physical activity and intensity-controlled conditions (for example, treadmill walking or running). Furthermore, since LPA data appear to be available, presenting these results would help to empirically explore the misclassification hypothesis proposed by the authors.
- Pages 11, 12, lines 259, 269. The manuscript states: "For MPA assessment, comparisons between adjacent epoch durations did not reveal significant differences, suggesting that nearby epochs may capture similar movement patterns for this intensity. However, this was not the case for VPA…" If I am not mistaken, this interpretation seems inconsistent with Figures 2 and 4. Differences appear to be more pronounced for MPA, with significant differences observed across nearly all epoch lengths, whereas for VPA, no differences were found among the 10 s, 15 s, 30 s, and 60 s epochs. The authors should carefully re-evaluate this section to ensure consistency between the results, figures, and narrative interpretation.

Conclusion
- The conclusion should be revised in light of the potential changes suggested above, particularly those related to the interpretation of MPA versus VPA findings and the possible inclusion of MVPA and LPA outcomes.

Final Decision
- Substantial revisions required

Reviewer B
Debora Priscila Lima de Oliveira
Faculdade Pernambucana de Saúde, Recife, Pernambuco, Brazil.

- First, I would like to congratulate the authors on the development of the study, which addresses a timely topic, is methodologically relevant, and is of great interest to the field of physical activity assessment using accelerometry. The manuscript demonstrates consistent logical organization, clarity in the presentation of ideas, and appropriate articulation between the theoretical background, methodological procedures, and analysis of results.
- The rigorous description of data collection and processing procedures is particularly noteworthy, as is the use of raw data and the GGIR package, which adds methodological robustness to the study. The systematic comparison between different epoch durations, combined with continuous monitoring over seven days, represents an important contribution to discussions on standardization and comparability in research using accelerometers.
- Overall, this is a well-structured study with the potential to make a meaningful scientific contribution. The comments presented below are constructive in nature and are intended to improve the manuscript.
- Title: The title clearly reflects the variables investigated (epoch duration and moderate and vigorous physical activity), as well as the study population. However, a minor editorial refinement is suggested to improve objectivity and flow. The expression "estimated time" could be simplified, as estimation is inherent to the use of accelerometry. Additionally, considering that the sample consists exclusively of workers from a single university, it is suggested to evaluate whether describing the population as "adults" in the title is sufficiently precise, or whether specifying "adult workers" or "university employees" would be more appropriate, in order to avoid overgeneralization.
- Correction: "Bonferroni test" instead of "Bonferrone".
- Line 51 – A slight editorial refinement is suggested in the first paragraph to avoid redundancy in the definition of wearable technologies, making the introduction more objective and fluid, as the target

audience is already familiar with this concept.

- Line 55 – Greater conceptual precision is recommended when referring to indicators such as "energy expenditure," emphasizing that these variables are estimated through predictive algorithms rather than directly measured by the accelerometer.
- Line 68 – A minor conceptual adjustment is suggested in the definition of epoch, clarifying that aggregation occurs during signal processing rather than in the sensor itself, which may improve methodological accuracy.
- Line 84 – Greater clarity is recommended in defining the scientific gap, as the text previously mentions evidence in adults and subsequently states that it is restricted to younger populations. It is suggested to clarify whether the limitation refers to study design, age range, or data processing approach.
- Line 98 – Greater precision is suggested in describing the study design, as the term "population-based" may imply broad population representativeness, whereas the study is restricted to workers from a single institution.
- Line 111 – It is recommended to briefly discuss, in the Methods or Limitations section, the potential selection bias resulting from convenience sampling and partial adherence to accelerometer use.
- Line 129 – It is suggested to clarify whether the non-use of the accelerometer by 733 participants was due exclusively to logistical limitations (number of devices) or to other factors, considering possible implications for external validity.
- Line 152 – Greater detail is suggested regarding the criteria used to classify "inconsistent PA parameters," in order to ensure methodological transparency.
- Line 162 – Considering that different epoch durations were applied to the same individuals, it is recommended to verify whether the statistical model accounts for the repeated-measures structure, as independence of observations is an assumption of traditional ANOVA.
- Results – Minor grammatical and typographical adjustments were identified throughout the Results section; a final language revision is recommended.
- Line 219 – It is suggested to moderate the interpretation related to "systematic disagreement," clearly distinguishing statistical differences from consistent methodological disagreement across the full range of values.

Discussion

- It is suggested to include a limitation related to the specificity of the sample (workers from a single university), considering possible implications for generalizing the results.
- Line 224 – Greater clarity is recommended in the practical recommendation provided, specifying which characteristics of the sample or activity pattern should guide the choice of epoch.

Conclusion

- The conclusion adequately summarizes the main findings; however, it could be more concise and strategically oriented, emphasizing the magnitude of the observed differences, their potential epidemiological implications, and the specific methodological contribution of the study. It is recommended to avoid overly general statements and to more objectively direct future research perspectives.

Final decision (recommendation)

- Substantial revisions required.