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Section II – Exercise Physiology and Sports Medicine

A New Mobile Application for the Monitoring and Assessment of Health-Enhancing Physical Activity and Sedentary Behavior: A Validation Study

by
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The contemporary lifestyle characterized by insufficient physical activity (PA) and prolonged sedentary behavior necessitates effective assessment tools aligned with current health guidelines. This study introduces a novel solution designed to address specific limitations of existing PA measurement methods, i.e., the AWF Activity mobile application. Unlike traditional questionnaires, the AWF Activity application enables daily real-time data collection across multiple PA domains, effectively reducing recall bias while incorporating components required by the latest WHO recommendations. In this cross-sectional validation study, 122 young adults (72 women, 50 men) were monitored for seven consecutive days using the AWF Activity application alongside the GENEActiv accelerometer (an objective standard) and the IPAQ-SF questionnaire (an established subjective method). Statistical analyses revealed that the AWF Activity application achieved good agreement with the objective accelerometer data for moderate-to-vigorous physical activity measurements ($\chi^2(2, N = 122) = 0.51$, $p = 0.775$), with no significant differences detected by the Bland-Altman analysis. The application demonstrated notable advantages over traditional assessment tools, including enhanced user accessibility, reduction of retrospective bias, comprehensive domain coverage, and personalized feedback on WHO guideline compliance. While sedentary behavior was underestimated compared to accelerometer data—a limitation common to all subjective methods—the AWF Activity application represents a valuable advancement in PA monitoring technology. This digital solution bridges an important gap between measurement precision and practical daily application, offering considerable potential for population monitoring, intervention planning, and public health promotion, particularly in contexts where objective measurements remain logistically challenging.

Keywords: *validation study; physical activity monitoring; sedentary behavior; mobile health application; self-report assessment*

Introduction

The contemporary lifestyle is characterised by insufficient physical activity (PA) and prolonged sedentary behavior (European Commission: Directorate-General for Education, 2022). Consequently, to accurately assess these behaviors and to design effective interventions aimed at their improvement, it is crucial to utilise tools with satisfactory validity and reliability.

The assessment of PA presents a complex challenge, primarily due to the diversity of PA types and the various variables by which they are described. Methods of PA assessment are typically categorised as either objective or subjective. Objective methods involve the measurement of

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physiological or kinematic indicators of movement. This category includes direct and indirect calorimetry, heart rate monitoring, accelerometers, pedometers, and multisensory techniques. These methods are generally associated with greater measurement accuracy and reliability in comparison to subjective tools (Bakker et al., 2020; Dowd et al., 2018; Kastelic et al., 2022). However, objective methods are not without limitations, particularly with respect to the logistical and organizational demands of data collection (Meh et al., 2023). The need to balance measurement precision with practical feasibility is likewise evident in sport monitoring, where sensor-based tracking systems and simple field-based indices are used to characterize external workload and performance without relying exclusively on laboratory assessment (Eler et al., 2026; Kuliś et al., 2025).

Subjective methods, in contrast, rely on self-reported data concerning levels of PA and periods of sedentary behavior, as provided by study participants through various instruments. Although less precise and affected by recall bias, they are widely used in large scale studies due to their low cost, simplicity and minimal technical requirements. This is largely due to their cost-effectiveness, ease of administration, minimal technical requirements, and relatively low time investment (Kastelic et al., 2022; Lee, 2022; Meh et al., 2023; Troiano et al., 2020).

According to data retrieved via the PubMed database, the most frequently utilized PA questionnaires are the International Physical Activity Questionnaire (IPAQ), the Global Physical Activity Questionnaire (GPAQ), and the European Health Interview Survey—Physical Activity Questionnaire (EHIS-PAQ) (based on data from Google Scholar and PubMed, accessed on the 3rd of January, 2025).

Major recognized challenges in the assessment of PA and its health-related evaluation is the low level of agreement between data obtained through objective versus subjective monitoring tools. Differences in weekly PA volume between questionnaire-based assessments and accelerometer data in the same cohort can reach up to 50% (Gudnadottir et al., 2019; Nelson et al., 2019; Niestrój-Jaworska et al., 2023; Sylvia et al., 2014). Subjective methods frequently lead to an overestimation of PA and an underestimation of sedentary behavior. Several studies have identified key factors contributing to this discrepancy (Lim et al., 2015; Stassen et al., 2021).

Firstly, subjective assessments rely on the individual's ability to recall all physical activities performed across various domains of daily life during a retrospective period, typically the previous seven days (Meh et al., 2023; Prince et al., 2020). Participants often struggle to accurately remember incidental or non-purposeful activities related to occupational tasks, domestic responsibilities, or active transportation. Secondly, respondents may find it challenging to calculate average activity levels over the reporting period, a difficulty compounded by variations in behavior between weekdays and weekends due to differing routines and work schedules. These issues can lead to substantial inaccuracies in reported PA and sedentary behavior, resulting in both overestimation and underestimation when actual values are derived.

Another key reason for the poor agreement between subjective and objective measures is the difficulty participants face in estimating the intensity of physical exertion. The reliability of self-reported PA data is influenced by an individual's level of physical fitness. Research by Meh et al. (2023) highlights that the descriptions used in most PA questionnaires rely on subjective indicators of effort—such as breathlessness or an elevated heart rate—which are inherently dependent on a person's cardiorespiratory fitness. More physically fit individuals tend to report PA more accurately. In the aforementioned study, participants grouped by the fitness level all overestimated their PA and underestimated sedentary behavior, with the most physically fit group demonstrating the least overestimation. Similar findings were observed by Shook et al. (2016) who reported that, irrespective of the fitness level, participants consistently over reported vigorous PA (VPA). However, those with lower fitness levels overestimated their VPA by approximately double, while more trained individuals produced estimates more closely aligned with accelerometer data.

It is also noteworthy that none of the currently validated PA questionnaires includes all components required to determine whether an individual meets the World Health Organization (WHO) guidelines for PA (World Health Organization, 2020). These components include the

duration of moderate and vigorous PA and the frequency of strength training per week (Bull et al., 2020; Tcymbal et al., 2024). Moreover, many widely used subjective assessment tools still require PA to be performed in continuous bouts of at least 10 min for inclusion in reported activity levels. This requirement is outdated, as recent guidelines have removed this threshold in recognition of evidence demonstrating that shorter bouts of PA also provide significant health benefits (Riebe et al., 2018). This revision also supports the broader public health objective of promoting PA in increasingly sedentary societies. The updated guidelines stress the importance not only of engaging in PA but also of minimizing sedentary time (Bull et al., 2020). Consequently, the WHO now recommends that sedentary behavior be assessed alongside PA to obtain a more comprehensive picture of health-related behaviors (World Health Organization, 2020). Therefore, there is a clear need for assessment tools that are consistent with current recommendations and reflective of the latest evidence in health promotion.

In response to these considerations, our research team developed a tool aimed at monitoring habitual PA and sedentary behavior while addressing the known limitations of existing subjective instruments and incorporating recent updates to health guidelines. We also aimed to design the tool to suit the lifestyle of the contemporary, time-constrained individual. To enhance usability and user engagement, we created a PA and sedentary behavior diary (PA&SBD) in the form of a mobile application, entitled AWF Activity.

Many mobile apps such as Google Fit, Fitbit, GymBeam, Gymlify, MyFitnessPal, RunKeeper and Strava focus mainly on tracking exercises for training, competition or progress monitoring. However, they are not designed to asses PA in the context of maintaining health. The AWF Activity application enables data collection on sleep duration, the PA level, and sedentary behavior across various life domains, including occupational activity, active commuting, domestic tasks, and leisure time. Users report the volume and intensity of their PA using a modified 10-point Borg scale reflecting perceived exertion. The app also gathers information on activities involving strength, flexibility, and short bouts of high-intensity effort. The inclusion of a perceived-exertion scale is consistent with monitoring frameworks that distinguish externally performed work from the individual's internal response; in sport, RPE-based measures provide a practical estimate of internal intensity and are commonly interpreted alongside sensor-derived indicators of external load (Li et al., 2026; Pareja-Blanco and Loturco, 2026).

The diary is supposed to be completed daily over a seven-day period, thereby reducing the recall bias typically associated with retrospective self-reporting of activity intensity, duration, and frequency (Edwards and Hooper, 2023; Niestrój-Jaworska et al., 2023; Sember et al., 2020). At the end of the monitoring period, users receive feedback regarding whether their reported activity meets the minimum thresholds recommended by the WHO (Bull et al., 2020).

The aim of this study was to develop and evaluate a tool for monitoring habitual PA and sedentary behavior in the form of a mobile application, and subsequently to assess its reliability, usability, and practical utility in comparison with commonly used instruments for the assessment of habitual PA.

Methods

Participants

A cross-sectional study was carried out among a cohort of physically active young adults. All first-year students enrolled in Health Promotion programs at the Academy of Physical Education in Katowice (AWF) were invited to participate. The inclusion criteria for participation were: (a) informed consent to take part in the study, and (b) the absence of medical conditions that would contraindicate engagement in PA.

A total of 203 students initially enrolled in the study. Exclusion criteria applied during the final analysis included: (c) failure to complete the full study protocol in accordance with the guidelines (n = 65), which encompassed: (c1) missing daily data entries in the AWF Activity application (n = 24); (c2) interruptions in accelerometer wear time exceeding the normal sleep period (n = 14); (c3) failure to complete the IPAQ questionnaire on the designated seventh day of PA monitoring or complete omission of the questionnaire (n = 27); and (d) self-reported

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atypicality of the monitored week due to illness, injury, or exceptional personal or professional circumstances (n = 16).

The final study sample consisted of 122 participants, including 72 women (mean ± SD body height = 166.0 ± 6.2 cm; body mass = 59.5 ± 7.4 kg; BMI = 21.6 ± 2.8 kg/m²) and 50 men (mean ± SD body height = 181.6 ± 5.8 cm; body mass = 80.7 ± 10.4 kg; BMI = 24.5 ± 3.0 kg/m²). The recruitment and selection process is illustrated in Figure 1.

A number of participants were excluded due to deviations from the study protocol or atypical monitoring weeks. Although the attrition rate was relatively high, it was anticipated given the strict criteria for data completeness and quality.

Measures, Design, and Procedure

Habitual PA and sedentary behaviors were monitored concurrently using three tools: one objective and two subjective. The monitoring period lasted for seven consecutive days and was conducted during the spring, in weeks declared by participants to be typical of their usual lifestyle.

Objective PA assessment was conducted using the GENEActiv Original triaxial accelerometer (Activinsights, Cambridge, United Kingdom), a device widely utilized in epidemiological, clinical, and behavioral research for the evaluation of PA and sleep patterns. The accelerometer is particularly suitable for analysing behavioral patterns and habit formation in these domains. When validated against indirect calorimetry, the device exhibited excellent criterion validity for placement on the non-dominant wrist (r = 0.86) and a high level of accuracy (AUC = 0.95) (Esliger et al., 2011). The intraclass correlation coefficient (ICC) for sedentary behavior (SB), when compared with the activPAL device, was 0.80 (95% CI: 0.68–0.88), indicating moderate limits of agreement (Pavey et al., 2016).

Participants were instructed to wear the device on the wrist of their non-dominant arm continuously for the full seven-day period. Prior to deployment, devices were personalised by inputting biometric data (date of birth, body mass, body height, and handedness). The GENEActiv device continuously captures accelerometric data across three axes and computes the resultant signal vector magnitude (SVM). The sampling frequency was set to 100 Hz. Raw data were extracted using GENEActiv PC Software (version 3.3) and subsequently processed via the GGIR package (version 2.6-0) within the R statistical environment (version 4.1.2) (Migueles et al., 2019; R Core Team, 2020). The thresholds used for analysis were: moderate-to-vigorous PA (M-VPA: SVM > 191.6 mg) and sedentary behavior (SB: SVM ≤ 56.3 mg) (Hildebrand et al., 2017).

Subjective assessment of PA was conducted using the Polish adaptation of the IPAQ-Short Form (IPAQ-SF) and an original mobile application named AWF Activity. The IPAQ-SF is a widely used tool in both epidemiological and clinical contexts for estimating self-reported PA volume, frequency, and intensity, as well as sedentary time. The tool has demonstrated satisfactory reliability, with a Spearman's rank correlation coefficient of 0.80 (Craig et al., 2003). The instrument includes seven items targeting PA undertaken over the previous seven days, grouped into three intensity categories: vigorous, moderate, and walking, in addition to sitting time. Respondents provide duration (in min) and frequency (days per week) for each PA category. These responses are used to calculate weekly totals for moderate and vigorous PA, as well as sedentary time (Biernat et al., 2007).

The AWF Activity application is a mobile tool developed to monitor habitual PA and sedentary behavior, with reference to current health guidelines. Respondents complete daily entries in the application for seven consecutive days, providing self-assessed estimates of activity volume and intensity for that specific day. The instrument comprises 11 items.

The AWF Activity daily question focuses on PA performed on the current day and includes: sleep duration, time spent at work/school, time spent sedentary at work/school, time spent on high- and on moderate-intensity PA at work/school, time spent sedentary during leisure time (outside work/school), time spent on high- and moderate-intensity PA during leisure time. This question structure allows respondents to more easily and accurately describe their total daily PA. To accurately determine exercise intensity, participants are provided with a visual guide using the Borg scale.

In contrast, the IPAQ questionnaire retrospectively asks about the number of days in the past week (7 days) during which the respondent engaged in PA of high, moderate, or

low intensity, as well as the average amount of time spent on PA on each of those days. The final question of the IPAQ concerns the average time spent in a sedentary position on weekdays (excluding Saturdays and Sundays).

Additionally, in accordance with WHO recommendations, the AWF Activity application asks daily about: performing strength exercises targeting major muscle groups during leisure time (outside work/school), muscle strengthening during leisure time, engaging in active transport (as part of the previously declared PA).

The application is currently available in Polish, as the present phase of validation was conducted in a Polish population. After logging into the application each day, participants were shown a notification indicating the requirement to complete the activity report for the current day. The report was to be submitted by 24:00. If no entry was submitted by this time, the participant was allowed to retrospectively complete the report by 12:00 on the following day, in order to minimize the recall period and maintain data accuracy. If the report was not submitted by 12:00, the participant was considered non-compliant and the monitoring protocol was discontinued. Adherence was monitored electronically. Once a daily report was missed beyond the allowed time window, the system automatically blocked the possibility of completing subsequent days, preventing partial or incomplete datasets. Upon completion, respondents received personalized feedback indicating whether their PA met the WHO minimum health-promoting recommendations.

Data were exported from the application in the Microsoft Excel format and aggregated to derive weekly PA metrics, including volume, intensity, and frequency. The app-derived indicators demonstrated satisfactory reliability. ICCs and 95% confidence intervals were as follows: MPA: ICC = 0.81 [0.75, 0.85], VPA: ICC = 0.80 [0.75, 0.84], M-VPA: ICC = 0.81 [0.69, 0.89], and SB: ICC = 0.58 [0.49, 0.66] (Dębska-Janus et al., 2024).

The study was conducted in-person, comprising eight cycles, each lasting seven days. On the initial day of each cycle, participants received detailed instructions on how to wear the accelerometer, and the device was personalized. They were also trained in using the AWF Activity application. Following the monitoring period, a second meeting was held during which participants returned the equipment and completed the IPAQ-SF in both electronic and supervised (auditorium) formats.

This study was conducted following the principles of the Declaration of Helsinki, and approved by the Bioethics Committee of The Jerzy Kukuczka Academy of Physical Education in Katowice, Katowice, Poland (Resolution No. 2/2012; approval date: 13 December 2012). Prior to participation, all individuals were informed of the study's objectives, the voluntary nature of their involvement, and their right to withdraw at any time. Written informed consent for participation and publication of anonymized results was obtained from all participants.

Statistical Analysis

Descriptive statistics were calculated, including the mean (M), the standard deviation (SD), the median (MD), the interquartile (IQR), and the rank mean (MR) for PA and sedentary behavior indicators. The normality of distribution was verified with the Shapiro-Wilk test. Agreement between measurements from the GENEactiv accelerometer, the AWF Activity app, and IPAQ-SF questionnaires was first analyzed using Friedman's nonparametric ANOVA. The Bland-Altman method (Bland and Altman, 1986) was applied to asses measurement agreement by plotting differences (Diff) against means (mean) and determining 95% limits of agreement. The mean difference (MDiff) from zero was tested with a one-sample *t*-test, and the relationship between diff and mean was evaluated using the Pearson's correlation coefficient (*r*) (Bland and Altman, 1999). Statistical analyses were performed in IBM SPSS Statistics (Version 26.0) with $\alpha = 0.05$.

Results

The Friedman rank variance analysis indicated that measurements of moderate-to-vigorous PA (M-VPA) obtained via the GENEActiv accelerometer (MR = 1.99), the AWF Activity application (MR = 2.05), and the IPAQ-SF questionnaire (MR = 1.96) did not differ significantly ($\chi^2(2, N = 122) = 0.51$, $p = 0.775$) among the students' sample. In contrast, statistically significant differences were identified in the assessment of sedentary behavior (SB) across the three instruments ($\chi^2(2, N = 122) = 77.16$, $p < 0.001$). Pairwise comparisons using the Dunn's test with Bonferroni correction revealed that SB estimates

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from the GENEActiv device (MR = 2.64) were significantly higher ($p < 0.001$) than those obtained via the AWF Activity application (MR = 1.58) and the IPAQ-SF (MR = 1.76). No significant difference was observed between SB measurements using the AWF Activity application and the IPAQ-SF questionnaire ($p > 0.05$) (Table 1).

Analysis of agreement using Bland-Altman plots (Bland and Altman, 1986, 1999) showed that M-VPA values recorded with the GENEActiv accelerometer were, on average, 16 min per week lower than those reported via the AWF Activity application. This difference was not statistically significant ($t(121) = -0.64$, $p = 0.523$). A significant negative correlation was observed between the difference in measurements and the mean of the M-VPA values from both tools (r(120) = −0.40, $p < 0.001$) (Figure 2A).

Similarly, Bland-Altman analysis (Bland and Altman, 1986, 1999) comparing the IPAQ-SF questionnaire and the AWF Activity app indicated that M-VPA was, on average, 2 min per week higher when measured using the IPAQ-SF. This difference was not statistically significant relative to zero ($t(121) = 0.10$, $p = 0.919$). However, a statistically significant positive correlation was found between the difference in measurements and the mean of M-VPA values from these tools ($r(120) = 0.21$, $p = 0.022$) (Figure 2B).

Considering sedentary behavior, Bland-Altman analysis showed that the GENEActiv accelerometer recorded, on average, 1135 min more sedentary time per week compared to the AWF Activity application. This difference was statistically significant ($t(121) = 12.46$, $p < 0.001$). No significant correlation was identified between the measurement difference and the mean SB values from these tools ($r(120) = -0.09$, $p = 0.336$) (Figure 3A).

The Bland-Altman plot comparing SB data from the IPAQ-SF and the AWF Activity app revealed that the IPAQ-SF yielded, on average, 252 min more sedentary time per week than the AWF Activity application. This difference was statistically significant ($t(121) = 2.06$, $p = 0.042$), as was the correlation between the measurement difference and the mean SB values from both tools ($r(120) = 0.41$, $p < 0.001$) (Figure 3B).

Table 1. Characteristics of physical activity and sedentary behavior among participants (N = 122).

Variable	*M* (*SD*)	*Me* (*IQR*)	*MR*
M-VPA			
GENEActiv (min/week)	415.4 (152.4)	386 (321–499)	1.99
AWF Activity (min/week)	431.3 (233.0)	397.5 (245–565)	2.05
IPAQ-SF (min/week)	433.7 (279.3)	370 (240–560)	1.96
SB			
GENEActiv (min/week)	2950.3 (740.4)	2936.5 (2537–3456)	2.64
AWF Activity (min/week)	1815.2 (807.7)*	1785 (1290–2350)	1.58
IPAQ-SF (min/week)	2067.0 (1233.5)*	1898 (1110–2940)	1.78

*M-VPA: moderate to vigorous-intensity aerobic physical activity; SB: sedentary behavior; M: mean; SD: standard deviation; Me: median; IQR: interquartile range; MR: mean rank; * statistically significant difference (p ≤.001) versus GENEActiv*

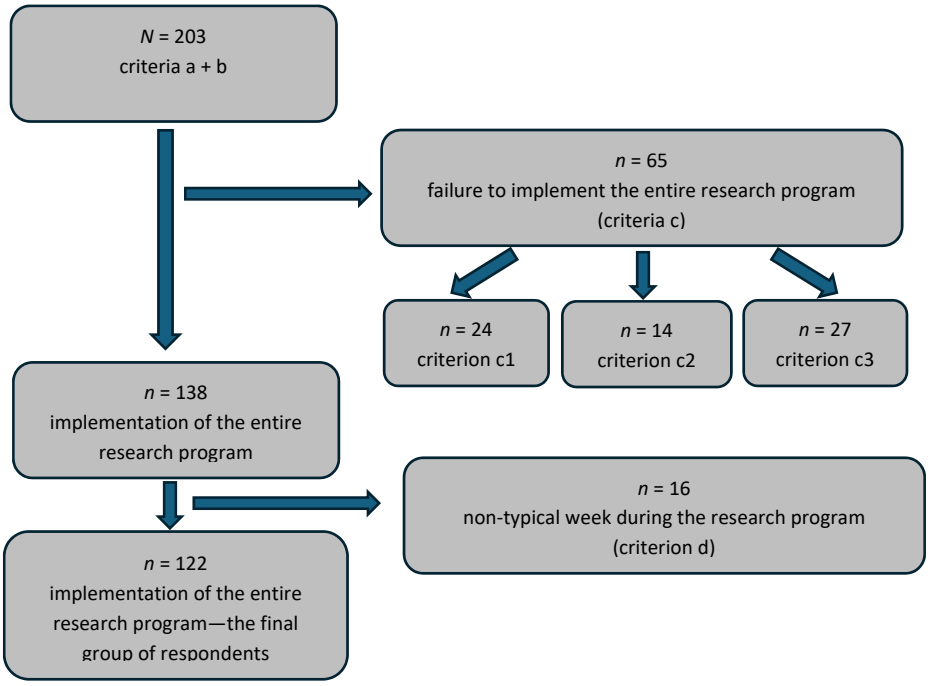


Figure 1. The process of forming the research sample.

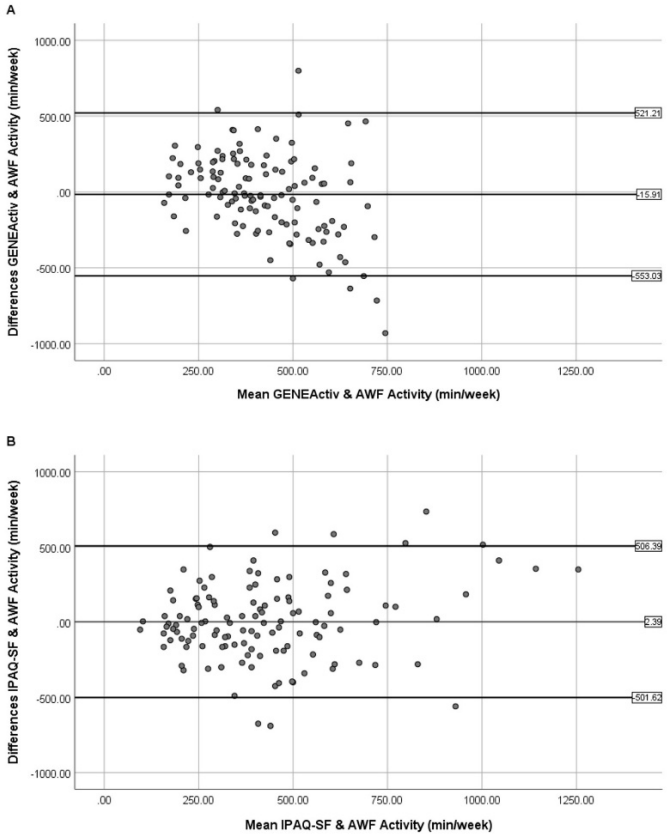


Figure 2. Agreement in measurements of M-VPA between the GENEActiv and the AWF Activity application (A) and between the IPAQ-SF and the AWF Activity application (B).

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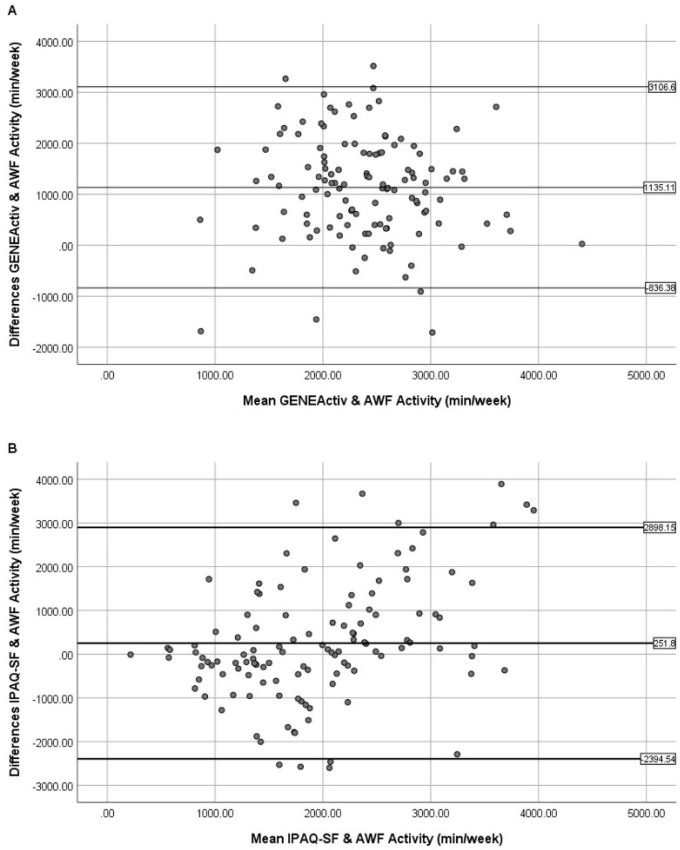


Figure 3. Agreement in sedentary behavior measurements between the GENEActiv and the AWF Activity application (A) and between the IPAQ-SF and the AWF Activity application (B).

Discussion

The objective of this study was to present a comprehensive description of the AWF Activity tool and report the findings from our validation studies assessing its reliability, usability, and practical utility.

The absence of statistically significant differences between measurements of moderate-to-vigorous PA (M-VPA) and sedentary behavior (SB) obtained via the AWF Activity application and established reference methods (i.e., the GENEActiv accelerometer and the IPAQ-SF questionnaire), alongside the results of agreement analysis using Bland-Altman plots, confirms the validity of the application in assessing health-enhancing PA.

The scientific literature offers a limited number of validation studies concerning research-oriented mobile applications (e.g., eMouveRecherche, The Mobile Teen, Google Fit, Moving Analytics). These applications primarily focus on capturing objective data collected through sensors embedded in mobile devices, such as accelerometers and pedometers (e.g., step counts, linear acceleration values). Validation protocols for these applications are typically based on comparisons between energy expenditure estimated by the mobile applications and data obtained from research-grade accelerometers or indirect calorimetry (e.g., Moving Analytics: ICC = 0.95; $p < 0.001$) (Zanin et al., 2021).

In contrast, the AWF Activity application employs a self-report approach, enabling users to subjectively declare both the volume of PA undertaken and periods of inactivity—a component not addressed by most existing tools.

The ICCs obtained were 0.81 (95% CI: 0.69–0.89) for M-VPA and 0.58 (95% CI: 0.49–0.66) for SB (Dębska-Janus et al., 2024), indicating good agreement with reference instruments. For comparison, validation of the IPAQ-SF questionnaire has demonstrated moderate criterion validity against the CSA accelerometer (ϱ = 0.30; 95% CI: 0.23–0.36) and high test-retest reliability (ϱ = 0.80) (Craig et al., 2003). Consistently with previous findings (Keating et al., 2019), our study also observed a tendency for participants to overestimate M-VPA and underestimate SB in self-reported data. It is important to note that the IPAQ-SF has not been validated for the assessment of sedentary time, which underscores the need for the continued development and validation of tools capable of comprehensively evaluating both PA and sedentary behavior.

Comparable outcomes have been reported in another study examining the potential of mobile applications for PA monitoring (Zanin et al., 2021). However, it should be emphasised that the majority of validation research on mobile applications for PA tends to focus on verifying various objective metrics, such as smartphone accelerometer data or step counts. In the present study, greater discrepancies were observed in the assessment of sedentary behavior across objective and subjective tools. Specifically, SB measurements obtained via the accelerometer were significantly higher than those reported through both the AWF Activity application and the IPAQ-SF questionnaire, suggesting a tendency to underestimate sedentary time when using self-report instruments. These challenges in accurately estimating SB through subjective measures have been well documented in previous research (Celis-Morales et al., 2012; Chastin et al., 2018; Prince et al., 2020). Nevertheless, a high degree of agreement was found between the two subjective tools (the AWF Activity app and the IPAQ-SF), likely attributable to their similar structure—both rely on the self-reported duration of specific activities.

One possible reason for the underestimation of sedentary behavior in self-reported tools is the fragmented and incidental nature of sedentary activities, which makes them harder to recall and quantify accurately. Unlike structured PA, sedentary behavior often occurs in short, intermittent bouts such as scrolling on a phone, commuting, or sitting during brief breaks, which are less salient in memory and therefore more likely to be underreported. Additionally, there may be a social desirability bias, whereby respondents unintentionally minimise their sitting time due to increasing public awareness of the health risks associated with prolonged sedentary behavior (Chastin et al., 2018). These tendencies are common in self-report instruments and highlight the inherent limitations of relying solely on subjective data when accurate estimation of sedentary behavior is required. The lack of improvement of the AWF Activity application over the IPAQ-SF in sedentary behavior assessment likely stems from inherent limitations of self-report methods. However, despite the similarity to traditional self-report questionnaires, the AWF Activity application offers several notable advantages. These include daily, real-time data entry, which reduces the bias associated with recall, as well as increased user accessibility due to its mobile format, eliminating the need for additional hardware or time-intensive procedures. Recent years have seen a marked rise in the utilisation of mobile applications to monitor various aspects of health, physical fitness, and the lifestyle (Albarrak et al., 2024; Delir Haghighi and Burstein, 2022; Elgendi et al., 2023; Polechoński et al., 2019). Research suggests that mobile applications may enhance user engagement and convenience compared to traditional paper-based questionnaires (Patterson et al., 2021), although maintaining adherence over extended monitoring periods remains a recognized challenge in digital health interventions (Albarrak et al., 2024). The AWF Activity app aligns with this trend and may serve as a reliable, user-friendly instrument for capturing health-related PA data. With the growing integration of digital technologies into everyday life, mobile applications are increasingly regarded as more intuitive and practical tools for monitoring health behaviors, in comparison with traditional paper-based or even electronic questionnaires.

Additionally, the app enables users to review their behavioral patterns continuously and provides personalised feedback on their compliance with the WHO PA guidelines (World Health Organization, 2020). Thus, beyond its utility in research contexts, the application also holds promise as an educational and motivational instrument within public health promotion

initiatives. This potential is supported by prior findings demonstrating that mobile applications for PA monitoring can enhance health awareness and encourage individuals to engage in regular PA (Patterson et al., 2021).

The observed discrepancies in sedentary behavior estimates have practical implications for both research and health promotion. From a validation standpoint, these findings highlight the need for cautious interpretation of self-reported sedentary time, particularly when such data are used to guide individual feedback or inform population-level interventions. While the AWF Activity app enhances usability and data precision through daily entries, it remains a subjective tool and may share some of the typical limitations of self-report measures.

Limitations and Directions for Future Research

Despite the promising findings, the study presents certain limitations. It was conducted among a cohort of young adults, thereby limiting the generalisability of results to other demographic groups, particularly older adults, individuals with lower levels of PA, people with chronic conditions as well as those with lower digital competence. Furthermore, the study was implemented in a controlled academic environment, which may have influenced participants' engagement and reporting behaviors. In the study, a high proportion of participants did not complete the entire research protocol. Of these, 32% were individuals for whom it was not possible to collect a complete set of data using all designated tools: the accelerometer, the mobile application, and the questionnaire survey. Several factors may account for this outcome, including a lack of understanding of the study's purpose, insufficient motivation to participate, or ineffective communication with participants. The remaining 8% of non-completers withdrew from the study due to personal reasons, such as illness, injury, or family-related issues. The reduced final sample size should be considered a limitation of the study, warranting caution in interpreting the results and drawing conclusions. Future research should aim to include more diverse participants' populations, with a particular emphasis on older individuals and those with lower PA levels. Additionally, environmental and occupational factors that may influence sedentary behavior and its reporting could be taken into account. Extending the monitoring period would also be valuable in assessing the temporal stability of the measurements. An important future direction involves examining the application's influence on actual behavioral change and its effectiveness as a component of public health promotion strategies. It is also important to further improve the application at the technical level. In particular, it seems purposeful to develop and implement an automated notification system reminding participants to complete the daily report. This feature is intended to facilitate adherence among individuals with high daily workload and to reduce the risk of missing data resulting from forgetfulness or delayed reporting. Future versions could, among other possible extensions, explore an optional module for recording pre-exercise hydration status. Such information might help to contextualise exercise reports, as insufficient hydration may alter sweat-rate responses and impair executive control during prolonged moderate exercise (Skotniczny et al., 2026).

Conclusions

Although the AWF Activity mobile application did not show a marked advantage over the IPAQ-SF in terms of agreement with objective measurements, it demonstrated significant utility as a practical tool for the daily monitoring of PA and sedentary behaviors. Its mobile format facilitates real-time reporting, thereby reducing retrospective bias, and enhances convenience and user engagement. The feedback functionality further supports its applicability in public health interventions, particularly for monitoring adherence to WHO recommendations for PA.

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