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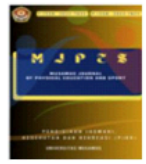

Wearable-Based Monitoring of Physical Fitness Among University Students: A Descriptive Study

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Abstract

Objectives: This study described the use of smartwatch-based monitoring and the physical-fitness profile of Physical Education students at Universitas Hamzanwadi.

Materials and Methods: A quantitative cross-sectional descriptive survey was conducted in February 2026. All 10 students in the accessible population (five men and five women) were included through total sampling. Data were collected using a 21-item, four-point Likert questionnaire covering smartwatch knowledge, perceived usefulness, usage, barriers, future-use intention, and physical-activity motivation, together with smartwatch-derived indicators such as heart rate, steps, activity duration, and activity intensity. The available fitness data were summarized using the mean and standard deviation.

Results: The composite physical-fitness score had a mean of 66.8 and a standard deviation of 4.83. The relatively small dispersion indicated limited between-participant variability within this group. The smartwatch provided an accessible means of recording activity-related indicators; however, the dataset did not support causal conclusions about whether smartwatch use improved fitness.

Conclusions: Smartwatches have practical potential as self-monitoring tools in university physical-education settings, but the present findings should be treated as a preliminary description because of the small, single-program sample and the absence of a comparator or longitudinal assessment. Future studies should report device validity, scoring procedures, adherence, and raw activity metrics and should use larger controlled designs.

Keywords: digital health; physical activity; physical fitness; self-monitoring; smartwatch; university students

Introduction

Wearable technologies have expanded the possibilities for continuous, real-world monitoring of physical activity and physiological signals. Consumer smartwatches can record step counts, heart rate, active minutes, energy expenditure, and sleep-related indicators, allowing users to review patterns that would otherwise be difficult to observe. Advances in wearable sensors may support individualized health monitoring, but the usefulness of the resulting information depends on data quality, device validity, interoperability, accessibility, and users' ability to interpret the measurements (Canali et al., 2022; Vo & Trinh, 2024).

University students are an important target population because academic workloads and sedentary routines can displace habitual physical activity. Within physical-education programs, wearable devices may have an additional pedagogical role: they can make activity patterns visible and encourage students to reflect on the relationship between daily behavior and fitness. In a randomized pilot study, Pope et al. (2019) demonstrated the feasibility of combining wearable feedback and social support to influence health behavior among college students. More broadly, a systematic review and meta-analysis found that consumer activity trackers can increase physical-activity participation, although effects vary across outcomes and intervention designs (Brickwood et al., 2019).

The availability of data does not guarantee accurate interpretation. Optical heart-rate estimates can vary by device, movement type, intensity, skin-device contact, and testing context. Validation studies have found reasonable performance for some devices and conditions, but they also caution against treating consumer wearables as interchangeable with criterion measures (Kim et al., 2023; Martín-Escudero et al., 2023). Consequently, research that uses smartwatch outputs should identify the device, measurement conditions, algorithms or variables used, and the scoring approach.

Adoption also depends on perceived usefulness, usability, affordability, and digital health literacy. Pan et al. (2025) found sociodemographic differences in wearable use and showed that digital health literacy partly explains patterns of adoption. In an Indonesian educational context, Deviyana and Makmur (2024) similarly emphasized the potential of smartwatches as learning-support media while noting practical barriers to implementation. These findings suggest that evaluating wearable use requires attention to both the recorded fitness indicators and the users' knowledge, perceptions, motivations, and constraints.

At Universitas Hamzanwadi, empirical information on smartwatch-supported fitness monitoring among Physical Education students remains limited. The original dataset provides a small-scale description of smartwatch use and a composite fitness score but does not test an intervention effect. Therefore, this study aimed to describe smartwatch-based fitness monitoring and the physical-fitness profile of students in the Physical Education Study Program. The study was intended as an exploratory baseline for the design of larger validation and intervention research.

Materials and Methods

Study Design

This study used a quantitative descriptive approach with a cross-sectional survey design. Measurements were collected at one time point; no treatment was administered. The design was therefore used to characterize the observed group rather than to estimate causality or change over time.

Study Participants

The study was conducted in the Physical Education Study Program, Universitas Hamzanwadi, Pancor, East Lombok, West Nusa Tenggara, Indonesia, in February 2026. The accessible population consisted of 10 students, and all were included through total sampling. The sample comprised five men and five women. The source manuscript did not report age, semester, anthropometric characteristics, inclusion and exclusion criteria, prior smartwatch experience, or health status; these characteristics should be supplied before submission.

Table 1. Participant distribution by sex (n = 10)

Group	Men	Women	Total
Physical Education students	5	5	10

Study Organization and Measures

Data collection used a 21-item questionnaire and smartwatch-derived monitoring indicators. Questionnaire responses were recorded on a four-point Likert scale: strongly disagree (1), disagree (2), agree (3), and strongly agree (4). The items addressed six domains: knowledge of smartwatches, perceived value for fitness monitoring, perceptions of smartwatch use, barriers to use, intention to use the technology in the future, and motivation for physical activity. The wearable indicators described in the source manuscript included heart rate, step count, activity duration, and activity intensity.

The source manuscript states that item validity was assessed using Pearson product-moment correlations and internal consistency using Cronbach's alpha, but it does not provide item coefficients, the alpha value, the smartwatch brand and model, wear-time criteria, data-processing rules, or the formula used to produce the composite fitness score. These details are essential for reproducibility and must be added from the original records. Without them, the score should be interpreted as a study-specific descriptive index rather than a validated clinical or population fitness measure.

Statistical Analysis

Data were summarized using frequencies, the arithmetic mean, and the sample standard deviation. Because the complete item-level questionnaire results and raw smartwatch metrics were not available in the source document, no inferential analyses or domain-specific estimates were performed. The analysis was descriptive and did not test a relationship between smartwatch use and physical fitness.

Results

Ten students completed the available assessment. The composite physical-fitness score was 66.8 ± 4.83 (Table 2). The standard deviation was approximately 7.2% of the mean, indicating that scores were relatively clustered within this small sample. Because no validated category thresholds were supplied, the score is reported numerically rather than assigned to a normative fitness category.

Table 2. Descriptive statistics for the composite physical-fitness score

Variable	n	Mean	SD
Composite physical-fitness score	10	66.8	4.83

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The available evidence establishes that the smartwatch and questionnaire were used as monitoring tools, but it does not quantify the separate heart-rate, step-count, activity-duration, activity-intensity, or questionnaire-domain results. Accordingly, the present Results section does not claim that participants had positive perceptions or that smartwatch use improved fitness; those claims would require the underlying scores, prespecified category cutoffs, or longitudinal comparison.

Discussion

This study offers a preliminary description of wearable-supported fitness monitoring among a small group of Physical Education students. The mean composite score of 66.8, coupled with a standard deviation of 4.83, indicates limited dispersion in the observed group. However, the substantive meaning of this value cannot be judged against external standards because the source manuscript did not document the composite-score construction or provide normative thresholds. The primary contribution is therefore methodological and contextual: it illustrates how a smartwatch and a brief questionnaire can be incorporated into field-based student monitoring, while also identifying the reporting elements needed for a stronger study.

The potential value of this approach is consistent with prior research. Brickwood et al. (2019) found that wearable activity trackers can increase physical-activity participation by providing feedback and self-monitoring cues. Pope et al. (2019) also demonstrated that wearable technology can be feasibly integrated into a college-student behavior-change program. These studies support the educational logic of making activity data visible, but they do not justify a causal inference in the present cross-sectional study. A monitoring device may facilitate awareness, whereas changes in fitness require sustained activity and an appropriately designed longitudinal assessment.

Measurement validity remains central. Kim et al. (2023) reported that wearable heart-rate devices can provide useful exercise-test information, but performance differs among products. Martín-Escudero et al. (2023) likewise showed that wrist-worn heart-rate accuracy can vary during intense exercise. Such findings are particularly relevant in physical education, where movement artifacts and rapidly changing intensities may affect optical measurements. Future work at Universitas Hamzanwadi should validate the selected smartwatch against a criterion device under the same activities used in the study and should report missing-data and valid-wear rules.

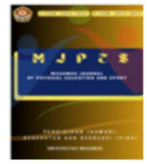
The findings should also be considered through the lens of digital health literacy and access. Canali et al. (2022) warned that data quality, interoperability, fairness, and health equity shape the responsible use of wearables. Pan et al. (2025) found that digital health literacy and sociodemographic characteristics were associated with wearable use, suggesting that the educational benefit may not be distributed equally. Cost, device ownership, connectivity, and the ability to interpret feedback may therefore influence participation and should be measured rather than treated as incidental barriers.

In practice, smartwatch monitoring could support reflective assignments, individual activity goals, and discussions of exercise intensity. Yet instructors should clarify that consumer-device estimates are not medical diagnoses and should avoid evaluating students solely through proprietary device metrics. A stronger university protocol would combine device data with validated field-fitness tests, a clearly scored questionnaire, training for data interpretation, and safeguards for privacy and voluntary participation.

This study has substantial limitations. The sample included only 10 students from one program, limiting precision and transferability. The cross-sectional design cannot demonstrate that smartwatch use changed activity or fitness. The device model, wear protocol, score calculation, questionnaire validity coefficients, reliability estimate, item-level results, and raw activity metrics were not reported. Potential determinants such as sleep, diet, stress, training load, and prior technology use were not controlled. Future studies should recruit larger samples, preregister measurement and analysis procedures, report sex- and age-relevant participant characteristics, validate the device and questionnaire, and use repeated measures or a controlled intervention design.

Conclusions

Smartwatch-based monitoring was feasible in this small group of Physical Education students, whose study-specific composite fitness score averaged 66.8 ± 4.83. The data support a preliminary descriptive account but do not establish that smartwatch use improved physical fitness. Wearables may serve as useful self-monitoring and educational tools when their measurements are validated, scoring procedures are transparent, and users receive appropriate digital-health guidance. Larger longitudinal and controlled studies are required to evaluate effectiveness.



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Conflict of Interest

The authors declare no conflict of interest.

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