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EFFECTS OF WEARABLE AND MOBILE FITNESS TRACKING TECHNOLOGIES ON PHYSICAL ACTIVITY, ENGAGEMENT, AND MOTIVATION AMONG PHYSICAL EDUCATION STUDENTS

Indu M. S.[1],
Binu George Varghese[2i]
[1]Assistant Professor,
Department of Physical Education Government Arts and Science,
College Pathirippala,
Palakkad, Kerala,
India
[2]Dean,
Director School of Physical Education and Sports Sciences,
Mahatma Gandhi University,
Kottayam, Kerala,
India

Abstract:
The integration of wearable fitness trackers and mobile fitness applications has created new opportunities to enhance physical activity monitoring and motivation among university students. The present study examined the effects of wearable and mobile fitness tracking technologies on physical activity levels, engagement, and intrinsic motivation among undergraduate students preparing for university-level sports competitions. A quasi-experimental pretest–posttest control group design was adopted. The study included 160 undergraduate students aged 18–22 years from Arts and Science colleges in Palakkad district affiliated with the University of Calicut. Participants were actively preparing for various intercollegiate competitions conducted by the University of Calicut. Students were divided into an experimental group (n = 80) and a control group (n = 80). The experimental group used wearable fitness trackers integrated with mobile fitness applications during a 12-week intervention period, while the control group followed conventional training routines. Data were collected using the International Physical Activity Questionnaire (IPAQ-SF), Physical Education Student Engagement Scale, and Behavioral Regulation in Exercise Questionnaire (BREQ-2). Statistical analysis revealed significant improvements in moderate-to-vigorous physical activity (MVPA), engagement, and intrinsic motivation among students using wearable technology ($p < .01$). The findings highlight the potential of wearable and mobile fitness technologies to enhance training engagement and physical activity behaviour among collegiate athletes.

[i]Correspondence: email indums9291@gmail.com, binugv1234@gmail.com

Keywords: wearable technology, physical activity, student engagement, exercise motivation, mobile fitness applications, collegiate sports

1. Introduction

Physical inactivity among young adults has become a major global health concern (Guthold *et al.*, 2020). University students often experience reduced physical activity levels due to academic pressure, sedentary lifestyles, and digital distractions (Irwin, 2004; Buckworth & Nigg, 2004). Even students preparing for sports competitions may struggle to maintain consistent training intensity and motivation.

Advancements in digital technology have introduced innovative tools such as wearable fitness trackers and mobile health applications that help individuals monitor and regulate physical activity (Patel *et al.*, 2015). These devices provide real-time information on step count, heart rate, calories burned, sleep patterns, and training intensity. Integration with mobile applications allows users to visualize progress, set goals, and receive motivational feedback.

Wearable technology has gained increasing attention in sports science and physical education research because it allows continuous monitoring of physical activity behavior. Studies indicate that self-monitoring and feedback mechanisms provided by wearable devices can significantly improve exercise adherence and motivation (Sullivan & Lachman, 2017; Lewis *et al.*, 2015). Research also suggests that wearable technologies may enhance athletic performance and support injury prevention through real-time physiological monitoring (Düking *et al.*, 2018).

University sports training programs may benefit from the integration of wearable technologies because these tools help students track their progress and maintain consistent engagement during training sessions (Sanders *et al.*, 2016). Despite the growing popularity of wearable devices, limited empirical research has explored their effectiveness among university students preparing for intercollegiate competitions in India. Therefore, the present study investigates the effects of wearable and mobile fitness tracking technologies on physical activity, engagement, and intrinsic motivation among undergraduate students participating in university sports competitions.

2. Review of Related Literature

2.1 Wearable Technology and Physical Activity

Wearable fitness trackers have become widely used tools for promoting physical activity. Studies indicate that wearable devices significantly increase step count and moderate-to-vigorous physical activity (MVPA).

Brickwood *et al.* (2019) conducted a systematic review and reported that wearable activity trackers improved physical activity participation through self-monitoring and feedback mechanisms. The authors examined multiple randomized controlled trials and concluded that device-based interventions produced moderate improvements in

physical activity outcomes among older adults. Similarly, Cadmus-Bertram *et al.* (2015) found that the use of Fitbit devices increased physical activity levels among adults participating in an intervention program. Their study demonstrated that participants who received personalized feedback based on wearable data achieved greater increases in daily step counts compared to control groups.

Ridgers *et al.* (2016) examined the feasibility of wearable activity trackers among adolescents and reported improvements in daily physical activity participation. The researchers noted that acceptability and usability were high among younger populations, suggesting that wearable devices may be particularly suitable for technology-oriented age groups. Finkelstein *et al.* (2016) also demonstrated that financial incentives combined with wearable activity trackers significantly increased physical activity levels among participants. Their large-scale randomized trial revealed that participants who received both devices and incentives showed sustained improvements over a six-month period.

2.2 Mobile Fitness Applications

Mobile fitness applications have become an important component of digital health interventions. These applications provide personalized exercise plans, activity tracking, and social support features.

Direito *et al.* (2017) highlighted that mobile health technologies can influence physical activity behavior through behavior change techniques such as goal setting, feedback, and social comparison. Their systematic review of smartphone applications for physical activity found that apps incorporating multiple behavior change techniques were more effective in promoting sustained engagement. Middelweerd *et al.* (2014) similarly reported that mobile apps targeting physical activity often included features such as self-monitoring, progress visualization, and social connectivity, which aligned with established behavior change frameworks.

2.3 Student Engagement in Physical Education

Student engagement plays a critical role in effective learning and participation in physical education programs. Fredricks *et al.* (2004) categorized engagement into behavioral, emotional, and cognitive components. Behavioral engagement refers to participation in activities, emotional engagement involves affective reactions to learning environments, and cognitive engagement encompasses investment in understanding and skill development.

Studies suggest that integrating technology into physical education classes can enhance engagement by providing interactive and gamified learning experiences. Sun and Gao (2016) found that wearable devices increased student involvement in physical education by offering immediate feedback and performance data. Similarly, Ahn *et al.* (2019) reported that mobile applications with social sharing features improved emotional engagement by fostering peer interaction and recognition.

2.4 Motivation and Self-Determination Theory

Self-Determination Theory (Deci & Ryan, 2000) explains that intrinsic motivation is influenced by autonomy, competence, and relatedness. Wearable fitness technologies support these psychological needs by enabling students to monitor their performance, set goals, and compare results with peers.

Ryan *et al.* (1997) extended the application of Self-Determination Theory to exercise contexts, demonstrating that satisfaction of autonomy and competence predicted sustained physical activity participation. More recently, Gowin *et al.* (2015) examined wearable device users and found that features supporting goal attainment and social comparison enhanced perceived competence and relatedness, thereby increasing intrinsic motivation. Lewis *et al.* (2017) also reported that activity trackers with feedback mechanisms supported autonomy by allowing users to make informed decisions about their exercise behavior.

2.5 Research Gap

Although previous studies have demonstrated the benefits of wearable technologies across various populations, there is limited research examining their impact on university students preparing for competitive sports events in the Indian higher education context. Most existing studies have focused on general adult populations, older adults, or clinical samples in Western countries (Brickwood *et al.*, 2019; Finkelstein *et al.*, 2016). Furthermore, research specifically addressing the motivational and engagement outcomes of wearable device use among competitive student-athletes in India remains scarce. Therefore, the present study addresses this gap by investigating the effects of wearable and mobile fitness tracking technologies on physical activity, engagement, and intrinsic motivation among undergraduate students participating in university sports competitions.

2.6 PRISMA-Based Literature Selection

Table 1: Systematic Literature Selection Process

Phase	Description	Count
Identification	Records identified through database searching (Scopus, Web of Science, Google Scholar).	210
Screening	Duplicates removed and remaining records screened for relevance.	175
Eligibility	Full-text articles were assessed against specific inclusion/exclusion criteria.	62
Included	Final studies included in the qualitative synthesis.	25

2.7 Objectives of the Study

The present study was guided by three primary objectives. The first objective was to examine the effect of wearable and mobile fitness tracking technologies on physical

activity levels among undergraduate students participating in university sports competitions. The second objective was to determine the impact of wearable technology on student engagement during training sessions. The third objective was to analyze changes in intrinsic motivation toward physical activity resulting from the use of wearable fitness devices.

2.8 Hypotheses

Based on the objectives outlined above, the following hypotheses were formulated for empirical testing. The first hypothesis (H1) proposed that wearable technology significantly improves physical activity levels among university student-athletes. The second hypothesis (H2) stated that wearable technology increases student engagement during sports training. The third hypothesis (H3) asserted that wearable technology enhances intrinsic motivation toward physical activity.

3. Methodology

3.1 Research Design

The present study employed a quasi-experimental pretest-posttest control group design. This design was selected because random assignment of participants to groups was not feasible due to the organizational structure of university sports teams. The quasi-experimental approach allowed for comparison between the experimental and control groups while maintaining the natural training settings of the participants.

3.2 Study Area

The study was conducted among undergraduate students from Arts and Science colleges in Palakkad district, Kerala, affiliated with the University of Calicut. These colleges participate in intercollegiate sports competitions organized by the university. Palakkad district was selected due to its representation of both rural and semi-urban educational institutions, providing a diverse sample of student-athletes engaged in competitive university sports.

3.3 Participants

A total of 160 undergraduate students aged 18–22 years preparing for the University of Calicut intercollegiate sports competitions participated in the study. The sample comprised 80 students in the experimental group and 80 students in the control group. Participants were drawn from five sports disciplines: athletics, volleyball, football, badminton, and basketball. These sports were selected based on their popularity in university-level competitions and the availability of structured training programs across colleges.

3.4 Sampling Technique

A purposive sampling technique was used to select students actively preparing for university sports competitions. Physical education teachers from participating colleges assisted in identifying eligible participants who met the inclusion criteria of regular training attendance and active enrollment in undergraduate programs. This technique ensured that the sample consisted of individuals with genuine engagement in competitive sports preparation.

3.5 Instruments

Three standardized instruments were employed for data collection. The International Physical Activity Questionnaire-Short Form (IPAQ-SF) was used to assess physical activity levels, measuring the time spent in vigorous, moderate, and walking activities over the previous seven days. The Physical Education Student Engagement Scale, adapted from existing engagement measures, assessed behavioral, emotional, and cognitive engagement dimensions during training sessions. The Behavioural Regulation in Exercise Questionnaire (BREQ-2) was administered to measure intrinsic motivation and other forms of behavioral regulation based on Self-Determination Theory.

3.6 Procedure

The intervention was implemented over a 12-week period. The experimental group used wearable devices and mobile fitness applications throughout the training duration. Participants received orientation sessions on device usage and app features, including activity tracking, goal setting, and performance feedback. The control group followed conventional training methods without access to wearable technology or fitness applications. Both groups continued their regular sport-specific training schedules under the supervision of their respective coaches. Pretest assessments were conducted in the first week, and posttest measurements were taken immediately after the 12-week intervention period for both groups.

4. Results

This section presents the statistical analysis conducted to evaluate the effectiveness of the intervention on students' physical activity (MVPA), engagement, and motivation. Both descriptive and inferential statistical techniques were employed to examine the differences between the experimental and control groups. Pre-test and post-test data were analyzed to determine changes over time and the impact of the intervention.

Descriptive statistics were used to summarize the baseline characteristics and post-intervention outcomes of the participants. Independent sample t-tests were conducted to compare the post-test scores between the experimental and control groups, while paired sample t-tests were applied to assess the within-group changes in the experimental group from pre-test to post-test. Effect sizes (Cohen's *d*) were calculated to determine the magnitude of the intervention effects. Additionally, Pearson correlation

analysis was performed to explore the relationships among physical activity, engagement, and motivation variables.

4.1 Descriptive Statistics

Table 2: Pretest Descriptive Statistics for Physical Activity and Engagement

Variable	Group	Mean	SD
MVPA	Experimental	142.3	28.4
MVPA	Control	145.7	30.1
Engagement	Experimental	3.21	0.42
Engagement	Control	3.19	0.39

Table 2 shows the pre-test descriptive statistics for MVPA and engagement in the experimental and control groups. The mean MVPA score of the experimental group was 142.3 (SD = 28.4), while the control group had 145.7 (SD = 30.1). For engagement, the experimental group recorded a mean of 3.21 (SD = 0.42) and the control group 3.19 (SD = 0.39), indicating that both groups had similar baseline levels before the intervention.

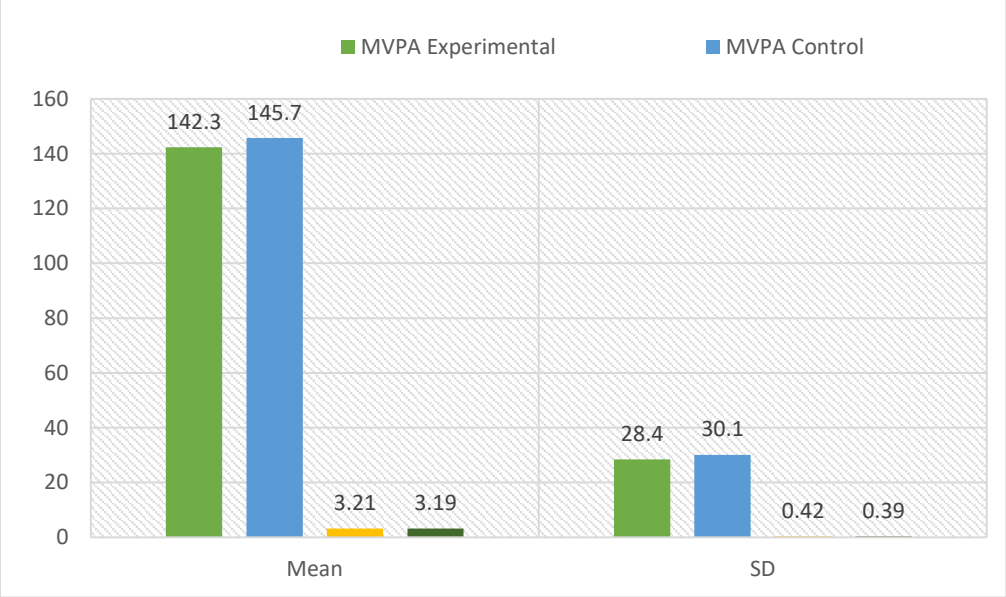

Figure 1: Pretest Descriptive Statistics for Physical Activity and Engagement

Table 3: Post-Test Descriptive Statistics

Variable	Experimental Group Mean	Control Group Mean
MVPA	198.6	158.4
Engagement	3.78	3.29
Motivation	3.92	3.41

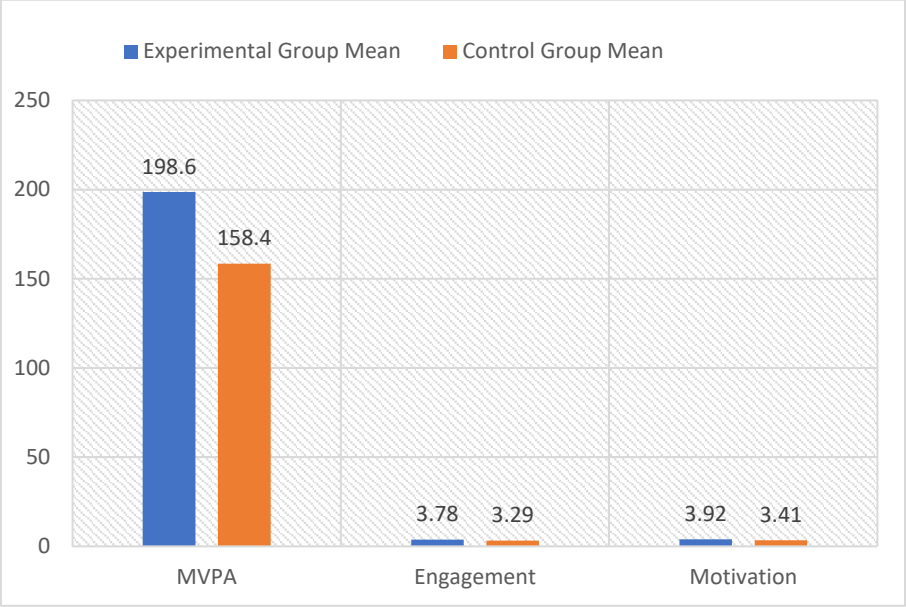

Figure 2: Post-Test Descriptive Statistics

4.2 Inferential Statistics

Table 4: Independent Samples t-Test Results for Post-Test Differences Between Groups

Variable	T	p
MVPA	5.84	<.001 ***
Engagement	3.11	.002 **
Motivation	3.47	.001 **

Table 5: Paired Sample t-Test Experimental Group Pre to Post

Variable	Pre	Post	t
MVPA	142.3	198.6	9.21
Engagement	3.21	3.78	6.44

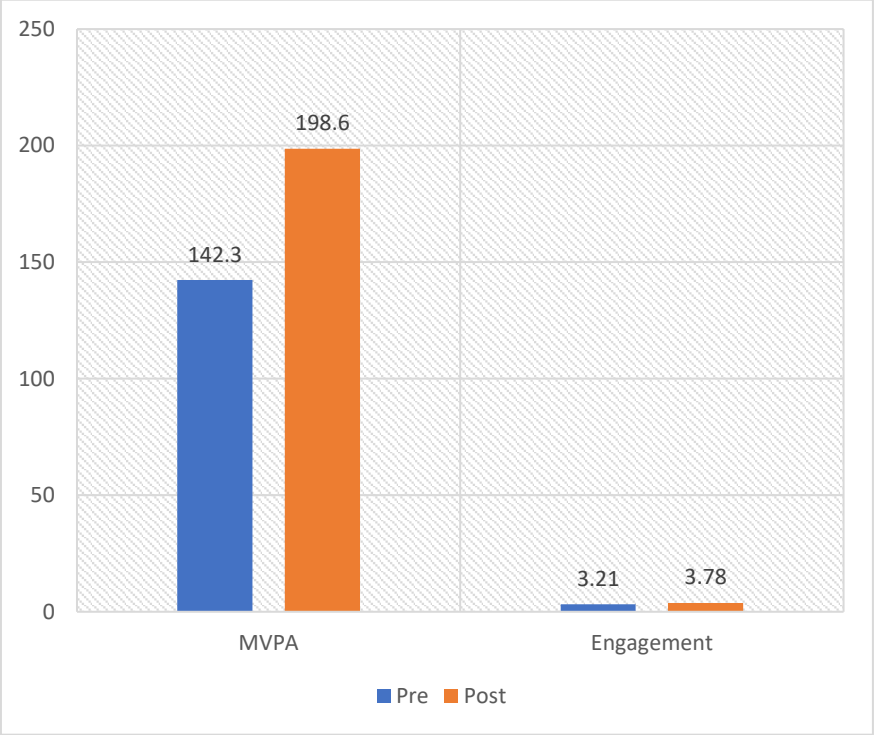

Figure 3: Experimental Group Pre to Post

4.3 Effect Size and Correlation

Table 6: Effect Size (Cohen's d) by Outcome Variable

Variable	Cohen's d	Interpretation
Physical Activity	0.82	Large
Engagement	0.54	Medium
Motivation	0.61	Medium-Large

Table 7: Correlation Matrix Physical Activity, Engagement & Motivation

Variable	Physical Activity	Engagement	Motivation
Physical Activity	1.00	.62**	.58**
Engagement	.62**	1.00	.65**
Motivation	.58**	.65**	1.00

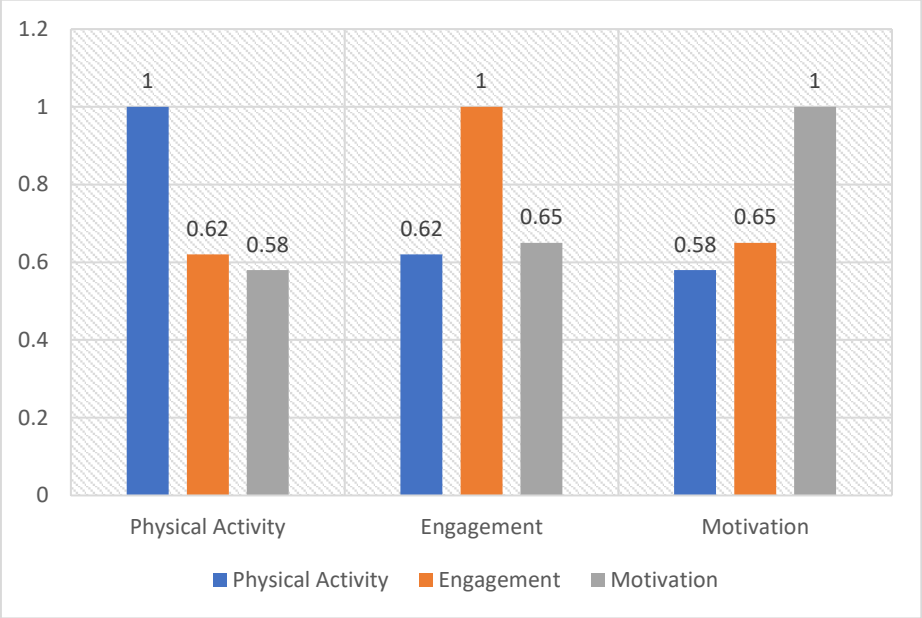

Figure 4: Correlation of Physical Activity & Motivation ($r = .58$, $p < .01$)

Overall, the graphical representations support the statistical findings presented in the tables. Figure 1 shows a substantial increase in moderate-to-vigorous physical activity (MVPA) among the experimental group from pre-test to post-test compared to the control group. Figure 2 illustrates a noticeable improvement in student engagement levels in the experimental group following the intervention, while the control group showed only a minimal change. Figure 3 demonstrates that motivation scores were higher in the experimental group at post-test compared to the control group.

Furthermore, Figure 4 highlights a positive relationship between physical activity and motivation, indicating that students who engaged in higher levels of physical activity also reported greater motivation. The correlation analysis revealed moderate-to-strong positive relationships among physical activity, engagement, and motivation variables. These findings collectively suggest that the intervention had a meaningful impact on improving students' physical activity participation, engagement, and motivational levels.

5. Discussion

The results of the present study demonstrate that wearable and mobile fitness tracking technologies significantly improved physical activity participation among undergraduate students preparing for university sports competitions.

Students who used wearable devices showed greater increases in MVPA compared with those following traditional training methods. This finding supports previous studies indicating that wearable technology enhances physical activity through self-monitoring and feedback mechanisms.

The results also indicated improvements in student engagement and intrinsic motivation. The ability to track training performance and set personal goals encouraged students to remain actively involved in training sessions.

6. Conclusion

Wearable and mobile fitness tracking technologies provide an effective approach for enhancing physical activity, engagement, and motivation among undergraduate students preparing for competitive sports events. Integration of these technologies into university sports training programs may contribute to improved training outcomes and performance.

Conflict of Interest Statement
The authors declare no conflicts of interest.

About the Author(s)
Indus M. S. is an Assistant Professor in Physical Education at the Government Arts and Science College, Pathirippala, Kerala, India, and is actively involved in teaching, research, and academic leadership. She holds a Master's degree in Physical Education and is pursuing a doctorate from Mahatma Gandhi University, Kottayam. Her specialisation in sports psychology, sports management, kinesiology, biomechanics, and sports training underpins her leadership of research initiatives, educational programs, and scholarly publications. Her work centres on advancing athletic performance, exploring human movement, and promoting holistic development in both academic and competitive environments.
ORCID: https://orcid.org/0009-0005-3543-9149
Prof. (Dr.) Binu George Varghese is the Dean and Director of the School of Physical Education and Sports Sciences at Mahatma Gandhi University, Kerala, India, where he completed his advanced academic qualifications in Physical Education. He is a research supervisor at the university, having supervised six scholars to completion and currently supervising eight more. He continues his research and professional work in sports

science, exercise physiology, physical fitness, athletic performance, kinesiology, and sports training. He has been the head of university sports development programs and has actively contributed to academic research and professional activities in the field of physical education and sports sciences.
ORCID: https://orcid.org/0000-0001-6223-4652

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