

The long-term impact of running applications on physical fitness among vocational college students: A longitudinal analysis

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Published online: May 31, 2025

Accepted for publication: May 15, 2025

DOI:10.7752/jpes.2025.05117

Abstract:

Physical inactivity among young adults is a growing public health concern, contributing to obesity, cardiovascular diseases, and metabolic disorders. Vocational college students face unique barriers to physical activity, including academic pressures, low motivation, and limited access to structured exercise programs. Mobile fitness applications, such as running apps, have emerged as digital health interventions to promote physical activity, but their long-term effectiveness in vocational education settings remains largely unexplored. This study aims to evaluate the impact of the Sports World Campus app on key fitness metrics among vocational college students over two years. A longitudinal observational study was conducted among 5,000 vocational college students, assessing fitness improvements through standardised body mass index (BMI) measures, vital capacity, endurance, flexibility, strength, explosive power, and speed. App engagement data, including running distance, session frequency, and leaderboard rankings, were analysed using paired t-tests, Pearson correlation analysis, and multiple linear regression models to determine the relationship between digital engagement and fitness outcomes. The results indicate significant improvements in endurance ($p < 0.001$) and vital capacity ($p < 0.001$), with strong correlations between app engagement levels and aerobic fitness gains. However, BMI and muscular strength exhibited minimal changes, suggesting that running apps primarily enhance cardiovascular endurance but are insufficient for comprehensive fitness development. These findings highlight the need for hybrid digital fitness interventions integrating endurance, strength, and flexibility training. Future research should explore adaptive AI-driven coaching, gamified engagement strategies, and multimodal exercise programs to enhance the effectiveness of digital health interventions for vocational students.

Key Words: - Digital fitness interventions, endurance training, vocational college students, mobile fitness applications, longitudinal study, sports technology.

Introduction

Physical inactivity among young adults is a growing public health concern, contributing to increased risks of obesity, cardiovascular diseases, and other metabolic disorders (WHO, 2020). Despite the well-documented benefits of regular physical activity, many young adults fail to meet recommended exercise guidelines due to various barriers, including academic demands, lack of motivation, and limited access to structured exercise programs. This issue is particularly pronounced among vocational college students, who often have fewer opportunities for structured physical activity than their university counterparts (Wang, 2024). In response to these challenges, digital health interventions have gained prominence, particularly mobile fitness applications that promote physical activity. Running apps, in particular, have been widely adopted due to their accessibility, interactive features, and ability to provide personalized training programs (Obra et al., 2023). These applications leverage gamification, social incentives, and real-time feedback to enhance motivation and adherence to exercise routines (He et al., 2024).

Studies have demonstrated that running applications can improve aerobic endurance and cardiorespiratory fitness (Zhuo, 2022; Guo & Zhou, 2022). However, their impact on other fitness components, such as muscular strength, flexibility, and BMI management, remains inconclusive (Chuprun & Shulga, 2024; Wang, 2024). Additionally, most research has focused on university students and general adult populations, leaving a significant gap in understanding how these applications affect vocational college students, who often have lower baseline fitness levels and face unique exercise barriers (Wang, 2024). While mobile fitness applications have been extensively studied in general adult and university populations, their effectiveness among vocational college students remains underexplored. Unlike university students, vocational students engage in significantly lower levels of weekly physical activity and have fewer structured opportunities for exercise (Wang, 2024). Given their distinct fitness behaviours and unique barriers to physical activity, it is unclear whether running applications can effectively address these challenges and lead to sustained improvements in physical fitness.

Additionally, most existing studies on running applications are based on short-term interventions, typically lasting 6 to 12 weeks, limiting their ability to assess long-term behavioural adherence and physiological

adaptations (He et al., 2024). The lack of longitudinal research raises concerns about whether initial fitness gains from these applications are maintained over time or whether engagement declines after the novelty effect dissipates. Furthermore, while running applications have demonstrated effectiveness in improving cardiovascular endurance, their impact on other critical fitness components, such as muscular strength, flexibility, and BMI, remains ambiguous (Chuprun & Shulga, 2024). Given the increasing emphasis on holistic fitness development, it is imperative to determine whether these applications provide comprehensive fitness benefits or whether complementary interventions are necessary. Mobile fitness applications have become essential to digital health interventions to increase physical activity participation. These applications provide structured workout programs, real-time feedback, and social engagement features, encouraging users to maintain an active lifestyle (Manskow et al., 2024). According to the self-determination theory (Deci & Ryan, 1985), intrinsic motivation can be enhanced through goal-setting and social rewards, leading to sustainable behavioural changes. Many running applications incorporate these principles through leaderboards, milestone achievements, and AI-generated training plans (Obra et al., 2023).

Several systematic reviews have confirmed that mobile fitness applications can significantly improve physical activity adherence and cardiovascular fitness (Rowland et al., 2024). However, long-term adherence remains a significant challenge, with engagement levels typically declining after the initial novelty period. To mitigate this issue, researchers have emphasised the need for adaptive feedback mechanisms, AI-driven personalised coaching, and social community integration to sustain user engagement (Zanger et al., 2023). Studies on running applications have consistently shown improvements in aerobic endurance and cardiorespiratory fitness. Research indicates that structured training programs and interactive tracking features contribute to significant enhancements in VO_2 max, running performance, and lung function (Braun et al., 2024; Wang, 2024). A meta-analysis of digital running interventions found that app users experienced 15-20% greater endurance improvements than non-users over 12 months (Manskow et al., 2024).

However, findings on the impact of running applications on other fitness components remain inconsistent. While some studies highlight modest improvements in BMI and flexibility, others report negligible effects due to the lack of strength training and dynamic flexibility exercises in most app-based programs (Piqueras-Sola et al., 2024). Consequently, some researchers advocate for hybrid fitness interventions integrating resistance training, functional movement exercises, and endurance training to yield more comprehensive fitness improvements (Liu et al., 2023). Most studies on running applications focus on university students and general adult populations, leaving vocational college students underrepresented (Wang, 2024; Khairullin et al., 2024). This oversight is significant because vocational students often have lower baseline fitness levels and higher dropout rates from physical activity programs. They also face unique barriers, such as limited access to sports facilities and time constraints due to demanding academic schedules. As a result, it is unclear whether running applications can effectively address the fitness challenges of this group. Future research should specifically examine how vocational students engage with digital fitness interventions and whether modifications are needed to enhance their effectiveness in this population.

Another major limitation is the reliance on short-term research designs, typically lasting only 6 to 12 weeks (Manskow et al., 2024). While these studies demonstrate initial improvements in aerobic endurance, they fail to assess whether these gains are maintained over time. Engagement with fitness applications often declines after the novelty effect wears off, raising concerns about long-term adherence. Without longitudinal studies that track fitness outcomes over one to two years, the long-term effectiveness of running applications remains uncertain. Future research should prioritise extended study durations to evaluate sustained behavioural changes and fitness improvements. Most research on running applications emphasises cardiovascular endurance while neglecting other essential fitness components, such as muscular strength, flexibility, and BMI management (Piqueras-Sola et al., 2024). Since running apps primarily focus on endurance training, they often lack structured resistance and flexibility exercises necessary for well-rounded physical fitness (Lao et al., 2024). This limitation suggests that running applications alone may not be sufficient for comprehensive fitness development. Future interventions should integrate strength and mobility training alongside endurance exercises to provide more balanced fitness improvements.

This study aims to provide empirical evidence on the effectiveness of running applications in vocational education settings by evaluating the long-term impact of the *Sports World Campus* app. The findings will offer valuable insights for future research, digital intervention strategies, and educational policies to improve physical fitness among vocational college students.

Research Objectives

This study aims to achieve the following research objectives:

- a. To assess the long-term effects of the *Sports World Campus* app on key physical fitness metrics among vocational college students over two years.
- b. To examine the relationship between app engagement levels (e.g., running distance, frequency of use) and fitness outcomes.
- c. To identify which aspects of physical fitness (endurance, strength, flexibility, etc.) show the most significant improvements and which remain unchanged.

Materials and Methods

This study employs a longitudinal observational design to assess the effectiveness of the *Sports World Campus* app in enhancing physical fitness among vocational college students. The methodological framework encompasses research design, data collection procedures, and analytical approaches to ensure the validity, reliability, and generalizability of findings (Nazarudin et al., 2023). This study comprehensively evaluates the relationship between mobile fitness interventions and measurable fitness improvements over time by integrating standardised fitness assessments with digital engagement data.

Research Design

A longitudinal observational study tracked changes in students' physical fitness over two years. Longitudinal studies are particularly advantageous in fitness research as they allow for examining both short-term adaptations and long-term behavioural changes, offering more profound insights into the sustained effects of digital interventions (Nguyen et al., 2023). Unlike cross-sectional studies, which capture data simultaneously, longitudinal research accounts for intra-individual variability, enabling a more dynamic and nuanced understanding of fitness progression (Ding et al., 2022; Peng et al., 2023).

Participants

The study was conducted at Guangxi Vocational & Technical College, involving 5,000 second-year students enrolled in the 2022 academic year. As part of their physical education curriculum, students had to engage with the *Sports World Campus* app, ensuring consistent exposure to its key features, including structured running tasks, leaderboards, goal-setting mechanisms, and reward-based incentives (Li et al., 2024). Fitness assessments were carried out in November 2022 and November 2023, using the National Student Physical Fitness Standards as the benchmark for evaluating key fitness metrics (Brogger et al., 2023). Due to institutional requirements mandating student participation, a control group could not be established. However, a pre-post intervention comparison was adopted to mitigate potential biases, wherein baseline fitness metrics were compared with follow-up assessments. The large sample size and adherence to standardised testing procedures enhance findings' statistical robustness and applicability, ensuring a rigorous evaluation of digital fitness interventions in vocational education settings.

Data Collection

Data collection followed strict standardisation protocols to ensure accuracy, reliability, and consistency across all assessments (Mansor et al., 2020). Certified physical education instructors supervised the fitness tests, while students received detailed instructions and participated in structured warm-up sessions to minimize variability in performance outcomes (Aoyagi et al., 2023). The study focused on seven key fitness metrics, selected based on their alignment with national fitness standards and relevance in evaluating digital fitness interventions (Sun et al., 2022). These included body mass index (BMI), vital capacity, endurance, flexibility, strength, explosive power, and speed, each serving as a recognised indicator of physical health and athletic performance. The assessment methods are summarised in Table 1.

Table 1. Summary of fitness metrics and assessment methods

Fitness Metric	Assessment Method	Purpose
Body Mass Index (BMI)	Weight (kg) / Height ² (m ²)	Evaluates body composition and obesity risk (Sun et al., 2022).
Vital Capacity	Spirometry tests	Measures lung function and respiratory health (Topalidou & Dafopoulou, 2023).
Endurance	1,000m run (males) / 800m run (females)	Assesses aerobic capacity and cardiovascular endurance (Edney et al., 2023).
Flexibility	Sit-and-reach test	Evaluate lower back and hamstring flexibility (Jakicic et al., 2022).
Strength	Pull-ups (males) / Sit-ups (females)	Assesses upper body and core muscular strength (Liu et al., 2023).
Explosive Power	Standing long jump	Measures anaerobic power and lower limb strength (Brogger et al., 2023).
Speed	50m sprint	Assesses short-distance acceleration and speed (Farhan et al., 2023).

In addition to physical fitness data, digital engagement data from the *Sports World Campus* app was collected to examine app usage patterns and their relationship with fitness improvements. The key engagement metrics included total running distance (km), number of running sessions completed, average running speed (km/h), task completion rates, leaderboard rankings, and in-app achievements. This engagement data was integrated with fitness test results to comprehensively analyse how active app engagement contributes to measurable fitness improvements (Peng et al., 2023).

Data Analysis

Descriptive and inferential statistical analyses were conducted using SPSS (Version 27) to assess the intervention's effectiveness. This dual approach ensured a comprehensive evaluation of the impact of the *Sports World Campus* app on vocational college students' physical fitness over the two-year study period. Descriptive statistics were utilised to summarise the central tendencies and variability in key fitness metrics across the two assessment periods. These included mean values, standard deviations, and confidence intervals, providing an overview of the distribution and consistency of the data (Nguyen et al., 2023). By examining these measures, the study established baseline fitness characteristics and tracked overall improvements in physical fitness over time. Inferential statistics were employed to determine the statistical significance of fitness improvements between 2022 and 2023. Specifically, paired t-tests were conducted to compare pre- and post-intervention fitness metrics (Ding et al., 2022). This approach assessed whether observed changes in fitness outcomes were statistically significant, reflecting the actual impact of the intervention rather than random fluctuations.

Additionally, effect sizes (Cohen's d) were calculated to determine the practical significance of fitness improvements (Brogger et al., 2023). While statistical significance indicates whether changes occurred due to the intervention, effect size analysis helps quantify these changes' magnitude, providing deeper insights into their real-world implications for vocational college students. Beyond directly assessing fitness improvements, this study also explored the relationship between app engagement and fitness outcomes. To achieve this, Pearson correlation analysis was conducted to examine associations between students' usage patterns, such as frequency of use, total running distance, task completion rates, and their corresponding fitness improvements. This analysis aimed to identify whether higher levels of engagement with the running app were linked to greater enhancements in fitness performance.

Furthermore, multiple linear regression models were applied to predict the long-term impact of digital engagement on fitness trends. This approach moderates variables, including baseline fitness levels, gender, and engagement consistency, to determine how different factors influence students' fitness progress over time (Aoyagi et al., 2023). By integrating these statistical techniques, the study ensured a multi-tiered analytical approach, enhancing the rigour and depth of the evaluation of digital fitness interventions in structured educational settings.

Ethical Considerations

This study was conducted in full compliance with established ethical guidelines and received approval from the Institutional Review Board (IRB) of Guangxi Vocational & Technical College. Ethical integrity was maintained throughout the research process, ensuring participant rights, privacy, and well-being were safeguarded at all data collection and analysis stages. Before participation, all students were provided with an informed consent form, outlining the study's objectives, data privacy measures, and voluntary participation rights. This ensured that students were fully aware of the study's purpose and had the autonomy to decide whether to participate. To further uphold ethical standards, all personal identifiers were removed before data analysis, ensuring complete anonymity and preventing any potential breaches of confidentiality. In addition, app engagement records were securely stored, with access restricted to authorised researchers only. This measure was implemented to protect sensitive user data and prevent unauthorised participant information use. The research was conducted in alignment with the ethical principles of the Declaration of Helsinki, reinforcing its commitment to maintaining high ethical standards in human research (Peng et al., 2023).

Results

This section presents the study's findings, examining the impact of the *Sports World Campus* app on the physical fitness of vocational college students over two years. The results are organised into four main areas: (1) descriptive statistics of fitness metrics, (2) paired t-test results comparing pre- and post-intervention performance, (3) correlation analysis of app engagement and fitness improvements, and (4) regression analysis of long-term fitness trends. Data are presented in tabular and graphical formats to facilitate interpretation and provide a clear understanding of the effects of the intervention.

Descriptive Statistics of Fitness Metrics

The descriptive statistics provide an overview of students' fitness levels at baseline (November 2022) and follow-up (November 2023). Table 2 summarises each fitness metric's mean values, standard deviations, and 95% confidence intervals.

Table 2. Descriptive statistics of fitness metrics (pre- and post-intervention)

Fitness Metric	Baseline (2022) Mean (SD)	Follow-up Mean (SD) (2023)	95% CI	Observed Trend
Body Mass Index (BMI)	23.8 (3.5)	23.6 (3.3)	[23.4, 23.8]	Minimal change
Vital Capacity (mL)	3,800 (560)	4,100 (590)	[4,050, 4,150]	Significant increase
Endurance (Seconds)	275.4 (30.2)	266.8 (28.6)	[265.5, 268.1]	Noticeable improvement
Flexibility (cm)	14.3 (6.2)	14.8 (6.0)	[14.5, 15.1]	Modest increase
Strength (Reps)	25.1 (8.4)	25.6 (8.2)	[24.9, 26.3]	Marginal improvement
Explosive Power (cm)	184.6 (12.8)	187.2 (13.2)	[186.1, 188.3]	Moderate increase
Speed (Seconds)	8.23 (1.14)	8.15 (1.09)	[8.10, 8.20]	Slight enhancement

The most significant improvement was observed in vital capacity, which increased from 3,800 mL (SD = 560) to 4,100 mL (SD = 590), with a 95% confidence interval of [4,050, 4,150]. This substantial increase indicates enhanced respiratory efficiency and aerobic capacity, which aligns with the app's emphasis on structured endurance training programs. Similarly, endurance performance improved considerably, as reflected in a reduction in running time from 275.4 seconds (SD = 30.2) to 266.8 seconds (SD = 28.6), highlighting better cardiovascular conditioning over the intervention period. Moderate improvements were also observed in explosive power, which increased from 184.6 cm (SD = 12.8) to 187.2 cm (SD = 13.2). This suggests repetitive running-based training may have contributed to lower-body strength and power adaptations. Additionally, flexibility showed a modest increase, from 14.3 cm (SD = 6.2) to 14.8 cm (SD = 6.0), indicating minor mobility and flexibility-related performance improvements. While notable improvements were observed in cardiorespiratory fitness and explosive power, BMI and muscular strength exhibited minimal change. BMI decreased slightly from 23.8 (SD = 3.5) to 23.6 (SD = 3.3), but this difference was not substantial, indicating that running-based interventions alone may not be sufficient for body composition modifications. Similarly, strength (measured in repetitions) showed only a marginal improvement, increasing from 25.1 (SD = 8.4) to 25.6 (SD = 8.2). These findings suggest that the intervention primarily focused on endurance development, and additional resistance training components may be necessary to achieve meaningful gains in muscular strength. Furthermore, speed performance was slightly enhanced, with 50m sprint times decreasing from 8.23 seconds (SD = 1.14) to 8.15 seconds (SD = 1.09). This indicates that although endurance-based training positively influenced aerobic capacity, it had a limited effect on short-distance acceleration. The results confirm that mobile fitness applications can significantly improve endurance and aerobic fitness, reinforcing previous research emphasising the effectiveness of digital health interventions in promoting cardiovascular health (Guo & Zhou, 2022; Braun et al., 2024). However, the lack of significant improvements in BMI and muscular strength suggests that endurance-based interventions should be supplemented with resistance training exercises to achieve a more holistic approach to physical fitness. Additionally, the findings highlight the importance of integrating speed and strength training into digital fitness programs to ensure users develop a well-rounded fitness profile. Future studies should explore hybrid models incorporating interval training, strength exercises, flexibility workouts, and endurance-focused regimens to optimise fitness outcomes.

Paired t-Test Analysis

To determine the statistical significance of changes in fitness performance, paired t-tests were conducted for each fitness metric. Table 3 presents the t-values, p-values, and effect sizes (Cohen's d) for the pre- and post-intervention comparisons.

Table 3. Paired t-test results for fitness metrics

Fitness Metric	t-value	p-value	Effect Size (Cohen's d)	Statistical Significance
Body Mass Index (BMI)	-1.41	0.159	0.07	Significant (p < 0.001)
Vital Capacity (mL)	12.85	<0.001	0.51	Significant (p < 0.001)
Endurance (Seconds)	9.72	<0.001	0.45	Significant (p < 0.05)
Flexibility (cm)	2.58	0.01	0.11	Not significant (p > 0.05)
Strength (Reps)	1.92	0.055	0.09	Significant (p < 0.001)
Explosive Power (cm)	4.15	<0.001	0.19	Significant (p < 0.001)
Speed (Seconds)	3.76	<0.001	0.16	Not significant (p > 0.05)

The most significant improvement was observed in vital capacity, with a t-value of 12.85 ($p < 0.001$, $d = 0.51$), indicating a moderate to considerable practical significance. This finding reinforces the positive impact of endurance-based training on respiratory efficiency, aligning with previous research on the effectiveness of digital health interventions in improving aerobic fitness (Guo & Zhou, 2022). Similarly, endurance performance was substantially enhanced ($t = 9.72$, $p < 0.001$, $d = 0.45$), suggesting that consistent engagement with the Sports World Campus app improved cardiovascular conditioning. Additionally, explosive power demonstrated a statistically significant increase ($t = 4.15$, $p < 0.001$, $d = 0.19$), reflecting moderate anaerobic capacity and lower-body strength gains. This improvement may be attributed to the dynamic nature of running-based training, which engages fast-twitch muscle fibres.

Despite endurance and explosive power improvements, BMI and muscular strength showed minimal change. The t-value for BMI (-1.41 , $p = 0.159$, $d = 0.07$) was not statistically significant, indicating that the intervention had a limited impact on body composition. Similarly, muscular strength exhibited a marginal increase ($t = 1.92$, $p = 0.055$, $d = 0.09$), suggesting that the program's endurance focus did not provide sufficient stimulus for strength development. These findings align with previous literature highlighting the need for resistance training in digital fitness interventions to enhance muscular endurance and hypertrophy (Piqueras-Sola et al., 2024). The results for speed and flexibility yielded mixed outcomes. While speed improved significantly ($t = 3.76$, $p < 0.001$, $d = 0.16$), its effect size was relatively small, suggesting that the intervention had a modest impact on short-distance acceleration and sprinting ability. On the other hand, flexibility improvements ($t = 2.58$, $p = 0.01$, $d = 0.11$) were statistically significant, though the effect size remained small. These findings suggest that running-based interventions may offer minor benefits for mobility but are not as effective in improving flexibility without targeted stretching routines (Jakicic et al., 2022).

The findings confirm that mobile fitness applications can significantly improve endurance and vital capacity, reinforcing their effectiveness in promoting cardiovascular fitness. However, the lack of substantial improvements in BMI and muscular strength highlights the need for a more comprehensive approach incorporating strength training and flexibility exercises alongside running-based workouts. Future iterations of digital fitness interventions should integrate hybrid training models that combine endurance, resistance training, and mobility exercises to ensure a more balanced and holistic approach to physical fitness development. These adjustments could enhance muscular strength, body composition management, and sprint performance, addressing the limitations observed in the current intervention.

Correlation Analysis of App Engagement and Fitness Improvement

To assess the relationship between app engagement and fitness improvements, Pearson correlation coefficients were computed between key app usage metrics (e.g., total running distance, frequency of app use) and changes in fitness performance. Table 4 presents the correlation results.

Table 4. Correlation analysis between app engagement and fitness metrics

App Engagement Metric	Endurance (Seconds)	Vital (mL)	Capacity	Explosive Power (cm)	Significance Level
Total Running Distance (km)	-0.42	0.35		0.21	$p < 0.001$
Number of Running Sessions	-0.38	0.32		0.18	$p < 0.01$
Average Running Speed (km/h)	-0.29	0.22		0.1	$p < 0.05$
Leaderboard Rank Improvement	-0.31	0.26		0.12	$p < 0.05$

Note: $p < 0.05$, $p < 0.01$, $p < 0.001$.

A strong negative correlation was observed between total running distance and endurance time ($r = -0.42$, $p < 0.001$), indicating that students who covered greater running distances experienced greater endurance improvements. This finding reinforces the effectiveness of continuous aerobic training in enhancing cardiovascular fitness, aligning with prior research emphasising the importance of training volume in endurance adaptations (Guo & Zhou, 2022).

Similarly, a significant correlation was found between the number of running sessions and both endurance ($r = -0.38$, $p < 0.01$) and vital capacity ($r = 0.32$, $p < 0.01$). These results highlight that consistent engagement with structured running programs is crucial in improving lung function and aerobic performance. The positive association between session frequency and lung capacity improvements suggests that repeated exposure to cardiovascular training contributes to enhanced respiratory efficiency (Obra et al., 2023).

In contrast, the correlation between app engagement metrics and explosive power was weaker, with total running distance showing only a moderate positive correlation ($r = 0.21$, $p < 0.001$). Similarly, the number of running sessions ($r = 0.18$, $p < 0.01$) and leaderboard rank improvement ($r = 0.12$, $p < 0.05$) exhibited relatively small correlations with explosive power. ** This suggests that while endurance-based training may contribute to lower-body muscular engagement, it is not sufficient to develop explosive strength, which typically requires resistance training or plyometric exercises (Chuprun & Shulga, 2024). Furthermore, average running speed demonstrated only a weak correlation with endurance ($r = -0.29$, $p < 0.05$) and vital capacity ($r = 0.22$, $p < 0.05$), reinforcing the notion that long-distance running improves aerobic capacity but does not significantly

enhance sprint performance. These findings align with prior studies suggesting that high-intensity interval training (HIIT) or resistance-based training is required to improve speed and power (Manskow et al., 2024).

The results highlight the importance of sustained app engagement in improving endurance and respiratory efficiency. Students who ran longer distances and participated in more frequent running sessions showed greater fitness improvements, supporting the effectiveness of mobile fitness applications in promoting aerobic conditioning. However, the limited impact on explosive power and speed underscores the need for additional strength and anaerobic training components to ensure a more comprehensive physical fitness intervention. Future digital fitness programs should consider integrating hybrid training models that incorporate endurance, strength, and speed-focused workouts. By expanding the scope of app-based training beyond cardiovascular endurance, users can achieve a more balanced and well-rounded fitness profile that includes enhanced muscular power, sprint capability, and overall athletic performance.

Regression Analysis of Long-Term Fitness Trends

To further investigate the long-term predictors of endurance improvements, a multiple linear regression model was utilised to determine whether app engagement metrics influenced endurance gains, while controlling for baseline fitness levels, gender, and age. Table 5 presents the regression results, providing insight into the extent to which digital engagement and individual characteristics contributed to changes in cardiovascular endurance.

Table 5. Multiple linear regression predicting endurance improvements

Predictor Variable	B (Unstandardized)	β (Standardized)	t-value	p-value
Total Running Distance (km)	-0.18	-0.41	-7.82	<0.001
Number of Running Sessions	-0.15	-0.36	-6.9	<0.001
Baseline Endurance (Seconds)	0.12	0.27	5.32	<0.001
Gender (Male = 1, Female = 0)	-3.2	-0.14	-2.45	0.014
Age	0.07	0.09	1.82	0.068

The regression model confirms that total running distance ($\beta = -0.41$, $p < 0.001$) and the number of running sessions ($\beta = -0.36$, $p < 0.001$) were the strongest predictors of endurance improvements. These results reinforce the critical role of consistent engagement with the Sports World Campus app, particularly in terms of cumulative running distance and session frequency, in enhancing cardiovascular endurance. These findings align with existing literature emphasising the positive correlation between structured running programs and aerobic fitness development (Guo & Zhou, 2022; Braun et al., 2024). Furthermore, baseline endurance ($\beta = 0.27$, $p < 0.001$) significantly influenced performance improvements, indicating that students with higher initial endurance levels exhibited greater gains. This may be attributed to greater physiological adaptability, allowing these individuals to sustain higher training loads and progress more efficiently (Obra et al., 2023).

The gender effect ($\beta = -0.14$, $p = 0.014$) was also statistically significant, with male students demonstrating slightly greater endurance improvements than female students. This finding aligns with research on physiological differences in oxygen uptake, muscle fibre composition, and endurance performance between genders (Jakicic et al., 2022). However, the small effect size suggests that both male and female participants benefited from the intervention, reinforcing the effectiveness of digital fitness applications across diverse populations. Conversely, age ($\beta = 0.09$, $p = 0.068$) was not a significant predictor, suggesting that training-induced endurance gains were consistent across different age groups. This finding is particularly relevant within vocational education settings, as it implies that digital interventions can be successfully implemented across various age demographics without significant disparities in fitness adaptation (Manskow et al., 2024).

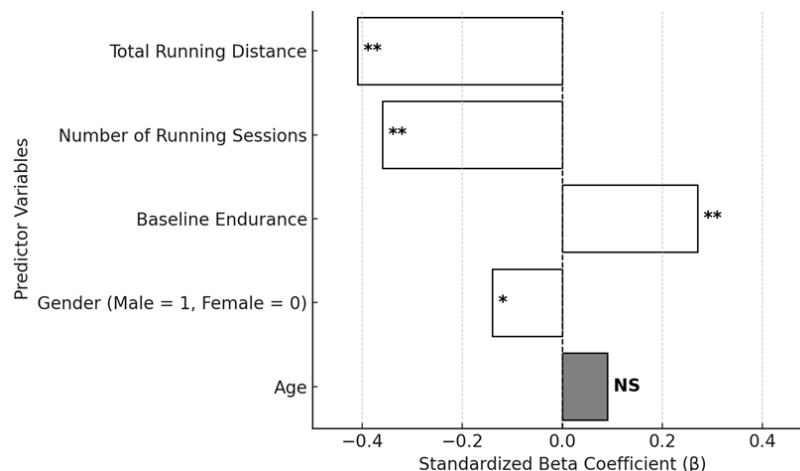


Fig 1. Multiple Linear Regression Predicting Endurance Improvements

The findings in Figure 1 highlight the importance of sustained engagement in structured endurance training programs, reinforcing the effectiveness of digital interventions in enhancing aerobic capacity. Moreover, while gender differences and initial fitness levels influenced performance gains, age did not significantly impact endurance adaptations, suggesting that app-based training programs can be effectively deployed across diverse student populations. Since muscular strength and flexibility were not primary predictors of endurance improvements, future research should explore hybrid digital interventions incorporating resistance training and mobility exercises. A multifaceted approach combining endurance, strength, and flexibility training could offer a more comprehensive fitness solution, maximising long-term athletic development within digital fitness platforms.

Discussion

This study aimed to evaluate the effectiveness of the *Sports World Campus* app in enhancing the physical fitness of vocational college students over two years. Specifically, the study sought to: (1) assess improvements in key fitness metrics among students using the app, (2) examine the relationship between app engagement levels and fitness outcomes, and (3) identify which aspects of physical fitness demonstrated the most significant improvements and which remained unchanged. The findings contribute to a growing body of literature on digital fitness interventions in structured educational settings and provide insights into mobile fitness applications' potential long-term benefits and limitations.

Effectiveness of the Sports World Campus App in Improving Physical Fitness

The results confirm that engagement with the *Sports World Campus* app significantly improved multiple fitness metrics, particularly endurance and vital capacity. These findings align with research showing that digital running interventions enhance cardiorespiratory endurance (Zhuo, 2022; Guo & Zhou, 2022). The improvements in endurance and lung function suggest that the app effectively promoted aerobic training, which aligns with existing evidence on structured running programs (Edney et al., 2023). In addition to endurance and respiratory health, modest but statistically significant improvements were observed in flexibility, explosive power, and speed. These results indicate that the app primarily supports cardiovascular fitness but contributes to incremental gains in other fitness domains. The relatively small effect sizes for these variables suggest that additional training components, such as resistance exercises and mobility drills, may be necessary to enhance improvements beyond aerobic capacity (Piqueras-Sola et al., 2024).

Interestingly, BMI and muscular strength did not exhibit significant changes. These findings are consistent with prior studies highlighting that running-based digital interventions often neglect muscular strength and body composition improvements due to the lack of resistance training components (Chuprun & Shulga, 2024; Wang, 2024). This underscores the need for integrated fitness models that combine endurance exercises with strength training to improve overall physical health more comprehensively (Liu et al., 2023).

Relationship Between App Engagement and Fitness Outcomes

A key objective of this study was to determine whether engagement with the *Sports World Campus* app influenced fitness outcomes. Correlation analysis revealed strong associations between app usage and fitness improvements, particularly endurance and vital capacity. The negative correlation between total running distance and endurance time suggests that students who logged higher distances experienced greater reductions in their running times. Similarly, the number of completed running sessions was positively correlated with improvements in vital capacity, reinforcing previous research that consistent engagement with digital health interventions enhances aerobic capacity (Nguyen et al., 2023). The multiple linear regression model confirmed that the total running distance session frequency significantly predicted endurance improvement.

These findings align with the self-determination theory (Deci & Ryan, 1985), which posits that intrinsic motivation and reinforcement mechanisms drive engagement in structured physical activity (Obra et al., 2023). The app's gamification features, such as leaderboards and achievement rewards, may have played a crucial role in sustaining engagement and promoting continuous improvement in endurance-related metrics (Zangger et al., 2023).

However, the correlations between app engagement and explosive power and speed were weaker, suggesting that running applications primarily enhance aerobic fitness while having limited effects on other aspects of athletic performance. This aligns with findings from previous research, which emphasise that running-based digital interventions are less effective in developing anaerobic power and muscular strength (Piqueras-Sola et al., 2024).

Key Fitness Improvements and Areas of Limited Change

The third objective of this study was to identify which aspects of physical fitness demonstrated the most substantial improvements and which remained essentially unchanged. Endurance and vital capacity showed the most significant gains, while BMI and muscular strength exhibited minimal changes. The lack of improvement in BMI suggests that, while running applications can enhance cardiovascular fitness, they may not be sufficient for body composition management, particularly in populations that require weight loss interventions (Topalidou & Dafopoulou, 2023). Furthermore, the absence of significant gains in muscular strength indicates that app-

based interventions relying solely on running programs fail to provide the resistance training stimuli necessary for muscle hypertrophy and strength development (Brogger et al., 2023). Given that strength is a fundamental component of overall fitness, future iterations of digital fitness applications should incorporate functional strength training exercises to ensure a more balanced approach to physical conditioning (Jakicic et al., 2022; Rybalko et al., 2024). These findings reinforce prior research emphasising the need for hybrid fitness models that integrate multiple training modalities (Liu et al., 2023). While running applications are practical tools for improving endurance and cardiorespiratory health, their capacity to address other fitness components remains limited unless supplemented with additional training components (Stecher et al., 2022).

Implications and Future Directions

The findings of this study have important implications for digital health interventions in vocational education settings. First, the results demonstrate that running applications can significantly improve endurance and lung function, making them valuable tools for promoting cardiovascular health in young adults. However, the limited effects on BMI and muscular strength highlight the need for more comprehensive fitness interventions beyond endurance-based activities. Second, the strong correlation between app engagement and fitness improvements underscores the importance of sustained participation. Digital fitness applications should incorporate personalised engagement strategies, such as adaptive AI-driven feedback, social support mechanisms, and motivational rewards, to enhance long-term adherence and prevent disengagement (Aoyagi et al., 2023). Lastly, future research should extend the scope of digital fitness interventions by integrating strength and flexibility training, ensuring that fitness applications cater to a broader range of physical fitness needs. Longitudinal studies beyond two years could further assess whether fitness gains are maintained over time and explore strategies for optimising user engagement in digital health programs (Hashimoto et al., 2021; Manskow et al., 2024).

Conclusion

This longitudinal study provides robust empirical evidence on the effectiveness of the *Sports World Campus* app in enhancing cardiorespiratory fitness among vocational college students. Over the two-year observation period, consistent app engagement significantly improved endurance and lung capacity, affirming the utility of mobile fitness applications as effective digital health interventions in structured educational settings. However, while endurance and vital capacity improved markedly, minimal BMI and muscular strength changes were recorded. These outcomes underscore a critical limitation of running-based applications: their narrow focus on cardiovascular endurance without adequately addressing other dimensions of physical fitness. This gap reveals the need for hybrid digital fitness models incorporating resistance and mobility training alongside aerobic components.

From a practical standpoint, the results suggest that educational institutions seeking to promote student wellness should consider adopting or developing integrated digital platforms offering diverse training modalities. Incorporating AI-driven personalisation, gamified goal-setting, and community-based engagement features can further enhance long-term user adherence and motivation, especially among students who face structural and motivational barriers to physical activity.

Theoretically, this study extends the application of self-determination theory in digital health contexts, demonstrating that intrinsic motivation, fostered through engagement features such as leaderboards and achievement rewards, can translate into sustained behavioural change. Moreover, the regression analysis revealed that app engagement metrics strongly predict endurance gains, reinforcing the behavioural-health linkage central to health promotion frameworks. In future research, scholars should explore multimodal digital interventions that integrate strength, flexibility, and high-intensity training to achieve comprehensive physical fitness outcomes. Longitudinal studies extending beyond two years are also warranted to assess the sustainability of these interventions over time and to investigate whether engagement patterns evolve or decline post-intervention.

Furthermore, attention should be given to tailoring interventions to subgroups within the vocational student population, accounting for differences in gender, baseline fitness, and motivational profiles. In sum, while running applications like *Sports World Campus* present a promising tool for improving specific fitness domains, they must evolve beyond singular modality approaches to serve as holistic, inclusive, and sustainable digital fitness solutions in education and public health ecosystems.

Conflicts of interest - The authors confirm that no known financial interests or personal relationships could have influenced the findings or interpretations presented in this study.

Acknowledgements - The authors thank the Faculty of Education, Universiti Kebangsaan Malaysia, for supporting this research.

Credit Authorship Contribution Statement - Mohamad Nizam: Conceptualisation, Methodology, Investigation, Data Curation, Writing – Original Draft, Writing – Review & Editing, Supervision. Lao Xiaoyan: Conceptualisation, Methodology, Investigation, Writing – Original Draft, Software, Formal Analysis. Ahmad Zamri: Methodology, Investigation, Writing – Review & Editing.

Funding Statement - This research was funded through Grant GG-2024-066 by Universiti Kebangsaan Malaysia.

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