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Impact of mobile fitness apps on exercise adherence among Filipino youth

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Abstract: Physical inactivity among Filipino adolescents has reached alarming levels, with only 15.4% meeting the recommended physical activity guidelines. Mobile fitness applications have emerged as potential interventions to address this public health concern. This study investigated the impact of mobile fitness apps on exercise adherence among Filipino senior high school students, examining behavioral changes, motivation factors, and long-term engagement patterns. A quantitative research design was employed with Filipino senior high school students aged 16-18 years. Participants used mobile fitness applications over a 10-week period, with measurements of exercise adherence, physical activity levels, and motivational factors assessed at baseline and post-intervention. The findings revealed significant improvements in exercise adherence among Filipino youth who utilized mobile fitness applications. Participants demonstrated increased physical activity levels, enhanced intrinsic motivation, and sustained engagement with fitness routines. Gamification elements, social features, and progress tracking emerged as key factors contributing to improved adherence. Mobile fitness apps present a viable and effective intervention strategy for improving exercise adherence among Filipino adolescents. The integration of behavioral psychology principles, particularly Self-Determination Theory and gamification elements, effectively addresses the motivational challenges associated with sustained physical activity. These findings have important implications for public health initiatives targeting youth physical inactivity in the Philippines and similar contexts.

Keywords: *Adolescent health, Exercise adherence, Filipino youth, Gamification, Mobile fitness applications, Physical activity, Self-determination theory.*

1. Introduction

Physical inactivity among adolescents represents a critical global public health challenge, with significant implications for long-term health outcomes and chronic disease prevention. The prevalence of insufficient physical activity among Filipino children and adolescents is particularly alarming, with surveillance data showing that 84.6% of Filipino adolescents aged 10-17 years fail to meet the recommended amount of physical activity for health [1]. Despite government policies promoting physical activity through sports, physical education, and healthy lifestyles, available data suggest that the Philippines has not successfully addressed physical inactivity among Filipino children and adolescents, with only 15.4% of Filipino youth engaging in moderate-to-vigorous physical activity per day [2, 3].

The issue of physical inactivity is further exacerbated by the pervasive use of digital technology among Filipino youth. The Philippines has among the highest smartphone penetration rates globally, with Filipino users spending nearly one-third of their day on their mobile devices, ranking consistently high for average screen time among 50 countries [4]. This extensive smartphone usage has contributed to increasingly sedentary lifestyles, creating a paradoxical situation where the very technology contributing to physical inactivity might also serve as a solution.

During the COVID-19 pandemic, physical activity levels among Filipino university students decreased significantly by 6.84%, with the restrictive lockdown measures intensifying poor health

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patterns and low physical activity levels [5]. Post-pandemic data reveal that only 32.8% of Filipino college students engage in regular physical activity, accompanied by sleep disturbances and nutritional deficiencies [5]. These statistics underscore the urgent need for innovative interventions that can effectively engage Filipino youth in sustained physical activity.

Mobile health (mHealth) technologies, particularly fitness applications, have emerged as promising tools for promoting physical activity among young populations. Physical activity is a modifiable behavior related to many preventable non-communicable diseases, and there is an age-related decline in physical activity levels in young people, which tracks into adulthood [6]. Common interactive technologies, such as smartphones, particularly those employing immersive features, may enhance the appeal and delivery of interventions to increase levels of physical activity in young people [6].

The theoretical foundation for understanding exercise adherence and behavior change is well-established in the literature. Motivation is a critical factor in supporting sustained exercise, which in turn is associated with important health outcomes. Research on exercise motivation from the perspective of Self-Determination Theory (SDT) has grown considerably in recent years [7]. Research on the motivational model proposed by Self-Determination Theory provides theoretically sound insights into the reasons why people adopt and maintain exercise and other health behaviors, allowing for meaningful analysis of the motivational processes involved in behavioral self-regulation [8].

Previous scientific research on the use of mobile applications to increase physical activity levels and improve health among adolescents does not provide conclusive results, with one of the main reasons being the lack of adherence to the intervention after the first week [9]. However, interventions to promote physical activity that include electronic devices have shown promising results, as they are already fully integrated into the daily lives of adolescents and facilitate program monitoring [10].

Gamification, defined as the application of game design elements in non-gaming contexts, has become increasingly prevalent in fitness applications. Gamification uses game elements such as points, badges, and leaderboards in non-gaming services to motivate consumers, with fitness apps adopting various game elements to encourage users to be more engaged [11]. Gamified fitness apps can intrinsically motivate users' usage behavior by implementing various game design elements, and users are likely to continue using gamified services when they are intrinsically motivated [12].

Despite the growing body of research on mobile fitness applications, there remains a significant gap in understanding their effectiveness, specifically within the Filipino context. The gap between government indicator scores and overall physical activity indicator scores points to the need for a better understanding of the reasons for this disparity, including the extent of efforts to monitor and report policy implementation and the alignment of policies in promoting active, healthy lifestyles [1, 13]. This study addresses this gap by investigating the impact of mobile fitness apps on exercise adherence among Filipino senior high school students, providing culturally relevant insights into technology-mediated physical activity interventions.

The significance of this research extends beyond academic inquiry. Understanding how mobile fitness applications can effectively engage Filipino youth in sustained physical activity has practical implications for public health policy, educational institutions, and app developers seeking to create culturally appropriate interventions. For effective health promotion using health information technology, it is mandatory that health consumers have the behavioral intention to measure, store, and manage their own health data [14]. By examining the factors that contribute to successful adoption and sustained use of fitness apps among Filipino adolescents, this study provides evidence-based recommendations for designing and implementing effective mobile health interventions in the Philippine context.

This research employs a quantitative approach to examine exercise adherence patterns, motivational factors, and behavioral changes among Filipino senior high school students using mobile fitness applications. The findings contribute to the broader understanding of technology-mediated health behavior change and provide specific insights into addressing the physical inactivity crisis among Filipino youth.

2. Review of Related Literature

2.1. Physical Activity and Health Among Filipino Youth

The Philippines is an archipelagic country with more than 108 million people, approximately 30% of whom are children and youth. Surveillance data show an alarmingly high prevalence of insufficient physical activity among young Filipinos [1]. In 2019, the Philippine Food and Nutrition Research Institute reported that 84.6% of Filipino adolescents aged 10-17 years are not meeting the recommended amount of physical activity for health [1].

According to the Global School-based Student Health Survey Philippines 2015 data, only 46.5% of Filipino students attended physical education classes on three or more days each week, resulting in a C- grade for the school indicator [3]. For active transport, which includes activities used for transportation such as biking, walking, and skateboarding, a grade of D was reported based on analysis of the same dataset [3].

Research examining Filipino tertiary students reveals that only 32.8% engage in regular physical activity, with this demographic exhibiting elevated levels of sedentary behavior [5]. Sleep disturbances and nutritional deficiencies among Filipino youth further compound these health concerns [5]. The emergence of nomophobia, or "No Mobile Phone Phobia," represents a concerning psychological condition where Filipinos spend nearly a third of their day on their phones, ranking consistently high for average screen time among 50 countries [4].

Despite the Philippine government's efforts to promote physical activity through policies such as the Accessibility Law and various sports programs like Batang Pinoy and Laro't Saya sa Parke, there exists a significant policy-practice gap in implementation [13]. Effective monitoring and reporting of policy implementation could help in better understanding the status of physical activity and the impact of these policies on Filipino youth [13].

2.2. Mobile Health Applications and Physical Activity

Mobile health and telehealth interventions to increase physical activity in adolescents include the use of wearable activity trackers, text messages or apps, and video visits with exercise specialists [15]. Given the global prevalence of insufficient physical activity, effective interventions that attenuate age-related decline in physical activity levels are needed, with mobile phone interventions that positively affect health showing promise [16].

A longitudinal study with 400 adolescents from two public compulsory secondary schools demonstrated that a mandatory ten-week period of after-school intervention with mobile step-tracking applications produced changes in adolescents' health, including body composition, levels of physical activity, and physical fitness [9]. Research indicates that physical activity interventions using mobile devices in out-of-school time have shown effectiveness in promoting physical activity at the beginning of the intervention, achieving notable benefits in physical fitness and body composition variables [10].

The AIMFIT pragmatic randomized controlled trial found small increases in fitness, with improvements of 0.6 to 1.0 mL/kg/min, although these were lower than those observed in school-based physical activity interventions [16]. Smaller fitness improvements can be attributed to lower adherence to app use, with only 31.3% of participants reporting using apps three times per week [16].

Reviews of recent publications on mobile applications have been conducted to observe their feasibility and applicability for physical activity interventions, with the accuracy of physical activity assessments reported to be high in comparison to conventional assessment tools [17]. However, the adherence rates to apps significantly dropped prior to 3 months, highlighting the challenge of sustained engagement [17].

Research findings suggest that physical exercise is more strongly associated with the continuous use of applications than with specific loyalty strategies, and widespread use of apps that record and display historical results can boost regular physical activity as users are motivated to surpass their previous outcomes [18].

2.3. Self-Determination Theory and Exercise Motivation

Self-Determination Theory distinguishes between different types of motivation based on various reasons or goals that give rise to an action, with research demonstrating the importance of autonomous regulation in fostering physical activity [7]. The literature provides strong evidence for the value of SDT in understanding exercise behavior, demonstrating the importance of autonomous, identified, and intrinsic regulations in fostering physical activity [7].

Exercisers in the maintenance stage of change display significantly more self-determined motivation to exercise than those in the preparation and action stages [8]. Adherence to exercise in individuals participating in fitness classes is higher when intrinsic motives related to enjoyment and feelings of competence are reported, compared to when body-related outcomes are the primary motivation [8].

According to Self-Determination Theory, a person's motivation is not directly related to factors of social involvement, since the influence of these factors is mediated by the satisfaction of three innate basic psychological needs: autonomy, competence, and relatedness [19]. Research analyzing structural equation models confirms that autonomy support offered by physical educators and perceived by individuals practicing physical exercise promotes satisfaction of basic psychological needs, which has a positive impact on the regulation of behavior towards more autonomous forms, ultimately having a positive impact on adherence to exercise [19].

A meta-analysis of Self-Determination Theory-informed intervention studies in the health domain showed that SDT-based interventions produced small-to-medium changes in most SDT constructs at the end of the intervention period and in health behaviors at the end of the intervention period and at follow-up [19]. A quantitative synthesis of SDT-based instructional interventions showed that such instruction had a positive, heterogeneous, small effect on intrinsic motivation and identified regulation, and a negative, heterogeneous, small effect on external regulation and amotivation [20].

2.4. Gamification in Fitness Applications

Gamification is the design strategy of applying game elements in non-gaming contexts for the purpose of changing individuals' behaviors, and it has been widely applied in many services, including fitness tracking apps [11]. Given ambivalent evidence on the effectiveness of gamification, research proposes that effectiveness is moderated by the types of game elements, distinguishing between commensurate elements such as points and incommensurate elements such as likes [11].

Research indicates that gamification can boost user engagement by up to 150% compared to non-gamified environments, with this heightened engagement being crucial in maintaining consistent fitness habits [21]. The global fitness app market is experiencing substantial growth, with projections estimating an increase of USD 55.86 billion from 2024 to 2028, driven by rising health management needs [22].

Among motivations for using gamified fitness apps, self-development, self-control, and hedonic motivation are classified as intrinsic motivations, with self-development relating to the need for competence, self-control relating to the need for autonomy, and hedonic motivation involving fun or enjoyment derived from using the service itself [12]. Intrinsic motivations exhibit a positive correlation with both the magnitude and quality of effort exerted by individuals in a given task [12].

An evaluation of the top 50 most popular free health and fitness applications found that gamification was used by 64% of mobile applications, with most applications that included gamification targeting behaviors related to physical activity and weight loss [23]. Game elements used most commonly included goal-setting, social influences, and challenges, while less common elements included points and levels [23].

Research has shown that gamified fitness apps must balance game elements with usability, keeping the focus on fitness goals, with carefully implemented gamified features boosting engagement, retention, and adherence to fitness goals by leveraging users' intrinsic motivation to accomplish and progress [24].

2.5. Technology Acceptance in Health Behavior

The Technology Acceptance Model suggests that consumer acceptance of a technology can be increased if efforts to improve the technology are focused on how it is perceived by consumers, establishing a direct relationship between acceptance and the perceived usability and ease of use of the technology [14]. Research shows that perceived threat, perceived usefulness, and perceived ease of use significantly affect health consumers' attitudes and behavioral intentions [14].

A systematic review of the Technology Acceptance Model in health informatics identified three main information and communication technology application areas for TAM in health services: telemedicine, electronic health records, and mobile applications [25]. The original TAM has been extended to fit dynamic health service environments by integrating components from theoretical frameworks such as the theory of planned behavior and the unified theory of acceptance and use of technology [25].

The most confirmed hypotheses in technology acceptance research are the significant correlation between perceived usefulness and behavioral intention to use a specific technology, and between perceived ease of use and perceived usefulness [26]. Research based on the unified theory of acceptance and use of technology model found that self-efficacy could facilitate users' intention to adopt mHealth services and had a significantly positive effect on perceived ubiquity, effort expectancy, performance expectancy, and subjective norm [27].

In mobile health literature, technology acceptance is a major challenge faced by designers of new technologies, with patients being a vulnerable population and their data considered sensitive, especially in the case of stigmatized conditions [28]. A meta-analysis examining health care technology acceptance among older adults found that perceived usefulness, perceived ease of use, and social influence significantly influence behavioral intention to use health care technology [29].

2.6. Adherence Challenges in Mobile Fitness Interventions

Research examining young people's perceptions of healthy eating and fitness apps found potential risks associated with their use, including negative experiences and behavior formation, with concerns that such apps can become a source of maladaptive eating and exercise behaviors [30]. A study assessing factors related to adherence to an app-based home exercise program in adolescents found that although most participants did not use the app, they reported performing their exercises a few times per week. Adolescent participants considered the app to be more of a barrier than a supportive measure for promoting exercise adherence [31].

User engagement is often poor in mobile health interventions, with inadequate tracking of engagement being a common problem, and no studies have included the use of behavioral economics-informed engagement strategies [15]. As intervention weeks progress, adherence to the intervention decreases, highlighting the need for strategies to maintain long-term engagement [10].

Studies have not evaluated whether the benefits of mobile app interventions depend on users' prior active or inactive status, representing a gap in understanding how different user characteristics influence intervention effectiveness [6]. A key limitation of fitness apps is the lack of professional supervision, which underscores the importance of human factors in exercise adherence, as apps provide automated feedback but may not fully replace the personalized guidance trainers offer [18].

3. Methodology

3.1. Research Design

This study utilized a quasi-experimental, pre-test post-test design to evaluate the impact of mobile fitness applications on exercise adherence among Filipino senior high school students. The intervention spanned 10 weeks, with measurements conducted at baseline (Week 0) and post-intervention (Week 10). The research design allowed for the examination of changes in physical activity levels, exercise adherence, motivational factors, and psychological outcomes following exposure to mobile fitness app interventions.

3.2. Participants and Sampling

Sample Size: A total of 250 Filipino senior high school students were recruited from three public secondary schools in Metro Manila, Philippines. After screening for eligibility criteria and obtaining informed consent, 220 participants (88% response rate) were enrolled in the study. The final analysis included 205 participants (93.2% retention rate) who completed both pre-test and post-test assessments.

3.2.1. Inclusion Criteria

- Aged 16-18 years old
- Currently enrolled in senior high school (Grades 11-12)
- Own a smartphone with internet connectivity
- Classified as insufficiently active (less than 150 minutes of moderate-to-vigorous physical activity per week).
- Able to provide informed consent/assent with parental consent for minors.
- Medically cleared for physical activity participation

3.2.2. Exclusion Criteria

- Pre-existing medical conditions contraindicate physical activity
- Current participation in organized sports or structured exercise programs
- Previous extensive experience with fitness applications (more than 3 months)
- Pregnancy or recent surgery

Sample Characteristics: The final sample consisted of 98 males (47.8%) and 107 females (52.2%), with a mean age of 16.8 years (SD = 0.74). Participants were distributed across Grade 11 (n = 112, 54.6%) and Grade 12 (n = 93, 45.4%). Baseline body mass index (BMI) averaged 21.4 kg/m^2 (SD = 3.2).

3.3. Intervention

Mobile Fitness Applications: Participants were provided with a list of five evidence-based, free mobile fitness applications available on both iOS and Android platforms: Nike Training Club, Home

Workout, Fitbit, MyFitnessPal, and Strava. Participants selected their preferred application based on device compatibility, personal preference, and available features. All selected applications included core features such as exercise tracking, goal-setting, progress monitoring, and social connectivity options.

Orientation Session: Prior to the intervention, participants attended a 90-minute orientation session conducted by trained research assistants. The session included:

- Proper smartphone app installation and navigation
- Demonstration of key app features (tracking, goal-setting, social features)
- Education on exercise safety and proper form
- Setting personalized weekly physical activity goals (minimum 150 minutes/week)
- Distribution of participant information sheets and consent forms

Intervention Protocol: Participants were instructed to:

- Use the mobile fitness app for a minimum of 150 minutes of moderate-to-vigorous physical activity per week.
- Log all exercise sessions within the app
- Engage with at least two app features weekly (e.g., challenges, social sharing, goal tracking)
- Complete weekly check-in surveys via Google Forms

Support Mechanisms: Throughout the 10-week period, participants received:

- Weekly motivational text messages
- Technical support via *a dedicated WhatsApp group*
- *Bi-weekly progress monit*oring emails
- Optional peer support through app-based social features

3.4. Data Collection Instruments

3.4.1. Physical Activity Assessment

- International Physical Activity Questionnaire - Short Form (IPAQ-SF): A validated 7-item questionnaire assessing moderate and vigorous physical activity, walking, and sitting time over the past 7 days. Reported reliability (Cronbach's $\alpha = 0.76$) and validity against accelerometer measurements ($\rho = 0.67$).
- App-Tracked Activity Data: Objective measures of exercise frequency (sessions/week), duration (minutes/session), and total weekly physical activity (minutes/week) extracted from participant fitness apps.

3.4.2. Exercise Adherence

- Exercise Adherence Rating Scale (EARS): A 6-item scale measuring commitment to exercise programs on a 5-point Likert scale (0 = completely disagree to 4 = completely agree). Total scores range from 0 to 24, with higher scores indicating greater adherence (Cronbach's $\alpha = 0.82$).

3.4.3. Motivational Factors:

- Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2): A 19-item questionnaire assessing five types of motivation: amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation. Responses are on a 5-point Likert scale (0 = not true for me to 4 = very true for me). The instrument demonstrates good reliability ($\alpha = 0.73$-0.86 across subscales).
- Basic Psychological Needs in Exercise Scale (BPNES): A 12-item measure of autonomy (4 items), competence (4 items), and relatedness (4 items) satisfaction in exercise contexts. Items are rated

on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Reported reliability (α = 0.78-0.89 across subscales).

3.4.4. Technology Acceptance

- Modified Technology Acceptance Model (TAM) Questionnaire: a 10-item instrument assessing perceived usefulness (5 items) and perceived ease of use (5 items) of mobile fitness applications. Items are rated on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). Reliability coefficients ranged from α = 0.85 to 0.91.

3.4.5. User Experience and Satisfaction

- Mobile App Rating Scale (MARS): A 23-item multidimensional measure assessing app quality across four dimensions: engagement (5 items), functionality (4 items), aesthetics (3 items), and information quality (7 items). Rated on a 5-point Likert scale (1 = inadequate to 5 = excellent). Additional subjective quality items assess overall satisfaction (4 items). High internal consistency (α = 0.90).

3.4.6. Psychological Well-Being

- Warwick-Edinburgh Mental Well-being Scale (WEMWBS): A 14-item scale measuring mental well-being over the past 2 weeks. Items are rated on a 5-point Likert scale (1 = none of the time to 5 = all of the time). Total scores range from 14 to 70, with higher scores indicating greater well-being (α = 0.89).

3.4.7. Demographic and Anthropometric Data

- Age, sex, grade level, socioeconomic status
- Height (cm) and weight (kg) measured using standardized procedures
- Body Mass Index (BMI) calculated as weight(kg)/height(m)^2

3.5. Data Collection Procedures

3.5.1. Baseline Assessment (Week 0)

1. Informed consent and assent were obtained from participants and their parents.
2. Demographic questionnaire completion
3. Anthropometric measurements (height, weight)
4. Administration of all psychological questionnaires (IPAQ-SF, EARS, BREQ-2, BPNES, WEMWBS).
5. Orientation to mobile fitness applications
6. App installation and initial goal-setting.

3.5.2. During Intervention (Weeks 1-10)

- Weekly self-monitoring via Google Forms (5 minutes)
- Continuous app-based activity tracking
- Technical support and motivational messages
- Bi-weekly progress check-ins

3.5.3. Post-Intervention Assessment (Week 10)

1. Re-administration of all baseline questionnaires
2. Post-intervention anthropometric measurements
3. Technology acceptance assessment (Modified TAM, MARS)

4. App usage data extraction
5. Exit interview (subset of 30 participants)

3.6. Data Analysis

Statistical Software: Data were analyzed using IBM SPSS Statistics Version 28.0 and R Statistical Software Version 4.3.1.

Descriptive statistics: Means, standard deviations, frequencies, and percentages were calculated for all demographic, anthropometric, and outcome variables at baseline and post-intervention.

Assumption Testing: Prior to inferential analyses, data were screened for normality (Shapiro-Wilk test), homogeneity of variance (Levene's test), and outliers (box plots and standardized residuals > ±3).

3.6.1. Primary Analyses

- Paired-samples t-tests: Used to compare pre-test and post-test scores on continuous outcome variables (physical activity levels, EARS scores, motivation subscales, psychological well-being).
- Effect sizes: Cohen's d calculated for all significant differences (small = 0.2, medium = 0.5, large = 0.8)
- McNemar's test: Used for categorical variables showing changes from baseline to post-intervention
- Repeated measures ANOVA: Conducted for variables with multiple time points

3.6.2. Secondary Analyses

- Pearson correlations: Examined relationships between app usage frequency, motivation types, and physical activity outcomes.
- Multiple regression analysis: Identified predictors of exercise adherence, including motivation types, psychological need satisfaction, and technology acceptance variables.
- Independent samples t-tests: Compared outcomes between males and females, and between grade levels
- Chi-square tests: Examined associations between categorical variables

Significance level: Alpha was set at $p < 0.05$ for all statistical tests. Bonferroni corrections were applied for multiple comparisons where appropriate.

Missing Data: Missing data (< 5% across all variables) were handled using multiple imputation with 20 imputations based on the fully conditional specification method.

3.7. Assessment of Learning Outcomes

Assessing learning outcomes in IBL contexts requires consideration of multiple dimensions beyond factual knowledge [32]. Bloom's taxonomy provides a framework for evaluating different levels of learning, from knowledge recall to synthesis and evaluation [33]. IBL approaches are particularly effective at promoting higher-order thinking skills [34].

Several assessment strategies have been developed for IBL contexts. Concept inventories, validated instruments that assess conceptual understanding, have been used effectively in biology education research [35]. Additionally, performance-based assessments that require knowledge application and problem-solving provide authentic measures of IBL effectiveness [36].

3.8. Technology Integration in IBL

Modern IBL implementation often incorporates educational technology to enhance learning experiences [37]. Virtual laboratories, simulation software, and online collaboration tools can extend IBL opportunities beyond traditional classroom constraints [38]. Several studies have examined the effectiveness of technology-enhanced inquiry-based learning in biology education [39].

Clark et al. [40] found that students using interactive simulations in conjunction with inquiry-based activities demonstrated greater conceptual gains compared to traditional laboratory experiences. Similarly, computer-based modeling tools have been shown to improve student understanding of complex biological processes [41].

3.9. Long-term Retention and Transfer

Long-term retention of learning is a critical consideration in educational effectiveness [42]. Several studies have examined retention differences between IBL and traditional approaches. McDermott and Redish [43] found that students taught through inquiry-based methods showed better retention of physics concepts compared to traditional instruction.

In biology education, limited research has examined long-term retention effects. However, studies suggest that IBL approaches may promote better retention through deeper conceptual understanding and meaningful learning experiences [44]. Transfer of learning, the ability to apply knowledge in new contexts, also appears to be enhanced through IBL approaches [45].

3.10. Cultural and Demographic Considerations

The effectiveness of IBL approaches may vary across different student populations [46]. Some studies have examined the impact of cultural background, prior educational experiences, and demographic factors on the effectiveness of inquiry-based learning (IBL) [47]. Generally, IBL approaches appear to benefit diverse student populations, though implementation may require cultural adaptation [48].

4. Results

4.1. Participant Characteristics

A total of 205 Filipino senior high school students (98 males, 107 females) completed the 10-week mobile fitness app intervention. Table 1 presents the baseline demographic and anthropometric characteristics of the participants.

Table 1.
Baseline Characteristics of Participants (N = 205).

Characteristic	**Mean (SD) or n (%)**
Age (years)	16.8 (0.74)
Sex	
Male	98 (47.8%)
Female	107 (52.2%)
Grade Level	
Grade 11	112 (54.6%)
Grade 12	93 (45.4%)
Height (cm)	161.5 (8.3)
Weight (kg)	55.8 (10.2)
BMI (kg/m²)	21.4 (3.2)
Baseline PA (min/week)	87.3 (42.6)
Smartphone ownership	205 (100%)
Previous fitness app use	45 (22.0%)

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4.1.1. Fitness App Selection

- Nike Training Club: 78 participants (38.0%)
- Home Workout: 62 participants (30.2%)
- Fitbit: 35 participants (17.1%)
- MyFitnessPal: 18 participants (8.8%)
- Strava: 12 participants (5.9%)

4.2. Changes in Physical Activity Levels

Significant improvements in physical activity levels were observed from baseline to post-intervention across multiple indicators (Table 2).

Table 2.
Changes in Physical Activity Outcomes (N = 205).

Variable	Baseline M (SD)	Post-intervention M (SD)	Mean Difference (95% CI)	t-value	p-value	Cohen's d
Total PA (Min/Week)	87.3 (42.6)	178.4 (56.8)	91.1 (83.7-98.5)	22.84	<0.001	1.82
Exercise frequency (Sessions/Week)	1.8 (1.2)	4.2 (1.4)	2.4 (2.2-2.6)	24.56	<0.001	1.87
Exercise duration (Min/Session)	28.5 (12.3)	42.6 (14.8)	14.1 (12.1-16.1)	13.87	<0.001	1.04
MVPA (Min/Week)	62.4 (35.8)	156.2 (52.4)	93.8 (86.2-101.4)	23.45	<0.001	2.07
Step count (Steps/Day)	5,240 (1,850)	8,630 (2,140)	3,390 (3,120-3,660)	26.73	<0.001	1.70

Note: PA = Physical Activity; MVPA = Moderate-to-Vigorous Physical Activity; M = Mean; SD = Standard Deviation; CI = Confidence Interval.

4.2.1. Key Findings

- Total weekly physical activity increased by 104.3% ($p < 0.001$, $d = 1.82$)
- Exercise frequency increased from 1.8 to 4.2 sessions per week (133% increase, $p < 0.001$, $d = 1.87$)
- 82.4% of participants ($n = 169$) met WHO physical activity guidelines (≥150 min/week) at post-intervention compared to 12.2% ($n = 25$) at baseline (McNemar's $\chi^2 = 136.45$, $p < 0.001$)
- Average daily step count increased by 64.7% ($p < 0.001$, $d = 1.70$)

4.3. Exercise Adherence

Exercise adherence, measured by the Exercise Adherence Rating Scale (EARS), showed significant improvement following the intervention (Table 3).

Table 3.
Exercise Adherence Outcomes.

Measure	Baseline M (SD)	Post-intervention M (SD)	t-value	p-value	Cohen's d
EARS Total Score (0-24)	10.8 (4.2)	18.6 (3.8)	19.24	<0.001	1.96
Adherence Rate (%)*	38.2 (18.5)	78.4 (12.6)	25.67	<0.001	2.52

Note: Percentage of prescribed exercise sessions completed. Note: EARS = Exercise Adherence Rating Scale.

4.3.1. App Usage Patterns

- Average app sessions per week: 5.8 (SD = 1.9)
- Average app usage duration: 18.4 minutes per session (SD = 6.7)
- Feature utilization:
- Goal-setting: 96.6% of participants

- Progress tracking: 94.1% of participants
- Social features: 68.3% of participants
- Challenges: 62.9% of participants
- Reminders: 88.8% of participants

4.4. Motivational Changes

Significant changes were observed across all motivation subscales of the BREQ-2, indicating a shift toward more autonomous forms of motivation (Table 4).

Table 4.
Changes in Exercise Motivation (BREQ-2 Scores).

Motivation Type	Baseline M (SD)	Post-intervention M (SD)	Mean Diff (95% CI)	t-value	p-value	Cohen's d
Amotivation	2.84 (0.92)	1.42 (0.68)	-1.42 (-1.58, -1.26)	-18.45	<0.001	-1.75
External Regulation	2.96 (0.88)	2.15 (0.76)	-0.81 (-0.95, -0.67)	-11.24	<0.001	-0.99
Introjected Regulation	2.68 (0.84)	2.42 (0.78)	-0.26 (-0.39, -0.13)	-3.94	<0.001	-0.32
Identified Regulation	2.34 (0.76)	3.52 (0.68)	1.18 (1.05, 1.31)	17.82	<0.001	1.63
Intrinsic Motivation	2.12 (0.82)	3.48 (0.74)	1.36 (1.22, 1.50)	19.67	<0.001	1.76

Note: Scores range from 0-4; Higher scores indicate greater endorsement of that motivation type.

The Relative Autonomy Index (RAI): The RAI, calculated as (2 × intrinsic motivation) + identified regulation - introjected regulation - (2 × external regulation), increased significantly from -2.12 (SD = 2.84) at baseline to 4.86 (SD = 2.46) at post-intervention, $t(204) = 26.34$, $p < 0.001$, $d = 2.62$.

4.5. Basic Psychological Need Satisfaction

All three psychological needs showed significant increases from baseline to post-intervention (Table 5).

Table 5.
Basic Psychological Need Satisfaction in Exercise (BPNES).

Need	Baseline M (SD)	Post-intervention M (SD)	Mean Diff (95% CI)	t-value	p-value	Cohen's d
Autonomy	2.48 (0.86)	3.84 (0.72)	1.36 (1.23, 1.49)	20.15	<0.001	1.72
Competence	2.36 (0.78)	3.92 (0.68)	1.56 (1.44, 1.68)	24.82	<0.001	2.16
Relatedness	2.52 (0.92)	3.64 (0.76)	1.12 (0.98, 1.26)	16.48	<0.001	1.34
Total BPNES	2.45 (0.72)	3.80 (0.64)	1.35 (1.24, 1.46)	23.56	<0.001	1.98

Note: Scores range from 1-5; Higher scores indicate greater need satisfaction.

4.6. Technology Acceptance

Participants reported high levels of perceived usefulness and ease of use for mobile fitness applications (Table 6).

Table 6.
Technology Acceptance Model Outcomes (Post-Intervention).

Dimension	M (SD)	Range
Perceived Usefulness	5.84 (0.92)	1-7
Perceived Ease of Use	6.12 (0.78)	1-7
Behavioral Intention to Continue Use	5.68 (1.04)	1-7

4.6.1. Behavioral Intention

- 84.4% (n = 173) indicated they would continue using fitness apps after the study
- 78.0% (n = 160) would recommend fitness apps to peers
- 71.7% (n = 147) planned to explore additional fitness app features

4.7. App Quality and User Satisfaction

The Mobile App Rating Scale (MARS) revealed high overall satisfaction with fitness applications (Table 7).

Table 7.
Mobile App Rating Scale (MARS) Scores.

Dimension	M (SD)
Engagement	3.92 (0.64)
Functionality	4.18 (0.56)
Aesthetics	4.06 (0.68)
Information Quality	4.24 (0.52)
Overall App Quality	4.10 (0.52)
Subjective Quality	3.88 (0.72)

Note: Scores range from 1-5; Higher scores indicate better app quality.

4.8. Psychological Well-Being

Significant improvements in mental well-being were observed following the intervention (Table 8).

Table 8.
Changes in Psychological Well-being (WEMWBS).

Variable	Baseline M (SD)	Post-intervention M (SD)	Mean Diff (95% CI)	t-value	p-value	Cohen's d
WEMWBS Total	48.6 (8.4)	56.2 (7.8)	7.6 (6.5, 8.7)	13.84	<0.001	0.94

Note: Scores range from 0-4; Higher scores indicate greater endorsement of that motivation type

Clinical Significance: Using established cut-off scores, the proportion of participants with low well-being (score ≤40) decreased from 28.3% (n = 58) at baseline to 8.8% (n = 18) post-intervention (McNemar's $\chi^2 = 36.72$, $p < 0.001$).

4.9. Anthropometric Changes

Modest but significant improvements in body composition were observed (Table 9).

Table 9.
Anthropometric Changes.

Variable	Baseline M (SD)	Post-intervention M (SD)	Mean Diff (95% CI)	t-value	p-value	Cohen's d
Weight (kg)	55.8 (10.2)	54.6 (9.8)	-1.2 (-1.6, -0.8)	-5.86	<0.001	-0.12
BMI (kg/m²)	21.4 (3.2)	20.9 (3.0)	-0.5 (-0.7, -0.3)	-5.12	<0.001	-0.16

4.10. Correlational Analyses

Pearson correlation analyses revealed significant relationships between key variables (Table 10).

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Table 10.
Correlation Matrix of Primary Outcomes.

Variables	1	2	3	4	5	6
1. App Usage Frequency	-					
2. Total PA (post)	0.68**	-				
3. Intrinsic Motivation	0.54**	0.72**	-			
4. Competence Satisfaction	0.48**	0.66**	0.78**	-		
5. Autonomy Satisfaction	0.46**	0.62**	0.74**	0.71**	-	
6. Exercise Adherence	0.62**	0.84**	0.76**	0.72**	0.68**	-

Note: **p < 0.01.

4.10.1. Key Correlational Findings

- App usage frequency strongly correlated with physical activity levels (r = .68, p < .001)
- Intrinsic motivation showed strong positive correlations with physical activity (r = .72, p < .001) and adherence (r = .76, p < .001).
- Competence satisfaction was highly correlated with intrinsic motivation (r = .78, p < .001)

4.11. Regression Analysis

Multiple linear regression was conducted to identify predictors of exercise adherence (Table 11).

Table 11.
Multiple Regression Predicting Exercise Adherence (Post-Intervention EARS Score).

Predictor	B	SE B	β	t	p	VIF
(Constant)	4.28	1.24	-	3.45	.001	-
Intrinsic Motivation	2.64	0.38	0.42	6.95	<.001	2.14
Competence Satisfaction	1.86	0.42	0.28	4.43	<.001	2.38
App Usage Frequency	0.78	0.18	0.24	4.33	<.001	1.56
Perceived Usefulness	0.52	0.22	0.14	2.36	.019	1.42

Note: $R^2 = .724$, Adjusted $R^2 = .718$, $F(4, 200) = 131.45$, $p < .001$.

Model Summary: The final regression model was statistically significant and explained 72.4% of the variance in exercise adherence. Intrinsic motivation emerged as the strongest predictor (β = .42, p < .001), followed by competence satisfaction (β = .28, p < .001), app usage frequency (β = .24, p < .001), and perceived usefulness (β = .14, p = .019).

4.12. Gender Differences

Independent samples t-tests revealed some gender differences in outcomes (Table 12).

Table 12.
Gender Differences in Post-Intervention Outcomes.

Variable	Males M (SD)	Females M (SD)	t-value	p-value	Cohen's d
Total PA (min/week)	186.4 (58.2)	171.2 (54.6)	1.92	0.056	0.27
Intrinsic Motivation	3.54 (0.76)	3.43 (0.72)	1.06	0.291	0.15
Social Feature Use (%)	58.2%	77.6%	$\chi^2 = 8.82$	0.003	-
Competitive Feature Preference (%)	72.4%	54.2%	$\chi^2 = 7.24$	0.007	-

4.12.1. Key Gender Findings

- No significant differences in physical activity levels or intrinsic motivation

- Females are significantly more likely to use social features ($\chi^2 = 8.82$, $p = .003$)
- Males are significantly more likely to prefer competitive features ($\chi^2 = 7.24$, $p = .007$)

4.13. Grade Level Differences

No significant differences were found between Grade 11 and Grade 12 students across primary outcomes (all $p > .05$).

4.14. App Feature Preferences and Usage

Analysis of feature utilization revealed distinct patterns (Table 13).

Table 13.
App Feature Utilization and Satisfaction.

Feature	% Users	Satisfaction M (SD)	Perceived Impact on Adherence M (SD)
Goal-setting	96.6%	4.32 (0.68)	4.18 (0.74)
Progress Tracking	94.1%	4.48 (0.62)	4.42 (0.66)
Reminders	88.8%	3.96 (0.82)	3.88 (0.86)
Social Features	68.3%	3.84 (0.88)	3.62 (0.92)
Challenges	62.9%	4.12 (0.76)	3.98 (0.82)
Badges/Rewards	58.0%	3.72 (0.94)	3.54 (0.96)
Leaderboards	45.4%	3.48 (1.02)	3.36 (1.08)

Note: Satisfaction and perceived impact are rated on a 1-5 scale.

4.15. Barriers and Facilitators

Participants were asked to rate barriers and facilitators to app use on a 5-point scale. The results are presented in Table 14.

Table 14.
Reported Barriers and Facilitators.

Factor	Type	M (SD)	% Reporting as Major Factor
User-friendly interface	Facilitator	4.28 (0.72)	82.4%
Progress visibility	Facilitator	4.42 (0.66)	86.8%
Social support features	Facilitator	3.84 (0.94)	64.4%
Flexibility in timing	Facilitator	4.36 (0.68)	84.9%
Technical issues	Barrier	2.46 (1.12)	22.4%
Limited space	Barrier	2.92 (1.24)	34.6%
Time constraints	Barrier	3.18 (1.08)	42.0%
Lack of equipment	Barrier	2.64 (1.16)	28.3%
Internet connectivity	Barrier	2.78 (1.22)	31.2%

Note: Scale 1 = not at all to 5 = extremely.

4.16. Sustainability Indicators

At the 10-week endpoint, participants were asked about their intentions for continued use:

- Definite continuation: 54.1% (n = 111)
- Probable continuation: 30.2% (n = 62)
- Uncertain: 11.2% (n = 23)
- Unlikely/Will not continue: 4.4% (n = 9)

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4.16.1. Reasons for Continued Use (n = 173)
1. Improved fitness and health (92.5%)
2. Convenience and flexibility (87.3%)
3. Progress tracking capability (84.4%)
4. Enjoyment of activities (78.6%)
5. Social connectivity (62.4%)

4.16.2. Reasons for Discontinuation (n = 32)
1. Achieved desired fitness level (37.5%)
2. Prefer traditional exercise methods (31.3%)
3. Technical difficulties (25.0%)
4. Cost concerns for premium features (18.8%)
5. Privacy concerns (15.6%)

4.17. Summary of Key Quantitative Findings
The 10-week mobile fitness app intervention resulted in:
1. Large effect size improvements in physical activity: Total weekly physical activity increased by 104.3% (Cohen's d = 1.82), with 82.4% of participants meeting WHO guidelines post-intervention compared to 12.2% at baseline.
2. Substantial increase in exercise adherence: EARS scores increased from 10.8 to 18.6 (Cohen's d = 1.96), representing a 72.2% improvement.
3. Significant motivational shifts: Intrinsic motivation increased by 64.2% (d = 1.76), while amotivation decreased by 50.0% (d = -1.75). The Relative Autonomy Index increased from -2.12 to 4.86, indicating a fundamental shift toward autonomous motivation.
4. Enhanced psychological need satisfaction: All three basic psychological needs showed large effect size improvements (autonomy: d = 1.72; competence: d = 2.16; relatedness: d = 1.34).
5. High technology acceptance: Participants rated apps highly on perceived usefulness (M = 5.84/7) and ease of use (M = 6.12/7), with 84.4% intending to continue use.
6. Improved psychological well-being: Mental well-being scores increased by 15.6% (d = 0.94), with clinically significant reductions in the prevalence of low well-being.
7. Strong predictive model: The regression analysis revealed that intrinsic motivation, competence satisfaction, app usage frequency, and perceived usefulness collectively explained 72.4% of the variance in exercise adherence.

5. Discussion
5.1. Interpretation of Primary Findings
The quantitative findings of this study provide robust evidence for the effectiveness of mobile fitness applications in improving exercise adherence among Filipino senior high school students. The large effect sizes observed across primary outcomes (Cohen's d ranging from 1.70 to 2.62) substantially exceed typical intervention effects reported in physical activity promotion literature, suggesting that mobile fitness apps represent a particularly potent strategy for this population.

The 104.3% increase in total weekly physical activity is especially noteworthy when contextualized within the broader landscape of youth physical activity interventions. This magnitude of change compares favorably with school-based interventions, which typically report increases of 40-60 minutes per week. The fact that 82.4% of participants achieved WHO physical activity guidelines post-intervention, compared to only 12.2% at baseline, represents a dramatic

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shift with significant public health implications for addressing the youth inactivity crisis in the Philippines.

The success of the intervention can be understood through multiple theoretical lenses, with Self-Determination Theory providing the most comprehensive explanatory framework. The observed increases across all three basic psychological needs autonomy (d = 1.72), competence (d = 2.16), and relatedness (d = 1.34) suggest that mobile fitness apps effectively create a motivationally supportive environment. The particularly large effect for competence satisfaction (d = 2.16) highlights the importance of progress tracking and achievement recognition features, which provide objective evidence of improvement and reinforce self-efficacy beliefs.

The motivational profile changes revealed by BREQ-2 scores provide compelling evidence of internalization processes. The 64.2% increase in intrinsic motivation, coupled with a 50.0% decrease in amotivation, indicates that participants genuinely began to value and enjoy physical activity rather than viewing it as an obligation. The dramatic shift in the Relative Autonomy Index (from -2.12 to 4.86, representing a 230% change) suggests a fundamental transformation in motivational orientation from controlled to autonomous regulation. This finding has critical implications for sustainability, as research consistently demonstrates that autonomous motivation predicts long-term behavioral maintenance.

The regression analysis provides valuable insights into the mechanisms driving exercise adherence. The model's high explanatory power (R^2 = .724) indicates that the measured psychological constructs capture the essential determinants of adherence behavior. Intrinsic motivation emerged as the strongest predictor (β = .42), supporting SDT's central tenet that autonomous motivation forms the foundation for sustained behavior change. The significant contribution of competence satisfaction (β = .28) underscores the importance of app features that support skill development and provide clear feedback on progress. The finding that app usage frequency independently predicted adherence (β = .24), even after controlling for motivational factors, suggests that simple behavioral consistency may create its own momentum through habit formation.

5.2. Physical Activity Outcomes in Context

The magnitude of physical activity improvements observed in this study warrants careful consideration. The increase from 87.3 to 178.4 minutes per week represents achievement of the WHO guidelines and alignment with evidence-based recommendations for adolescent health. Importantly, the improvements extended across multiple indicators, frequency, duration, and intensity suggesting comprehensive rather than selective behavior change.

The 133% increase in exercise frequency (from 1.8 to 4.2 sessions per week) is particularly significant, as frequency often proves more challenging to modify than duration. This finding suggests that mobile fitness apps effectively reduced barriers to exercise initiation, likely through reminder features, reduced planning burden, and lowered activation energy required to begin sessions. The fact that participants exercised more than four times per week indicates that physical activity became integrated into regular routines rather than remaining an occasional activity.

The 64.7% increase in daily step count (from 5,240 to 8,630 steps) provides objective validation of increased lifestyle physical activity beyond structured exercise sessions. This suggests that the intervention generated spillover effects, with participants becoming generally more active throughout the day. The achievement of approximately 8,600 steps per day approaches recommended targets for adolescents (10,000-12,000 steps/day) and represents a substantial improvement in total daily energy expenditure.

5.3. Adherence Patterns and Sustainability Considerations

The 72.2% improvement in EARS scores (from 10.8 to 18.6) indicates a strong commitment to exercise programs by the intervention end. However, the 78.4% adherence rate, while impressive, should be interpreted cautiously. This metric reflects adherence during an active intervention period with regular support and monitoring. Research on mobile fitness apps consistently demonstrates declining adherence over time, with dropout rates typically exceeding 50% within 3-6 months.

Several factors suggest reasons for cautious optimism regarding sustainability in this study. First, 84.4% of participants indicated an intention to continue app use, with 54.1% expressing a definite commitment. Second, the strong development of intrinsic motivation (as opposed to reliance on external incentives) provides a more stable foundation for continued engagement. Third, the integration of physical activity into social networks through app features may create accountability structures that persist beyond formal intervention.

However, sustainability challenges remain evident. The 11.2% of participants uncertain about continuation and 4.4% indicated discontinuation underscore the need for ongoing support mechanisms. The reported barriers, particularly time constraints (42.0% reporting as a major factor) will likely intensify as novelty effects wane and competing demands reassert themselves. The finding that 25.0% of those planning discontinuation cited technical difficulties highlights the importance of robust app functionality for retention.

The high app usage frequency during intervention (M = 5.8 sessions/week) may not be sustainable long-term without continued support structures. Research suggests that successful long-term maintenance often involves a transition from intensive monitoring to intermittent engagement, with apps serving as resources drawn upon as needed rather than daily requirements. Future research should examine whether participants successfully navigate this transition or whether sustained engagement remains necessary for maintaining behavioral gains.

5.4. Motivational Mechanisms and Theoretical Implications

The strong correlational findings support SDT's theoretical propositions regarding the relationships among psychological needs, autonomous motivation, and behavioral outcomes. The correlation between competence satisfaction and intrinsic motivation (r = .78) is particularly noteworthy, suggesting that experiences of mastery and improvement fundamentally influence how individuals experience physical activity. This finding emphasizes the importance of appropriately challenging activities that enable visible progress, precisely what well-designed fitness apps can provide through progressive difficulty adjustment and clear performance feedback.

The correlation between intrinsic motivation and physical activity (r = .72) aligns with meta-analytic findings in exercise psychology but represents the upper end of typically observed effect sizes. This strong relationship may reflect the synchronized measurement of motivation and behavior (both at post-intervention) or may indicate that mobile fitness apps particularly effectively translate motivation into action by reducing implementation barriers.

The finding that autonomy satisfaction showed somewhat lower correlations with physical activity (r = .62) and adherence (r = .68) compared to competence (r = .66 and .72) suggests that competence may be particularly critical in exercise contexts, possibly because adolescents' self-perceptions are especially attuned to ability feedback. Alternatively, this may reflect characteristics of the specific apps used, which generally provided substantial flexibility (supporting autonomy) but varied more in quality of competence-supportive features.

The theoretical contribution of this study lies in demonstrating that SDT principles apply effectively in technology-mediated intervention contexts within a non-Western cultural setting. The universal importance of basic psychological need satisfaction, combined with culture-specific expression (e.g., stronger emphasis on relatedness in collectivist contexts), supports both the universality and cultural specificity of SDT. This finding has implications for app design, suggesting that core motivational architecture should be similar across cultures while specific feature implementation should reflect cultural values.

5.5. Technology Acceptance and User Experience

The high levels of perceived usefulness (M = 5.84/7) and perceived ease of use (M = 6.12/7) indicate that contemporary fitness apps have achieved sufficient maturity to meet user expectations. The slightly higher rating for ease of use compared to usefulness suggests that interface design has reached high standards, while some room for improvement remains in value proposition and feature development.

The MARS scores across dimensions (ranging from 3.92 to 4.24 on 5-point scales) indicate generally high app quality with no major weaknesses. The highest rating for information quality (M = 4.24) suggests that apps provide credible, helpful content, an important consideration given concerns about misinformation in digital health spaces. The slightly lower engagement score (M = 3.92) suggests this may be an area for improvement, despite the strong adherence outcomes observed.

The feature utilization analysis reveals clear preferences that should inform design priorities. Goal-setting (96.6% utilization) and progress tracking (94.1% utilization) emerged as near-universal features, with high satisfaction ratings (M = 4.32 and 4.48, respectively). These features directly support competence need satisfaction by making progress visible and concrete. The lower utilization of leaderboards (45.4%) suggests that competitive features appeal to a subset of users consistent with individual differences in competitive orientation.

The moderate utilization of social features (68.3%) warrants interpretation within a cultural context. While lower than hypothesized given Filipino collectivist values, this figure represents higher social feature engagement than typically reported in Western studies (40-50%). The gender difference (77.6% of females vs. 58.2% of males) suggests that social connectivity appeals more strongly to female users, possibly reflecting gender socialization patterns.

5.6. Psychological Well-being Outcomes

The 15.6% improvement in mental well-being scores (WEMWBS increase from 48.6 to 56.2, d = 0.94) provides compelling evidence that physical activity gains translated into broader psychological benefits. This effect size exceeds typical improvements observed in school-based mental health interventions (d = 0.30-0.50) and approaches magnitudes seen in targeted psychological treatments.

The reduction in low well-being prevalence from 28.3% to 8.8% represents a meaningful clinical impact. Given the elevated rates of mental health concerns among Filipino youth, particularly post-pandemic, interventions that simultaneously address physical and mental health offer substantial value. The mechanism likely involves multiple pathways: direct neurobiological effects of exercise on mood, psychological benefits of achievement and mastery, social connection through app communities, and structured activity as a coping strategy for stress.

The correlation between physical activity change and well-being improvement ($r = .52$, $p < .001$) supports the causal pathway from exercise to mental health, though the cross-sectional nature of this analysis precludes definitive causal inference. The fact that well-being improvements occurred despite the absence of explicit mental health content in apps suggests that addressing physical inactivity may function as an effective indirect mental health intervention a finding with significant implications for resource-limited settings where mental health services are scarce.

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5.7. Anthropometric Changes and Health Implications

The modest anthropometric changes (1.2 kg weight loss, 0.5 kg/m^2 BMI reduction) should be interpreted in context. While statistically significant, these changes represent relatively small effect sizes (d = -0.12 and -0.16). This pattern is common in physical activity interventions without dietary modification, particularly over relatively short timeframes. The 10-week duration may have been insufficient for substantial body composition changes, especially in participants whose baseline BMI (M = 21.4) fell within healthy ranges.

However, the health significance of these changes should not be dismissed. Even modest weight loss in overweight individuals confers metabolic benefits, and the BMI reduction shifts the sample mean toward lower health risk. More importantly, improved cardiorespiratory fitness and increased muscle mass (not directly measured but implied by strength-focused exercises) provide health benefits independent of weight changes. Research increasingly recognizes that fitness matters more than fatness for health outcomes, suggesting that the physical activity improvements may generate substantial health benefits regardless of weight change.

The lack of dietary intervention may have limited anthropometric changes but enhanced the study's focus on exercise behavior. Participants' weight loss likely resulted entirely from increased energy expenditure rather than a combination of energy intake reduction and expenditure increase. This "pure" physical activity effect provides clearer evidence for app effectiveness in promoting activity specifically, though future research incorporating nutrition components might yield larger weight-related effects.

5.8. Gender and Developmental Considerations

The absence of significant gender differences in primary outcomes (physical activity levels, motivation, adherence) contrasts with some previous research reporting greater physical activity increases among males. This gender equity in outcomes represents a positive finding, suggesting that mobile fitness apps can effectively engage both male and female adolescents when appropriately designed.

The observed gender differences in feature preferences, females favoring social features (77.6% vs. 58.2%) and males preferring competitive elements (72.4% vs. 54.2%), align with gender socialization patterns and have practical implications. Apps targeting diverse users should offer both cooperative/social and competitive features, allowing individuals to engage with preferred elements. The fact that strong outcomes were achieved despite these differential preferences suggests that apps offering multiple engagement pathways can successfully serve heterogeneous populations.

The lack of grade level differences (Grade 11 vs. 12) suggests that developmental stage within senior high school does not substantially moderate app effectiveness. This finding simplifies implementation, indicating that similar interventions can be applied across senior high grades without major modifications. However, this age range (16-18 years) represents relatively mature adolescence; effectiveness in younger adolescents remains uncertain and warrants investigation.

5.9. Cultural Context and Local Relevance

The effectiveness of mobile fitness app interventions among Filipino youth must be understood within a specific sociocultural context. The high smartphone ownership (100% in this sample) and digital literacy create favorable conditions for technology-based interventions. However, this sample likely overrepresents socioeconomically advantaged youth with access to technology, limiting the generalizability to low-income populations.

The strong response to social features, while moderate in absolute terms, exceeded levels typically reported in individualistic Western cultures. This pattern suggests that collectivist cultural values influenced engagement, with fitness activities serving social connection functions beyond individual health benefits. The finding that family involvement facilitated adherence (reported qualitatively by participants) underscores the importance of considering family dynamics in the Filipino cultural context.

The successful improvisation around resource constraints, participants using limited space creatively, and substituting household items for equipment reflect broader Filipino cultural characteristics of resourcefulness (kaya) and adaptability. This resilience suggests that mobile fitness apps may be particularly well-suited for the Philippine context, where formal exercise facilities are less accessible than in high-income countries. However, this also indicates that apps should prioritize bodyweight exercises and minimal equipment requirements.

The post-pandemic timing of this study created both opportunities and challenges. Elevated awareness of health behaviors and disrupted routines may have increased receptivity to new health initiatives. However, elevated stress, mental health concerns, and family economic pressures created competing demands. The strong outcomes despite these challenges suggest robust intervention effectiveness, though replication during more typical circumstances would strengthen conclusions.

5.10. Comparison with International Research

The physical activity improvements observed in this study (104.3% increase) substantially exceed those reported in most international mobile fitness app studies, which typically report increases of 30-60%. Several factors may explain this discrepancy. First, the lower baseline activity levels in this sample (87.3 min/week) provided greater room for improvement compared to moderately active Western samples. Second, the novelty of fitness apps in the Philippine context may have generated stronger initial engagement than in markets with high existing app penetration. Third, the structured support provided during the intervention (weekly check-ins, motivational messages) exceeded the passive app-only approaches common in other studies.

The motivational changes, particularly the shift in the Relative Autonomy Index (230% increase), represent among the largest effects reported in SDT-based intervention research. This finding suggests either that mobile fitness apps particularly effectively support autonomous motivation development or that the specific features of apps used in this study (strong goal-setting and progress tracking) optimally facilitated internalization. The correlation patterns observed (e.g., competence-intrinsic motivation $r = .78$) align closely with meta-analytic findings from Western populations, supporting the cross-cultural validity of SDT constructs.

The improvements in mental well-being ($d = 0.94$) surpass those typically reported in physical activity interventions among Western populations ($d = 0.4$-0.6), possibly reflecting greater mental health needs among Filipino youth post-pandemic or cultural differences in how physical activity influences well-being. The finding that relatively modest increases in physical activity generate substantial well-being benefits suggests that Filipino adolescents may derive psychological benefits from small behavioral changes, an encouraging finding for public health interventions.

5.11. Practical Implications for Stakeholders

5.11.1. For Public Health Policy

The strong outcomes observed support policy initiatives promoting mobile fitness app adoption among Filipino youth. The cost-effectiveness of app-based interventions requiring only smartphones that participants already own plus modest support infrastructure, compares favorably with facility-based programs requiring substantial capital investment. The scalability of mobile interventions allows reaching large populations rapidly, addressing the urgency of the youth inactivity crisis.

Specific policy recommendations include: (1) integration of fitness app use into national youth health programs with government endorsement of evidence-based apps; (2) partnerships with app developers to create culturally adapted versions with Filipino content; (3) provision of data subsidies or Wi-Fi access to reduce connectivity barriers; (4) training of teachers and healthcare providers to recommend and support app use; (5) incorporation of app-tracked physical activity into school PE credit systems.

5.12. For Educational Institutions

Schools can leverage mobile fitness apps to extend PE beyond limited class time, with apps serving as homework assignments requiring 30-minute exercise sessions 3-4 times weekly. Teachers could monitor student activity through app data, providing feedback and recognition. Integration with existing LMS platforms would streamline data collection. Schools should establish infrastructure supporting app use: WiFi access, charging stations, and designated exercise spaces for home-based workouts.

Professional development for PE teachers should include app features, goal-setting strategies, and motivational interviewing techniques supporting autonomous motivation. Schools should also address potential concerns: developing clear policies on data privacy, ensuring equity for students without smartphones through loaner device programs, and preventing maladaptive behaviors such as excessive exercise or unhealthy body image concerns.

5.13. For App Developers

The feature utilization and satisfaction data provide actionable insights for development priorities. The near-universal use and high satisfaction with goal-setting and progress tracking indicate these core features should receive continued investment. The moderate engagement with social features, despite their importance for adherence, suggests potential for improvement, perhaps through better onboarding explaining social benefits or enhanced privacy controls to reduce sharing concerns.

For the Filipino market specifically, developers should: (1) prioritize bodyweight exercises requiring minimal equipment and space; (2) integrate family involvement features allowing household members to participate together; (3) include culturally familiar activities and Filipino-language content; (4) optimize for low-bandwidth connectivity with offline functionality; (5) implement freemium models carefully, ensuring core features remain accessible to users unable to pay for premium subscriptions; (6) provide clear privacy policies addressing parental concerns about adolescent data.

5.14. For Healthcare Providers

The strong mental well-being outcomes support recommending fitness apps as part of holistic adolescent healthcare. Providers working with youth presenting with mild to moderate anxiety, depression, or stress should consider prescribing specific apps with evidence of effectiveness. Integration of app recommendations into standard anticipatory guidance at well-visits would normalize their use.

Providers should receive training on available apps, their evidence base, and how to support patient adoption. Simple prescriptions ("Use Nike Training Club 30 minutes, 4 times per week for 10 weeks, then follow up") combined with brief motivational interviewing can facilitate uptake. Monitoring app-tracked data during follow-up visits allows providers to reinforce progress and troubleshoot barriers.

5.15. Addressing Implementation Barriers

While overall outcomes were positive, the reported barriers require systematic attention for successful scaled implementation. Technical issues, though reported by only 22.4% as major barriers, represent critical failure points when they occur. Apps must maintain robust functionality across diverse devices and operating system versions common in the Philippines. Developers should implement comprehensive testing, clear error messages, and responsive customer support.

Time constraints, reported by 42.0% as major barriers, reflect genuine competing demands on adolescent schedules. Addressing this requires both individual-level strategies (helping students identify optimal exercise times, emphasizing that short workouts count) and structural changes (schools allocating dedicated time, reducing homework loads). Emphasizing the academic benefits of physical activity improved concentration, stress reduction, and better sleep, may help students view exercise as an investment rather than a distraction.

Internet connectivity issues (31.2% reporting as a major barrier) particularly affect lower-income students in areas with poor infrastructure. Apps should maximize offline functionality, allowing workouts to be completed without an active internet connection and syncing data when connectivity resumes. Alternatively, partnerships with telecommunications companies could provide zero-rated data access for approved fitness apps, similar to existing arrangements for educational platforms.

The space and equipment limitations (34.6% and 28.3% reporting as major barriers) require careful app design emphasizing adaptability. Apps should prominently feature bodyweight exercises performable in confined spaces, with clear modifications shown for different space constraints. Video demonstrations should depict realistic home environments rather than spacious gyms, normalizing limited-space exercise.

Privacy concerns, while only mentioned by 15.6% planning discontinuation, warrant serious attention given the growing awareness of data protection issues. Apps should implement transparent data practices, obtain explicit consent for data sharing, allow granular control over what information is visible to others, and comply with child protection regulations. Schools and parents need clear information about what data are collected and how they are used.

5.16. Limitations and Methodological Considerations

Several methodological limitations warrant acknowledgment. The quasi-experimental design without a randomized control group limits causal inference. While the pre-post changes strongly suggest intervention effects, factors like regression to the mean, seasonal variation in activity, or concurrent events could contribute to observed changes. Historical threats to validity are particularly concerning given the post-pandemic context, where societal reopening may have independently increased physical activity opportunities.

The 10-week intervention duration, while sufficient to demonstrate short-term effects, provides limited insight into long-term sustainability the ultimate metric for public health impact. The high intention to continue use (84.4%) provides encouraging signals but requires validation through extended follow-up, measuring actual rather than intended behavior. Research consistently shows intention-behavior gaps, particularly for health behaviors.

The self-selected sample of youth with smartphone access and baseline interest in fitness apps limits generalizability. The 88% recruitment response rate, while respectable, may have excluded the least interested individuals. The 93.2% retention rate, though excellent, means outcomes do not reflect the experience of the 6.8% who dropped out, potentially those facing the greatest barriers or experiencing the poorest results.

Reliance on self-reported physical activity via IPAQ-SF introduces social desirability bias and recall error, despite IPAQ's validation. While app-tracked data provide objective verification for app-mediated activities, they do not capture non-app physical activity. Future research should incorporate accelerometry for comprehensive, objective activity assessment. The absence of physiological measures (cardiorespiratory fitness, blood pressure, metabolic markers) represents another limitation, though pragmatic constraints often necessitate such tradeoffs in field research.

The heterogeneity of apps used (five different applications) enhances ecological validity but complicates the attribution of effects to specific features. A factorial design systematically varying feature availability would clarify which elements drive effectiveness, though such designs sacrifice participant autonomy in app selection, potentially undermining the autonomous motivation the intervention aims to foster.

Finally, the cultural specificity of findings limits generalizability beyond the Filipino context, though this represents more a delimitation than a limitation. The study deliberately focused on Filipino youth to address gaps in understanding non-Western populations. The strong outcomes suggest promise for similar collectivist Asian cultures, though empirical verification is required.

5.17. Future Research Directions

Several critical research questions emerge from this study's findings:

Long-term sustainability: Extended follow-up at 6, 12, and 24 months post-intervention would clarify whether behavioral changes persist. Research should identify factors differentiating maintainers from relapsers, examining how app usage patterns evolve over time. Does sustained engagement require continued active use, or can apps transition to occasional reference resources while behaviors persist? Understanding the minimal effective dose of continued app engagement would inform sustainability recommendations.

Comparative Effectiveness Research: Head-to-head comparisons of different apps or feature combinations would clarify optimal design. Dismantling studies could isolate the effects of specific features (e.g., comparing apps with and without social components). Adaptive trial designs could efficiently test multiple variations. Integration with implementation science frameworks would accelerate the translation of findings into practice.

Moderator and mediator analyses: Larger samples would enable examination of who benefits most from app interventions and why. Potential moderators include: baseline activity levels, previous app experience, motivation profiles, family support, socioeconomic status, and urban versus rural residence. Mediator analyses could test theoretical propositions about pathways from app features to psychological needs, motivation, and behavior. Such analyses would enable targeting interventions to those most likely to benefit and personalizing features to individual characteristics.

Hybrid intervention models research should explore how to optimally combine app-based and in-person elements. Would apps supplemented with monthly group exercise sessions enhance outcomes? Could peer mentorship programs leverage app social features for greater impact? Would periodic coaching contacts prevent disengagement? Hybrid models might capture the benefits of both approaches while mitigating limitations.

Underserved populations, including rural areas, low-income communities, and youth without personal smartphone access, require targeted interventions to address equity concerns. Such research necessitates creative solutions: shared devices, community centers equipped with smartphones and WiFi, and feature phones with SMS-based interventions. Understanding barriers unique to these populations and developing appropriate solutions are essential to ensure interventions do not exacerbate health disparities.

Family-Based Interventions: Given the importance of family in Filipino culture and the observed influence of family support, research should explicitly test family-oriented interventions. Would apps designed for shared household use enhance outcomes? How should features balance individual tracking with family challenges? Could interventions targeting parent-adolescent dyads generate synergistic benefits?

A detailed examination of how improvements in physical activity translate to mental health benefits would inform both theory and practice. Mediation analyses could test proposed pathways, including neurobiological effects, psychological benefits of mastery, social connection, and structured coping. Identifying which exercise characteristics, such as frequency, intensity, type, and social context, most strongly influence mental health would guide the optimization of interventions.

App feature optimization involves user experience research employing A/B testing of specific features to refine design. Which notification timing and content maximize engagement without causing annoyance? What visualization formats best communicate progress? How can social features be designed to foster supportive communities while preventing negative comparison? What gamification elements enhance rather than undermine intrinsic motivation? Continuous iterative improvement, informed by data, would advance the field.

Economic evaluation: Cost-effectiveness analysis comparing app interventions to traditional PE expansion, facility-based programs, and the status quo would inform resource allocation. Such analyses should adopt societal perspectives, capturing benefits beyond the health sector: productivity gains, reduced healthcare utilization, and educational improvements. Modeling long-term costs and benefits of adolescent activity increases would demonstrate true economic value.

Integration with healthcare systems research should examine how to embed app recommendations in primary care and school health services. What training do providers need? How should prescriptions be written? What monitoring and follow-up systems work best? How can app data be integrated into electronic health records? Successfully routinizing app recommendations requires addressing these pragmatic questions.

6. Conclusion

This study provides compelling evidence that mobile fitness applications represent an effective intervention strategy for improving exercise adherence among Filipino senior high school students. The significant improvements in physical activity levels, intrinsic motivation, and sustained engagement observed throughout the 10-week intervention period demonstrate that technology-mediated approaches can successfully address the youth physical inactivity crisis in the Philippines.

The effectiveness of mobile fitness apps can be attributed to their alignment with fundamental principles of human motivation, particularly the satisfaction of psychological needs for autonomy, competence, and relatedness as described by Self-Determination Theory. By providing flexible, personalized, and socially connected exercise experiences, these apps create conditions conducive to behavior change and habit formation. The integration of gamification elements, progress tracking, and social features leverages both intrinsic and extrinsic motivational pathways to sustain engagement. Cultural context emerged as an important moderating factor, with the collectivist orientation of Filipino society amplifying the effectiveness of social features and community-oriented challenges. This finding underscores the importance of cultural adaptation in mobile health interventions, suggesting that apps designed with specific cultural contexts in mind will likely outperform generic, one-size-fits-all approaches. While the findings are encouraging, several important considerations temper enthusiasm. The question of long-term sustainability remains unanswered, with research from other contexts suggesting that adherence typically declines over time. Technical, resource, and time constraints represent ongoing challenges that must be addressed through thoughtful app design and supportive policies. The limitations of purely digital interventions, particularly the absence of qualified professional instruction and face-to-face social interaction, suggest that hybrid approaches combining mobile technology with traditional elements may ultimately prove most effective. The practical implications of this research extend across multiple domains. For public health policy, mobile fitness apps offer a scalable, cost-effective complement to traditional physical activity promotion efforts. For educational institutions, these apps provide tools for extending physical education beyond classroom walls and fostering selfdirected fitness habits. For app developers, the findings highlight the importance of incorporating evidence-based motivational principles and cultural adaptation. For healthcare providers, fitness apps represent concrete resources for supporting physical activity counseling with adolescent patients. The theoretical contributions of this study advance understanding of technology-mediated behavior change by demonstrating the applicability of Self-Determination Theory in mobile health contexts and highlighting the importance of cultural factors in intervention effectiveness. The integration of SDT with Technology Acceptance Model constructs provides a more comprehensive framework for understanding both adoption and sustained use of mobile health technologies.

Looking forward, several research priorities emerge. Long-term follow-up studies are essential for understanding the sustainability of behavior change. Comparative effectiveness research can identify optimal app features and intervention approaches. Studies examining moderators and mediators of intervention effects will enable personalization and targeting. Research exploring hybrid models combining digital and in-person elements may reveal synergistic approaches. Extension of research to underserved populations will ensure equitable access to effective interventions. In conclusion, mobile fitness applications hold substantial promise for addressing physical inactivity among Filipino youth, offering a culturally appropriate, technologically mediated solution to a critical public health challenge. While not a panacea, when designed thoughtfully and implemented strategically, these apps can contribute meaningfully to promoting healthier, more active lifestyles among adolescents. The convergence of high smartphone penetration, growing health awareness, and improving app technology creates a favorable environment for the scaled implementation of evidence-based mobile health interventions in the Philippines.

The journey from physical inactivity to active lifestyles is complex and multifaceted, influenced by individual, social, environmental, and cultural factors. Mobile fitness apps represent an important tool in a comprehensive approach to youth physical activity promotion. By leveraging technology that Filipino adolescents already use extensively, these interventions meet young people where they are, transforming smartphones from contributors to sedentary behavior into catalysts for positive health behavior change. With continued research, thoughtful policy support, and evidence-based app development, mobile fitness applications can play a significant role in improving the health and well-being of Filipino youth for generations to come.

Transparency:

The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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