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ORIGINAL SCIENTIFIC PAPER

Physical Fitness Status of Tertiary Students under the New Physical Activity towards Health and Fitness (PATHFit) Course: A Quasi-Experimental Study

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Abstract

According to the latest findings of the World Health Organization (2022), most young people nowadays are deficient in fulfilling the global standard for moderate- to vigorous-intensity physical activities. Concurrently, the issue of girls being less active than boys in most countries, including the Philippines, remains. To address this health issue, the Philippines' Commission on Higher Education (CHED) implemented the new Physical Activity Towards Health and Fitness (PATHFit) Courses. Thus, this study aimed to evaluate existing program models that focused on developing students' cardiorespiratory and muscular fitness. An exercise model underwent a quasi-experimental analysis using three fitness tests: Prone Bridge Test (PBT), 3-minute Step Test (STEP), and Wall Squat (WS). Results revealed that participants showed significant improvement after the 12-week fitness program, with $p<0.01$ in PBT, STEP, and WS scores. However, while differences in means were all significant (N=155), Cohen's d results show that small to medium effects occurred for the three performance test scores after the treatment period. Effects also showed that female participants still exhibited lower effect magnitudes. These findings recommend developing innovative exercise models incorporating health motivation and gamification. It is also suggested that tertiary PE consider modified models for female students, addressing their sports fitness needs and attraction to sports participation. Lastly, the Philippine Commission should vigilantly endorse tertiary program models following the availability of exercise and sports scientists in institutes, effectively implementing PATHFit on the ground and improving the overall sports fitness of students.

Keywords: *physical fitness, physical activity, physical education, fitness exercise, cardiorespiratory endurance, muscular fitness*

Introduction

Physical fitness (PF) is a "physiological state of well-being that provides the foundation of the tasks of daily living, a degree of protection against chronic disease, and a basis for participation in sport" (Bakinde, 2022, p. 124). It entails the execution of moderate to vigorous physical activities that "allow the body to respond or adapt to the needs and stress of physical effort" (Guidangen, 2016; Bakinde, 2022) without being quickly exhausted (Guidangen, 2016; Nurhasan et al., 2020; Bakinde, 2022). It helps avoid heart-related diseases,

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cancer, diabetes, and others (Bakinde, 2022).

Even if it is expected for young people to lead more active lives because of their play and recreational activities, both at home and school, surprisingly, the World Health Organization (2022) still found that 81% of boys and girls aged 11 to 17 years spend less than one hour a day doing moderate- to vigorous-intensity physical activity (PA). Moreover, "more girls are inactive (85%) than boys (77.6%) in most countries" (p. 8). In Asia, in particular, this situation could be attributed to the fact that promoting PA is not a priority in Asia's low- to middle-income countries, such as the Philippines (Lee et al., 2023). Cagas et al.'s study (2022) on the PA level of young Filipinos found that their PA is rated as F or the lowest out of the 16 countries that joined the Global Matrix 4.0 compilation.

Most studies found that students have insufficient levels of PA and PF (Bora & Dutta, 2020; Nurhasan et al., 2020; Osipov et al., 2021; Xia et al., 2021; Kyrychenko et al., 2023). These were attributed to the inefficiency of the existing Physical Education (PE) Program (Prontenko et al., 2019), lack of sports participation and sedentary lifestyle (Bora & Dutta, 2020), and lack of awareness of the importance of physical exercise and proper nutrition (Guidangen, 2016). Only three studies have revealed favorable results; two were from the Philippines (Giron, 2011; Kim & So, 2018; Pituk & Cagas, 2019). Some studies also found no difference in the PF level of male and female young adults (Guidangen, 2016; Kim & So, 2018; Xia et al., 2021), while others found that males have better PF levels than females (Cheng & Ting, 2011; Ribeiro et al., 2013; Pituk & Cagas, 2019).

With the abovementioned alarming results on young adults' PF status at present, studies recommended that more information and attractive physical activities for them (Cheng & Ting, 2011; Multani, Bhawna, & Singh, 2013), especially young female adults (Pituk & Cagas, 2019; Osipov et al., 2021) be provided in their PE classes.

Only three studies on this topic have been conducted in a Philippine university context. Also, none of the studies conducted an experimental study on the interventions to improve the PF status of the students in a PE class. Most of them were descriptive (surveys) and cross-sectional studies. Also, most studies offered generic explanations of the cause of the decline of young people's PF levels, and the recommendations for addressing this pressing health issue were not very context-specific.

Also, while there have been continued efforts to increase the PA and decrease the sedentary behavior of students locally and abroad, many of these programs are not sustainable. Thus, there is still a need for measurable and systematic PE programs that educate and motivate more young people to engage in more PA and appreciate and live an active and healthy lifestyle to improve their PF (Singh et al., 2013; Cagas et al., 2022; Shakya et al., 2022; Lee et al., 2023).

The decreasing trend in PA and PF among children has become a threat to the level of higher education physical education. The Commission on Higher Education (CHED) in the Philippines recognized this and introduced new guidelines for implementing the Physical Activity Towards Health and Fitness (PATHFit) courses. Its direction is to integrate fitness engagement with sports participation, social interaction, and diversity of movement. One of the program's objectives is to address the deficiencies in fitness levels so students may be ready for sports- or recreation-specific education, which students will bring along with them for lifelong fitness. The program has three phases, namely the drill-based or movement competency phase (PATHFit 1), exercise-based or fitness phase (PATHFit 2), and sport-specific and recreational-based education (PATHFit 3 and 4).

As the new framework implementation begins, several exercise program prototypes emerge primarily based on the feasibility of their application per institute. Thus, this study aims to evaluate how a fitness program model influences the fitness testing scores of students in a school setting, particularly in core strength, aerobic, and muscular fitness tests. Anthropometric measurements will also be collected and included in the analysis of certain health variables. It is hypothesized that the structured program will direct positive changes in fitness test scores after the intervention, and results will be delimited to cardiorespiratory and muscular fitness components only. This study can possibly contribute to an evidence-based advancement of the tertiary PE programs in the Philippines and countries with sports education models.

Method

Participants and Ethics

One hundred fifty-five (N=155) Physical Education students participated in this quasi-experimental study, including 88 males and 67 females, with a mean age of 18.79±0.9 years, all officially enrolled in a private university in Manila. Subjects were screened through the Physical Activity Readiness Questionnaire (PARQ) and by the university physician to ensure they were healthy and activity-safe research participants.

Twenty (20) students, 11 males and nine females, were excluded from the study due to any of the following conditions: (1) not compliant with the pre-requisite course (PathFit 1 – Movement Competencies); (2) has vices such as smoking or drinking alcohol; (3) healing from or under medication due to cardiovascular ailments, injuries, or fracture; (4) athletes or member of any sports club in the university; and (5) transferee from other schools due to possible curriculum mismatch.

This study was approved by the San Beda University Research Ethics Board (SBU-REB). The committee has approved SBU-REB 2022-006 No. 11-11 under the expedited category. The students were asked to sign an informed consent form that indicated their willingness to undergo the study. The data gathered were only accessible to the students and the researchers and were kept in a safe online repository. They will not be shared with anyone and will be retained until the study is published.

Research Design and Procedures

This study using a One-Group Pretest-Posttest Design determined the significant difference between the results of the tertiary students' PF pre-and post-tests and examined if the progressive exercise model influences the core strength, aerobic, and muscular fitness test outcomes.

The participants' age, height, weight, waist, and hip were taken by the university physician and a nurse. An orientation was facilitated as a pre-participation briefing for research participants, which explained the schedule, study process, exercises, and risks for physical activity before the accomplishment of the PARQ and physician's clearance. Qualified participants then proceed to fitness test demonstrations. Body Mass Index (BMI) and Waist-Hip Ratio (WHR) were computed as participants' anthropometric health-related scores.

Next, the university physician, Sports Science teacher, and cardiologist supervised the implementation of the pre-test protocols using the following tests.

Prone Bridge Test or PBT

This aims to test the student's core stability by holding a position with the upper body off-the-ground, elbows and forearms as the base of support, and legs straight down to the toes where the weight is also supported. The head is facing toward the ground, and as the stopwatch starts, the subject maintains the position until unable to hold back and the hips are straight (Bohannon et al., 2018).

Wall Squat or WS

This measures isometric leg endurance, requiring students to warm up for 5 to 10 minutes. They will assume a sitting position with their back against the wall, hips, and knees bent 90 degrees. The duration of the wall sitting will be measured using a stopwatch (Biscarini et al., 2020).

Three-Minute Step Test or STEP

This assesses the aerobic fitness level based on the standard and guidelines published by the Young Men's Christian Association (YMCA) and recently validated in Kieu et al.'s study in 2020.

A 12-week structured exercise program (see Table 1) was implemented as the study's independent variable. It was hypothesized to improve participants' lower body strength, core strength, and cardiovascular endurance. The progression in intensity, variety, and difficulty levels were gradually increased according to the model. Specific workouts were adopted from common exercises and the implementation guidelines set by the National Strength and Conditioning Association (Baechle & Earle, 2008). Lastly, the post-test was administered with identical conditions and protocols as the pretest.

Table 1. The 12-Week Cardiorespiratory and Muscular Fitness Progressive Exercise Model

PHASE 1	Week 1			Week 2			Week 3		
MODERATE 60 – 70 maximal heart rate	No. of Set(s)	No. of Rep(s)	Rest (Secs)	No. of Set(s)	No. of Rep(s)	Rest (Secs)	No. of Set(s)	No. of Rep(s)	Rest (Secs)
1. Sit to stand 2. Seated hip hinge 3. Assisted lunge 4. Bird Dog (arm & leg moving up-do 5. Assisted lunge 6. Up and down plank 7. Inclined burpees	3	8	30	3	10	30	3	12	30
PHASE 2	Week 4			Week 5			Week 6		
MODERATE 60 – 80 maximal heart rate	No. of Set(s)	No. of Rep(s)	Rest (Secs)	No. of Set(s)	No. of Rep(s)	Rest (Secs)	No. of Set(s)	No. of Rep(s)	Rest (Secs)
1. Normal squats 2. Good mornings (leg exercise) 3. Split Squats 4. Bird dog (arm and leg – moving sideways) 5. Side lunge 6. High planks with shoulder tap 7. Gentle burpees	3	8	30	3	10	30	3	12	30
PHASE 3	Week 7			Week 8			Week 9		
MODERATE TO VIGOROUS 60 – 90 maximal heart rate	No. of Set(s)	No. of Rep(s)	Rest (Secs)	No. of Set(s)	No. of Rep(s)	Rest (Secs)	No. of Set(s)	No. of Rep(s)	Rest (Secs)
1. Narrow – wide squats 2. Half kneeling 1- leg straight hip hinge 3. Reverse lunge 4. Bird dog (knee to elbow contralateral) 5. Courtesy lunge 6. Contralateral planks 7. Baby burpees	3	8	30	3	10	30	3	12	30
PHASE 4	Week 10			Week 11			Week 12		
VIGOROUS 60 – 100 maximal heart rate	No. of Set(s)	No. of Rep(s)	Rest (Secs)	No. of Set(s)	No. of Rep(s)	Rest (Secs)	No. of Set(s)	No. of Rep(s)	Rest (Secs)
1. Single leg sit to stand-pistol squats 2. Single leg - romanian deadlift 3. Front lunge 4. Bird dog (knee to elbow unilateral) 5. Elevated side lunge 6. High planks with trunk rotation 7. Hop squat burpees	3	8	30	3	10	30	3	12	30

Statistical Treatments

The ratio type of data acquired from the tests, PBT, STEP, and WS, were analyzed using the Wilcoxon Signed-rank Test, calculating the W value from the pre-test and post-test scores of the participants. The significant differences in the means of anthropometric data were also examined using the same statistical test. On the other hand, Cohen's d was used to analyze the magnitude of the 12-week program's effect on the mentioned variables and performance scores. GNU PSPP (2015) was the program used in analyzing the gathered quantitative data.

Results

The following results were revealed after the 16-week implementation of the progressive exercise and testing. Figure 1 shows the dynamics of score change from the pretest results and after the 12-week progressive model. BMI and WHR scores were derived from the anthropometric measurements of participants, which were post-measured after the treatment period. BMI scores showed a 0.19 difference, from 23.22 before the exercise involvement to 23.03. WHR also scored less than 0.867, a 0.005 difference from the pretest. Both measures are considered to be optimal, if not near, according to the WHO standards (2011).

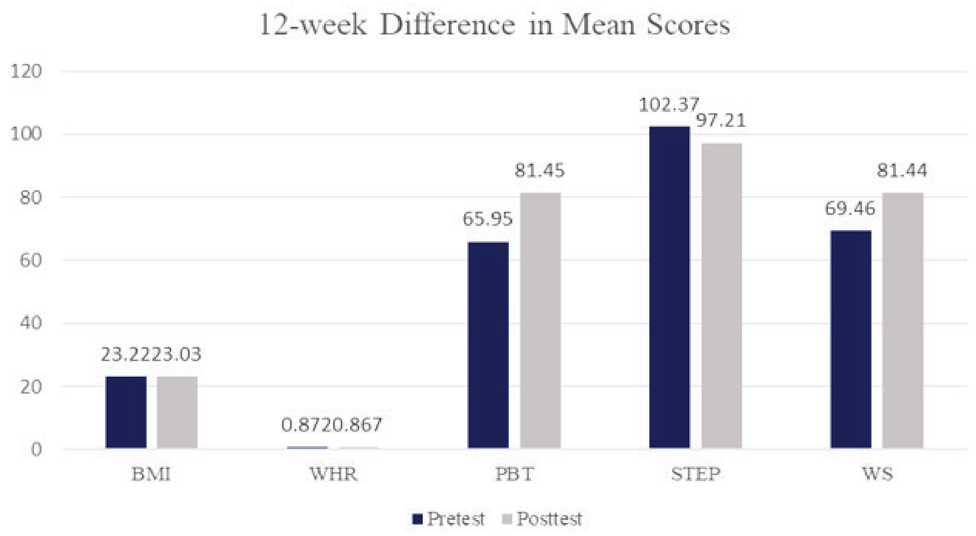

FIGURE 1. Mean scores of Anthropometric and Performance Scores Pre-Test and Post-Test Data

For the performance fitness tests, the PBT, STEP, and WS results showed a score difference of 15.5 seconds, 5.16 bpm discrepancy, and 11.98 seconds, respectively. PBT and WS were positively different from the pre-treatment scores, lasting from 65.95 to 81.45 seconds and 69.46 to 81.44 seconds, respectively. Figure 1 also showed positively different heart rate scores after treatment in STEP, from 102.37 to 97.21 bpm.

Using a Wilcoxon Signed-rank analysis, the mean difference in PBT scores resulted in a W value of 141.5; STEP scores resulted in a W value of 317; and WS had a 26 W value (see Table 2). All scores appeared to be significant at $p<0.01$, N=155. The p-values show that the score difference among participants in the three fitness tests exhibited consistency.

BMI and WHR scores derived from anthropometric data were also statistically analyzed regarding their mean differences before and after the treatment. BMI and WHR results showed significant score differences with Z values of -5.65 and -3.08, as presented in Table 3.

Table 2. W and Z Values from Performance Fitness Tests via Wilcoxon Signed-rank Test

Fitness Tests Administered		Mean	SD	W	Z
PBT (seconds)	Pre-test	65.95	30.09	141.5*	-10.283
	Post-test	81.45	36.70		
STEP (bpm)	Pre-test	102.37	10.76	317*	-9.692
	Post-test	97.21	11.37		
WS (seconds)	Pre-test	69.46	26.31	26*	-10.468
	Post-test	81.44	30.91		

*p-value = 0.01

Effect magnitudes of the anthropometric and performance test scores were also analyzed using Cohen's d. Table 4 shows small to moderate effects on performance-based fitness tests for all participants. Male participants exhibited medium effect size scores in PBT and STEP, while a small effect was shown for females. Both sexes showed medium effect size scores in the WS fitness test. Males showed the greatest effect in WS scores with a Cohen's d score of 0.726.

The Cohen's d results also revealed that the 12-week program had minimal to no effect on BMI and WHR for both sexes. Table 4 presents the lowest BMI effect in females after the intervention, with a d score of 0.029. Generally, the effect on female participants shows lower effect sizes than their male counterparts except in WHR.

Table 3. Z Values of BMI and WHR and their Significance Based on the Wilcoxon Signed-rank Test

	N		Mean Rank	Z
BMI	Negative Ranks	11	47.36 41.77	
	Positive Ranks	73		-5.65*
	Ties	71		
	Total	155		
Waist-Hip Ratio	Negative Ranks	18	23.44 30.89	
	Positive Ranks	38		-3.08*
	Ties	99		
	Total	155		

*p-value < 0.01

Table 4. Effect Size of Anthropometric and Performance Test Variables Using Cohen's d

Variable		N	Cohen's d
BMI	Male	88	0.060
	Female	67	0.029
Waist-Hip Ratio	Male	88	0.067
	Female	67	0.072
PBT	Male	88	0.720**
	Female	67	0.296*
STEP	Male	88	0.682**
	Female	67	0.300*
WS	Male	88	0.726**
	Female	67	0.605**

*small effect; **medium effect

Discussion

While physical fitness is understood as a "physiological" concept, lack of physical fitness due to low participation time transcends physiological exercise variables, migrating the issue to psychological approaches in exercise participation. Self-efficacy and competence motivation are starter factors, and increased participation has been seen to continue, resulting in improved physical fitness levels of college students. The group of Liu (2023) provided this psychological view in addressing exercise participation and has posed new strategies for achieving this outcome. Promotion of exercise participation through health motivation is observed to work in the Western region and the Asian cluster. Improvement of physiological domains from psychological methods are some of the many strategies that seem to work, which makes the inclusion of competence motivation in exercise program structures imperative.

Relating competence motivation and the Philippine PATHFit model, using sports education as a pathway in attaining participation and increased fitness scores is a viable option as it involves task orientation, engagement, social support, and stress relief among students. This is validated by a recent Asian investigation (Li et al., 2022), showing significantly longer student participation and opening doors for sport education as a compelling motivation for lifelong physical activity and well-being. The rules in exercise structures increase stimuli engagement and chunking motor adaptation, strengthening bioelectrical and physiological dependence.

Demands in sports education entail fitness before incorporating rules in exercise models. Gamifying the development of fitness parameters poses a critical factor for student motivation for sport-related fitness. Gamified fitness programs (Mora-Gonzalez, Navarro-Mateos & Perez-Lopez, 2023) have been reported to improve cardiorespiratory, upper, and lower muscular fitness significantly. Stimuli diversity makes exercise unpredictable in training and enhances the body's physiological response, delaying progress plateau as stated by the Principle of Diminishing Returns. Variation and limiting the structure through gamification make the experience alive, not merely a structure written on paper.

The pandemic, aside from willpower as an intrinsic form of physical activity barrier, also played a significant role in the global physical activity status. In Feng et al., 2023, it was observed that the lockdown caused by the COVID-19 pandemic increased the BMI levels and affected some running performance results of college women. While women are most vulnerable in physical activity access and opportunities for participation, this bears a problem across all genders and perhaps all age groups.

Specific to the Philippine context, the development of the PATHFit course highlights how tertiary PE students are being prepared for sport-specific physical activity, fitness, and participation. This made the fitness status issue transcend students' health-related fitness and concerns, the skill component, and the preparation for sports education. Being at their prime condition, students' health-related anthropometric scores are close to the ideal for both BMI and WHR scores. Overall, it can be said that the students who participated in the study are generally fit to take the PATHFit 2 course.

Part of the pathway to sport-specific fitness and education is training specific fitness parameters for the demands of sports participation, and this entails that no fitness model will work for all types of sports. In Wang et al.'s study (2023), no functional training effectively covers all parameters of fitness, which makes training for sports be given in a highly specialized manner. Specific Adaptation for Imposed Demands (SAID) is a driving mechanism progressing from PATHFit 2 (fitness-related phase) to PATHFit 3 and 4 (sport-specific education). The fitness levels acquired in the fitness training phase theoretically contribute to positive performance in sports education later in the PATHFit course. This is expected, as observed in other studies, including Portillo et al. (2022).

Apart from preparing students for sports performance fitness, specific training adaptations were also intended to prepare their bodies for the forces and stress of sports participation. Adaptations include optimizing the musculoskeletal structures to prevent and minimize the occurrence of injuries in sports effectively. Lee, Hsu, and Lee (2022) stressed how special fitness testing and scientific knowledge of implementors are essential references in formulating the fitness program. No fixed curriculum can address all performance parameters for sports and even beyond performance, particularly sport-specific conditioning and injury prevention.

With the details of sports performance and education preparation, heavily trained individuals are expected to be part of the implementation for the transition and groundwork. Sports participation being highly specialized, the inclusion of interferences is also highly dependent on specific cases, which demands teachers to have the ability to customize their interventions. This will be a problem if the findings of Miguel (2012) regarding PE teachers in the Philippines having poor teaching competencies in content knowledge are investigated.

Lastly, the lack of readiness of PE teachers for customization and modification of training to achieve fitness goals is also validated in another Philippine-based study where physical educators in the Philippines reported the need for sports injury prevention training and increased knowledge about PE injuries and prevention (Marcaida et al., 2022).

Conclusion and Recommendations

The progressive cardiorespiratory and muscular fitness exercise was a prototype experimental treatment for the PATHFit 2 course. After the 12-week intervention period, differences in health-related anthropometric and performance-related scores were all significant, and the progressive exercise model has little to no effect on BMI and WHR. The program has a medium effect on WS scores for both genders and on PBT and STEP for male participants, while small effects were documented among female participants for PBT and STEP scores post-treatment.

It is then recommended to revisit the value of gamification and inclusion of play-like rules in the structure of tertiary PE programs that may lead to increased participation, engagement, and fitness levels. Secondly, an innovative exercise design is suggested for female participants to address their fitness preferences and motivate them to intensify their exercise participation. Lastly, it is recommended that PE teachers be equipped with knowledge in exercise science, as progression from the fitness phase to the sport-specific phase demands technical and case-to-case knowledge in exercise programming and customization.

While the study is the first of its kind in the Philippines, limitations arise, particularly in the lack of several versions of different exercise models to be evaluated to identify better how program elements affect the test scores. Also, this study is limited to using only the three performance tests mentioned. Future studies may further expand the variables to be tested and fitness tests to be used.

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Conflict of Interest
The author declares that there is no conflict of interest.

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