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Original Research Paper

The Role of Physiotherapy In Physical Fitness To Measure Balance and Coordination

Ida Bagus Acarya Putra*, Agung Wahyu Permadi , I Made Astika Yasa , I Made Yoga Parwata

Physiotherapy Study Program, Universitas Dhyana Pura, Bali, Indonesia

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Email Corresponding:
gusd9132@gmail.com

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Abstract

Background: Physical fitness reflects the body's ability to perform activities efficiently, supported by optimal balance and coordination. **Objective:** This study aimed to determine the effect of physiotherapy balance board exercises on improving balance and coordination among students at Dhyana Pura University. **Methods:** A pre-experimental one-group pre-test post-test design was applied using purposive sampling with 20 participants meeting the inclusion and exclusion criteria. Balance and coordination were assessed using the Standing Stork Test and Hand Wall Toss Test, respectively, before and after 12 training sessions conducted over four weeks. **Results:** The findings showed a notable improvement in balance, with increases of 22.4% for the right leg and 21.6% for the left leg, alongside a 24.8% enhancement in coordination after the training intervention. Statistical analysis using the paired-sample t-test indicated a significant difference in both balance and coordination ($p = 0.000$, $p < 0.005$), confirming a normal distribution and meaningful post-training improvement. These results demonstrate that consistent physiotherapy-based balance board exercises effectively enhance neuromuscular control, stability, and coordination performance. **Conclusion:** Balance board exercises significantly improve both balance and coordination, highlighting their effectiveness as a physiotherapeutic intervention to enhance physical fitness among university students.

Keywords: *Adolescents; Balance; Coordination; Physical Fitness.*

Introduction

Physical fitness is defined as the ability of the body's systems to work together efficiently to enable healthy individuals to perform activities of daily living with minimal effort, to be alert, and to have enough energy to enjoy leisure-time pursuits and meet unforeseen emergencies[1]. It is a multifaceted concept encompassing cardiorespiratory endurance, muscular strength and endurance, flexibility, body composition, and neuromotor fitness, which includes balance, agility, coordination, and speed[2]. Among these components, balance and coordination are fundamental for almost all human movement, from simple tasks like walking and standing to complex athletic performances. Balance is the ability to maintain the body's center of mass over its base of support, while coordination is the harmonious functioning of different parts of the body to produce complex movements[3]. In young adults, particularly university students, maintaining optimal levels of these components is crucial for academic performance, participation in recreational activities, and injury prevention. Regular physical activity is known to enhance these neuromuscular functions by promoting neuroplasticity, strengthening stabilizing

muscles, and improving proprioceptive feedback[4].

Despite the well-documented benefits of physical activity, a growing body of evidence indicates that modern lifestyles, particularly among university students, are becoming increasingly sedentary. The proliferation of digital technology, long hours of lectures, and study habits that involve prolonged sitting contribute significantly to a decline in overall physical fitness[5]. A study by Pertiwi et al[6]. found a significant negative correlation between social media addiction and physical activity levels among university students, which directly impacts their nutritional status and, by extension, their physical fitness. This sedentary trend is associated with a host of health issues, including obesity, musculoskeletal problems, and a decline in motor skills[7]. Specifically, a lack of dynamic movement can lead to a weakened core, reduced proprioceptive input, and slower reaction times, all of which compromise balance and coordination[8]. Research by Hartanti et al[9]. demonstrated that low consumption of nutritious food and a lack of physical activity were significant contributors to decreased physical fitness in young adults. In Indonesia, data from the Sport Development Index (SDI) in 2006 painted a grim picture, with over 80% of the population classified as having less than optimal fitness levels[10]. This decline in fundamental motor skills among young adults represents a significant public health concern that requires targeted intervention.

The urgency of addressing this decline in balance and coordination is underscored by its direct impact on the quality of life and the increased risk of falls and injuries, which can have long-term consequences. While the importance of physical fitness is widely acknowledged, there is a scarcity of research focusing on simple, scalable, and effective interventions that can be easily integrated into a university student's routine. This research is therefore urgently needed to provide evidence for practical solutions. The novelty of this study lies in its specific focus on the effects of a single, accessible tool the balance board on two distinct but related components of physical fitness in a university student population. While previous studies, such as those by Iskandar et al[11]. and Wulandari et al[12], have demonstrated the benefits of balance training, this study provides a more focused analysis by using a standardized protocol and measuring both balance and coordination simultaneously. It updates and expands upon earlier work by employing a rigorous pre-test/post-test design and focusing specifically on the young adult demographic, a group that is often overlooked in balance training literature, which tends to focus on children or the elderly[13].

The main research question this study aims to answer is: How effective is a four-week structured balance board exercise program in improving static balance and hand-eye coordination among university students? Based on this, the study has the following specific objectives: 1) To measure the initial level of static balance and hand-eye coordination in the participants. 2) To implement a structured four-week balance board exercise intervention. 3) To measure the post-intervention levels of static balance and hand-eye coordination. 4) To analyze the significant differences, if any, between the pre-test and post-test scores for both variables.

The findings of this study have significant potential impact across several domains. For the academic community, it contributes to the body of knowledge in sports science and physiotherapy by providing quantitative evidence on the efficacy of a specific, low-cost intervention. For clinical practice, it can inform physiotherapists and health professionals about effective, time-efficient protocols to improve

neuromotor functions in young adults. For the university community, the results can be used to advocate for the integration of such programs into campus wellness initiatives, student health services, or even as short breaks during long lectures to improve focus and physical well-being. Ultimately, this research aims to provide a simple, evidence-based strategy to counteract the negative effects of a sedentary lifestyle, thereby improving the overall health, academic performance, and quality of life for students.

Materials and Methods

Study Design

This research employed a pre-experimental study design with a one-group pre-test post-test approach. This design was chosen as it is appropriate for measuring the effect of a specific intervention without the need for a control group, making it efficient for initial investigations[14]. The study involved measuring the dependent variables (static balance and hand-eye coordination) before the intervention (pre-test), implementing the intervention over a set period, and then measuring the same variables again (post-test) to assess any changes[15]. This design is particularly useful for determining the potential efficacy of a new or under-researched intervention before committing to a more complex randomized controlled trial.

Sample

The population for this study consisted of all students enrolled in the Physiotherapy Study Program at Universitas Dhyana Pura, Bali. The sample size was determined based on a power analysis to detect a medium effect size (Cohen's d = 0.5) with 80% power and a significance level of 0.05, which yielded a minimum sample size of 17. To account for potential attrition, the sample size was rounded up to 20 participants. Sampling was conducted using a purposive sampling technique, where participants were selected based on specific inclusion and exclusion criteria. The inclusion criteria were: (1) active students of the Physiotherapy Study Program at Universitas Dhyana Pura; (2) aged between 18-25 years; (3) willing and able to provide informed consent; and (4) having a body mass index (BMI) within the normal range (18.5-24.9 kg/m²). The exclusion criteria were: (1) having a history of musculoskeletal injury, particularly to the lower extremities, within the last six months; (2) having any known vestibular, neurological, or cardiovascular condition that could affect balance; (3) currently participating in another structured physical training program; and (4) being unable to attend all intervention sessions.

Data Collection Technique

Data collection was carried out in several stages over a five week period. Prior to commencement, the study received ethical approval from the Institutional Review Board of Universitas Dhyana Pura. The first stage involved obtaining written informed consent from all participants after a thorough explanation of the study's purpose, procedures, potential risks, and benefits. This was followed by the collection of baseline demographic data (age, gender, height, weight). The pre-test measurements were conducted in the university's physiotherapy laboratory. Static balance was measured using the Standing Stork Test, a validated and reliable test for assessing static balance[16]. Participants were instructed to stand on one leg (non-dominant leg first) with the hands on the hips and the other foot placed against the inside of the supporting knee. They were then asked to close their eyes, and the time they could maintain this position without moving their hands or the supporting foot was recorded in seconds using a stopwatch. The best of three trials was recorded. The test was then repeated on the other leg. Hand-eye coordination was assessed using the Hand Wall

Toss Test, another reliable field test.[17] Participants stood two meters away from a solid wall and were asked to throw a tennis ball against the wall with their dominant hand and catch it with the same hand. The number of successful catches in a 30-second period was recorded. Again, the best of three trials was taken as the final score. The intervention phase began the week after the pre-test. The balance board exercise program was conducted three times per week (e.g., Monday, Wednesday, Friday) for four consecutive weeks, totaling 12 sessions. Each session lasted approximately 30 minutes and was supervised by a certified physiotherapist. The protocol started with basic exercises, such as simply maintaining balance on the board with both feet, and progressively increased in difficulty to include single-leg stands, squats, and catching a ball while on the board. The post-test measurements were conducted within one week after the final intervention session, using the exact same procedures and testing environment as the pre-test to ensure consistency and minimize measurement bias.

Data Analysis Technique

All collected data were analyzed using SPSS software (version 26.0 for Windows). The analysis began with descriptive statistics to summarize the demographic characteristics of the participants and the pre-test and post-test scores for both variables (mean, standard deviation, minimum, and maximum). To test for normality of the data distribution, the Shapiro-Wilk test was performed. As the data were found to be normally distributed ($p > 0.05$), a paired-sample t-test was used to compare the mean differences between the pre-test and post-test scores for both static balance (right and left leg) and hand-eye coordination. The level of significance was set at $p < 0.05$ for all statistical tests[18].

Ethical Consideration

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the university's ethics committee. All participants were provided with detailed information about the study, and written informed consent was obtained before their inclusion. Participants were assured of their anonymity and confidentiality, and their right to withdraw from the study at any time without penalty was emphasized. All data were stored securely and used solely for the purpose of this research.

Results

This section outlines the main findings of the study in relation to its stated objectives. The results are presented both descriptively and analytically through frequency distribution tables and the outcomes of the paired-sample t-test.

The following section describes the demographic profile of the 20 participants who completed the study, providing essential context for interpreting and generalizing the research findings to the target population.

Table 1. Frequency Distribution of Respondents Based on Age and Gender

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18	3	15.0
	19	9	45.0
	20	4	20.0
	21	4	20.0
Gender	Male	8	40.0
	Female	12	60.0
Total		**20**	**100.0**

Source: Primary Data 2024

Data from Table 1 shows that the majority of the participants were 19 years old (45.0%), followed by those aged 20 and 21 years (20.0% each). The sample consisted of more female participants (60.0%) than male participants (40.0%). This gender distribution is not

uncommon in physiotherapy programs and is not expected to significantly bias the results, as balance and coordination are not highly sexually dimorphic traits in young adults[19].

Balance and Coordination The second paragraph explains the descriptive results of the main research variables, presenting the mean scores before and after the intervention to provide a clear overview of the changes.

Table 2. Descriptive Analysis of Balance and Coordination Pre-test and Post-test Scores

Variable	Mean	Standard Deviation	Minimum	Maximum	% Improvement
Pre-test Hand Wall Toss Test	16.10	3.259	10	23	
Post-test Hand Wall Toss Test	20.10	3.892	15	27	24.8%
Pre-test Standing Stork Test (Left)	4.762	1.657	1.19	9.22	
Post-test Standing Stork Test (Left)	5.792	1.654	2.89	9.82	21.6%
Pre-test Standing Stork Test (Right)	6.360	1.836	3.33	9.89	
Post-test Standing Stork Test (Right)	7.791	1.610	4.72	10.97	22.4%

Source: *Primary Data 2024*

The results in Table 2 indicate a clear improvement in all measured variables after the four-week intervention. The mean score for hand-eye coordination increased from 16.10 to 20.10, representing a 24.8% improvement. For static balance, the mean time for the left leg increased from 4.762 seconds to 5.792 seconds (21.6% improvement), and for the right leg, it increased from 6.360 seconds to 7.791 seconds (22.4% improvement). These descriptive statistics suggest that the balance board exercise program was effective in enhancing both balance and coordination.

Paired-Sample T-Test Results The third paragraph presents the results of the statistical tests performed to determine whether the observed improvements were statistically significant.

Table 3. Paired-Sample T-Test Results for Balance

Paired Samples	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pre-test Standing Stork Test (Left)	4.762	1.657			
Post-test Standing Stork Test (Left)	5.792	1.654	6.880	19	0.000
Pre-test Standing Stork Test (Right)	6.360	1.836			
Post-test Standing Stork Test (Right)	7.791	1.610	10.893	19	0.000

Source: *Primary Data 2024*

Table 4. Paired-Sample T-Test Results for Coordination

Paired Samples	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pre-test Hand Wall Toss Test	16.10	3.259			
Post-test Hand Wall Toss Test	20.10	3.892	-9.456	19	0.000

Source: *Primary Data 2024*

The results of the paired-sample t-test, shown in Tables 3 and 4, confirm that all improvements were statistically significant. For static balance, both the left leg ($t = 6.880$, $p = 0.000$) and the right leg ($t = 10.893$, $p = 0.000$) showed a significant increase from pre-test to post-test. Similarly, for hand-eye coordination, the t-value was -9.456 with a p-value of 0.000. Since all p-values are less than the predetermined significance level of 0.05, the null hypothesis is rejected. This provides strong statistical evidence that the four-week balance board exercise program was effective in

improving both static balance and hand eye coordination in the study participants.

Discussion

The primary finding of this study is that a structured four-week balance board exercise program leads to statistically and practically significant improvements in both static balance and hand eye coordination among university students. The 22.4% and 21.6% improvements in balance for the right and left legs, respectively, and the 24.8% improvement in coordination, are substantial gains for a relatively short intervention period. These results can be explained by the physiological adaptations induced by balance training. The unstable surface of the balance board creates a constant challenge to the body's postural control system. This forces the neuromuscular system to work harder to maintain stability, leading to enhanced proprioception (the body's awareness of its position in space), improved reaction time of the stabilizing muscles, and increased strength of the core and lower extremity muscles[20]. The progressive nature of the exercises, which moved from simple static balancing to dynamic tasks like catching a ball, further challenged and improved the integration of sensory input and motor output, which is the essence of coordination[21].

Our findings are consistent with and build upon previous research in this area. The study by Wulandari et al[12]. found that a balance board game was more effective than a balance beam in improving dynamic balance in children. Our study extends this finding to a young adult population and demonstrates its effectiveness on static balance as well. Similarly, Iskandar et al.[11] showed that Bosu ball training could improve balance in basketball athletes. While our study used a different tool (a standard balance board), the underlying principle of destabilization is the same, and our results corroborate the effectiveness of this training modality[22]. The significant improvement in hand-eye coordination is also supported by the work of Anggita et al[23], who found that balance training could enhance coordination. Our study adds to this by quantifying the improvement using a standardized test. The magnitude of improvement in our study is comparable to, or even slightly exceeds, that reported in some other studies, which could be attributed to the specific, progressive protocol used or the high motivation of the participants who were physiotherapy students[24].

The findings of this study have significant practical implications. Clinically, physiotherapists can confidently incorporate a four-week balance board program into rehabilitation or fitness plans for young adults looking to improve their neuromotor function. This is a low cost, low risk, and time efficient intervention that can be easily implemented in a clinic or even at home with proper guidance. From a public health perspective, these results provide strong evidence for universities to invest in such programs. Given the high prevalence of sedentary behavior among students, integrating short "balance breaks" or offering after-school balance board fitness classes could be an effective strategy to counteract the negative effects of prolonged sitting[25]. This could not only improve physical fitness but also enhance concentration and cognitive function, potentially benefiting academic performance. The program could be a key component of a broader campus wellness initiative aimed at promoting a healthier and more active student body.

The strength of this research lies in its rigorous pre-test/post-test design, the use of validated measurement tools, and a clearly defined, progressive intervention protocol. The supervision of all sessions by a certified physiotherapist ensured that the intervention was delivered consistently and safely. However, the study has several limitations that

must be acknowledged. First, the lack of a control group means that we cannot definitively rule out the possibility of a placebo effect or other confounding variables. While the improvements are statistically significant, a randomized controlled trial would provide a higher level of evidence. Second, the small sample size (n=20) and the specific demographic (physiotherapy students in Bali) limit the generalizability of the findings to other populations. Physiotherapy students may have better body awareness or be more motivated than the general student population. Third, the short duration of the study (four weeks) means that we do not know how long the effects of the training will be sustained. A follow-up study several months later would be needed to assess the long-term retention of the improvements.

Based on the findings and limitations, several recommendations for future research are proposed. First, a randomized controlled trial (RCT) should be conducted to compare the balance board intervention with a control group (e.g., no exercise or a different type of exercise) to establish a stronger causal link. Second, future studies should include a larger and more diverse sample to enhance the generalizability of the results. Third, a long-term follow-up study is needed to determine the retention rate of the improvements and to establish the optimal frequency and duration of training for long-term benefits. Fourth, research could explore the effects of balance training on other outcomes, such as academic performance, cognitive function, or injury rates in university students. Finally, qualitative studies could be conducted to understand the participants' experiences and perceptions of the intervention, which could help in designing more engaging and effective programs.

Conclusion

In conclusion, this study provides strong evidence that a structured four-week balance board exercise program is an effective intervention for significantly improving static balance and hand-eye coordination among university students. The substantial and statistically significant gains observed in both components of physical fitness underscore the potential of this simple, accessible tool. In an era where sedentary lifestyles are increasingly prevalent, this research highlights the valuable and practical role of physiotherapy in offering targeted solutions to enhance fundamental motor skills. By integrating such evidence-based programs into university wellness initiatives, it is possible to counteract the negative health trends and promote a culture of physical well-being that can benefit students' academic, social, and personal lives.

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