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Balance or Burst: Comparing Two Training Paths to Volleyball Ball Control

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Abstract: Ball control is a fundamental skill in volleyball that serves as the foundation for successful game performance. This study aimed to determine the effectiveness of postural control exercises and agility drills on the self-bump passing ball control of Grade 8 students in volleyball, grounded on the need to enhance foundational motor skills in early adolescence, addressing the gap in the literature regarding comparative effects of balance- and agility-focused interventions, and justified by the importance of evidence-based physical education practices. A quasi-experimental pretest-posttest design was utilized involving 79 Grade 8 students divided into a postural control exercise group and an agility drills group, with interventions conducted over eight weeks while controlling for confounding variables through intact group assignment and health screening, and ball control was assessed using the Wall Volley Test adapted. Findings revealed that both postural control exercises and agility drills significantly improved participants' ball control scores, as determined by the paired samples t-test. However, the Analysis of Covariance showed that postural control exercises were more effective in enhancing ball control than agility drills. These results align with Motor Control Theory and Dynamic Systems Theory, emphasizing that both balance-oriented and agility-oriented pathways support the complex development of motor skills necessary for volleyball performance among novice PE students. In conclusion, while both interventions were effective in enhancing self-bump passing ball control, it is recommended that physical education programs flexibly integrate postural control exercises according to learner needs, resource availability, and instructional objectives.

Keywords: Postural control exercises, agility drills, volleyball, ball control, motor learning

Introduction

Mastering ball control in volleyball, particularly through self-bump passing, remains critical for developing both defensive stability and offensive opportunities (Chhiede, 2023; Khoirudin, 2023), yet it is notably challenging for beginners due to underdeveloped proprioception, muscular strength, and reaction timing (Sobko, 2023; Wicaksono & Rejarjo, 2020). Volleyball is a significant component of Physical Education (PE), providing not only physical fitness but also contributing to cognitive development and the enhancement of social skills (Astuti, 2023; Risma *et al.*, 2020; Yudiana *et al.*, 2022). Globally, coaching approaches range from sophisticated biomechanical analyses to sensor-based feedback systems and more traditional, community-based training methods, as seen in countries like the Philippines (Batez *et al.*, 2021, Đolo *et al.*, 2023; Khoirudin, 2023). Given the wide-ranging benefits of volleyball and its integration into youth development, understanding effective training strategies is crucial for both disciplinary advancement in sports education and broader societal health initiatives (Muharram *et al.*, 2023).

Improving self-bump passing ball control is essential in volleyball, as this skill requires technical precision, quick decision-making, and spatial awareness, with expert players relying on dynamic head movements to assess ball trajectory and opponent positioning (Fortin-Guichard *et al.*, 2020). Motor coordination further supports performance, as higher levels are associated with better execution of sport-specific skills (Marinho & Chagas, 2022). In PE, interactive drills and small-sided games have proven effective in enhancing forearm passing and promoting student engagement (Cruz, 2024). Moreover, integrating tactical and decision-making elements into instruction fosters self-regulation and teamwork, thereby contributing to improved volleyball performance and sustained interest in physical activity (Batez *et al.*, 2021).

Despite the recognition of volleyball's benefits, a specific gap persists in targeted interventions for improving ball control, especially self-bump passing, among beginners (Permana *et al.*, 2022; Pratama, 2023). Practical challenges include beginners' struggle with timing, body positioning, and coordination (Chhiede, 2023; Khoirudin, 2023). Although prior studies have tested plyometric exercises, Teaching Games for Understanding (TGfU), and generic drill-based training (Permana *et al.*, 2022; Pratama, 2023), little focus has been placed on comparing postural control exercises and agility drills for enhancing self-bump passing (Batez *et al.*, 2021; Castillo-Rodríguez *et al.*, 2023). Current educational trends favor evidence-based practice, making this investigation particularly timely (Selmi, 2024).

As selected interventions, postural control and agility are essential yet distinct elements in volleyball training that, when combined, enhance performance and skill acquisition. Postural control exercises develop core stability, balance, and proprioceptive awareness, which are vital for maintaining effective positioning and preventing injury during dynamic movements, while also refining motor control through neuromuscular activation (Khorjahani *et al.*, 2021; Yang & Butler, 2020). In contrast, agility drills improve rapid directional changes, reaction time, and dynamic coordination, directly benefiting defensive techniques and cognitive processing required in gameplay (Chuang *et al.*, 2022; Jiang & He, 2023; Latino *et al.*, 2021).

Previous studies confirmed that postural stability is crucial for effective volleyball performance (Ardigò *et al.*, 2020; Borzucka *et al.*, 2020), while agility development significantly improves reaction time and footwork (Pramono *et al.*, 2023; Selmi, 2024). Motor Control Theory (Bernstein, 1996) emphasizes neuromuscular coordination through organized muscle synergies, while Dynamic Systems Theory (Thelen & Smith, 1994) highlights how motor behavior emerges from the interaction of subsystems, including perception, cognition, and the environment (Saltarelli *et al.*, 2020). However, limited studies have simultaneously examined the impact of targeted postural control versus agility training on foundational volleyball skills in adolescent learners (Khoirudin, 2023). Currently, research and practice lack a clear, comparative understanding of how different training modalities—specifically, postural control exercises versus agility drills—influence self-bump passing ball control in early adolescent learners. Most existing studies (Batez *et al.*, 2021; Castillo-Rodríguez *et al.*, 2023; Đolo *et al.*, 2023; Khoirudin, 2023; Permana *et al.*, 2022; Pratama, 2023) focus on experienced players or general fitness gains, leaving a critical gap in evidence-based strategies for beginners within school-based Physical Education settings.

This study addresses the underexplored comparative effectiveness of postural control and agility drills in improving volleyball self-bump passing among early adolescents (Batez *et al.*, 2021; Pramono *et al.*, 2023). By focusing on a PE context with beginner students, it fills a gap left by prior research largely focused on elite or experienced athletes (Đolo *et al.*, 2023). Addressing this gap offers crucial insights for curriculum development and instructional design in sports education (Astuti, 2023; Castillo-Rodríguez *et al.*, 2023).

The purpose of this study was to determine the effectiveness of postural control exercises and agility drills in enhancing ball control through self-bump passing among Grade 8 students (Khoirudin, 2023; Pramono *et al.*, 2023). Specifically, it aimed to (1) measure pretest and posttest changes in ball control for each intervention, (2) compare the effectiveness of the two interventions, and (3) determine which training method better supports ball control skill development (Selmi, 2024; Wicaksono *et al.*, 2020).

This study contributes to both theoretical and practical domains by strengthening understanding of motor learning theories in practice (Bernstein, 1996; Thelen & Smith, 1994) and providing actionable strategies for PE teachers, coaches, and curriculum developers (Batez *et al.*, 2021 Risma *et al.*, 2020). Offering evidence-based training interventions benefits students, educators, and the broader school health programs, paving the way for future research on sport-specific skill acquisition strategies (Astuti, 2023; Castillo-Rodríguez *et al.*, 2023).

The remainder of this paper discusses the methods used, presents the results of the interventions, interprets the findings through theoretical and practical lenses, and concludes with recommendations for future research and practice (Pramono *et al.*, 2023; Saltarelli *et al.*, 2020).

Methods and Materials

This study employed a quasi-experimental pretest-posttest non-equivalent groups design (Genç, 2023). A quasi-experimental design was appropriate because random assignment was not feasible in a school-based setting where intact classroom groups were used (Genç, 2023; Özden & Yenice, 2020). Two comparison groups were created: one received postural control exercises, and the other received agility drills, allowing a structured comparison of interventions' effectiveness.

The participants consisted of Grade 8 students (aged 12 to 15 years) enrolled in a public high school in Macasandig, Cagayan de Oro (Republic of the Philippines, Department of Education, 2016). Group A consisted of 40 students and Group B, 39, totaling 79 participants. A convenience sampling method was utilized, as participants were drawn from intact sections assigned by the school (Genç, 2023). Inclusion criteria included Grade 8 enrollment, physical fitness certification, and parental consent; exclusion criteria included injury, musculoskeletal issues, or formal volleyball training. Informed assent and parental consent were secured following ethical research guidelines (Galozo & MacDonald, 2021; Soares *et al.*, 2023).

The study took place in the school gymnasium and surrounding open grounds, ensuring consistent environmental conditions such as surface type, space availability, and instructor supervision across all sessions. The same research assistants and lead researcher facilitated all sessions to maintain instructional uniformity.

The independent variable was the type of intervention: postural control exercises or agility drills. Each group trained three times a week for eight weeks, with each session lasting 45–60 minutes. The Postural Control group engaged in Single-Leg Stand (balance training), Plank exercises (core strengthening), and Dual-Task Walking (cognitive-motor coordination) (Jo *et al.*, 2022; Choi *et al.*, 2021). The Agility Drills group performed In-Out Ladder Drills, T-Drills (Cone Drills), and Forward Hurdle Hops (Pramono *et al.*, 2023; Selmi, 2024). All activities were standardized with scripted instructions and pre-intervention demonstrations.

To enhance the study's replicability and clarity, detailed protocols were followed for both the testing and the exercise interventions. The Wall Volley Test was administered in a controlled environment where participants performed continuous self-bump passes against a flat wall for 60 seconds. Each successful pass—defined as returning the ball to the wall without it touching the ground—was counted. Participants received a standardized demonstration and practiced the test in advance to reduce performance variability (Baumgartner *et al.*, 2016; Clem, 2020; Patenaude *et al.*, 2020).

The Postural Control Group followed a progressive intervention structure over the eight weeks. Initial sessions focused on building fundamental balance and core endurance, with Single-Leg Stands (10–15 seconds/leg) progressing to 30–45 seconds, eventually incorporating head turns or light arm movements. Planks progressed from static holds to dynamic variations, such as shoulder taps and leg lifts, with an increase in duration each week. Dual-Task Walking evolved from simple counting while walking to memory tasks and obstacle navigation, challenging both motor and cognitive functions (Jo *et al.*, 2022; Choi *et al.*, 2021)

The Agility Drills Group also underwent a structured progression. In-Out Ladder Drills began with slow, controlled steps and advanced to high-speed, multi-directional footwork by mid-intervention. T-Drills initially involved basic sprint-touch patterns and were scaled to timed circuits with reduced rest. Forward Hurdle Hops started with low, three-hurdle jumps and progressed to higher repetitions with lateral elements and faster turnover. All interventions adhered to a set warm-up, main activity, and cool-down format. Intensity and complexity were adjusted weekly to ensure physiological adaptation, skill reinforcement, and safe progression (Pramono *et al.*, 2023; Selmi, 2024)

The dependent variable was ball control in self-bump passing, measured using a standardized Wall Volley Test (Baumgartner *et al.*, 2016). Participants completed as many successful self-bump passes as possible within 60 seconds. The Wall Volley Test was validated for skill testing and had been previously tested for known-group validity and test-retest reliability in preliminary pilot trials (Clem, 2020; Patenaude *et al.*, 2020).

Data were collected in three phases: (1) pretest administration, (2) eight-week intervention implementation, and (3) posttest administration. Standardized scripts and protocols were used during testing to minimize bias. Pretest and posttest performances were recorded, with researchers blinded to group assignment during scoring.

Descriptive statistics (mean, standard deviation, frequency distribution) were computed. For within-group comparisons (pretest vs. posttest), the Paired Sample T-test was used. For between-group comparisons post-intervention, Analysis of Covariance (ANCOVA) was employed to determine the difference between the two interventions, controlling for the pretest scores, using adjusted scores. A significance level of $p < 0.05$ was set. Effect sizes, indicated by the partial eta squared (η^2p) were also calculated to interpret the magnitude of differences.

Results

Results are presented according to the sequence of research objectives: (1) within-group changes from pretest to posttest, (2) comparison of groups post-intervention, and (3) evaluation of which intervention was more effective. The data presented in the tables were obtained through the administration of the Wall Volley Test, a standardized psychomotor assessment tool designed to measure ball control in volleyball self-bump passing. Participants were evaluated individually by performing as many consecutive self-bump passes as possible against a flat wall within a 60-second time frame. A pass was considered successful if the ball rebounded cleanly off the wall without touching the ground. Scores were recorded as the total number of successful passes within the time limit. The test was administered in a controlled gymnasium environment, using standardized instructions, demonstrations, and scoring protocols to ensure consistency and reduce potential bias. All participants completed both pretest and posttest evaluations under identical conditions, and results were categorized into performance ranges (Poor to Outstanding) based on raw scores to facilitate analysis. Tables 1, 2, and 3 (*see p. 8*) clearly summarize descriptive statistics, within-group comparisons, and between-group comparisons. All tables are referenced and discussed within the text.

Group A (postural control exercises) started with the pretest mean score of 9.80, while Group B (agility drills) began at 9.59, falling under the border of the Fair performance category. After the intervention, Group A improved to a mean of 38.10, while Group B reached 26.87, classified as Good. Although both groups progressed to the Good category, Group A demonstrated a higher average increase. Standard deviation also increased in both groups, indicating more varied posttest scores. Group A's standard deviation (SD) rose from 4.75 to 10.72, while Group B's increased from 4.16 to 7.93. This suggests that while overall performance increased, the range of individual outcomes widened.

Table 2 holds for analyzing the first null hypothesis (Ho_1): the self-bump passing ball control scores between before and after interventions of the two groups are not significantly different. Based on the analysis, both the Postural Control Exercises and Agility Drills showed significant enhancement between the posttest and pretest in terms of task performance, with $t(39) = 17.70$, $p <. 001$ for the postural control group, and $t(38) = 16.00$, $p <. 001$ for the agility drills category.

In Table 3, the analysis indicated a significant effect of the intervention, $F(1, 76) = 32.20$, $p < 0.001$, suggesting that the intervention had a meaningful impact on the measured outcomes. Furthermore, the large effect size ($\eta^2_\rho = 0.30$) underscores the practical significance of these results. This indicates that the intervention not only produced statistically significant changes but also a considerable degree of change in the dependent variable.

Moreover, while critiques suggesting deeper analysis are valid in broader experimental contexts, they are less applicable in this quasi-experimental study. This study focused on evaluating overall effectiveness within a school-based setting using intact, non-randomized groups. Subgroup analyses (e.g., by age or gender) were intentionally excluded due to the limited sample size and insufficient power for such stratified comparisons. Exploring individual-level variability—such as differences in standard deviation—was beyond the scope of this design, which aimed to capture group-level effects. Furthermore, potential confounding variables were statistically controlled through ANCOVA, strengthening internal validity by adjusting for baseline differences. Future studies using randomized or stratified designs may be better suited for such detailed subgroup exploration.

Discussion

These results suggest that both types of training interventions—postural control and agility drills—are effective in enhancing foundational volleyball skills among beginners. The improvements align with expectations based on motor learning and physical education frameworks, confirming that balance, core stability, and agility are critical elements in ball control development.

According to Bernstein's Motor Control Theory (1996), successful movement execution requires the nervous system to achieve ideal control over the various degrees of freedom of the musculoskeletal system. The postural control program, focusing on balance, core stability, and controlled movement patterns, may have directly maximized the students' neuromuscular coordination compared to the agility drills. In addition, the Dynamic Systems Theory (Thelen & Smith, 1994) also helps explain that motor behavior is the result of the real-time interplay between the properties of the individual, the task, and the environment. Postural control training probably has led to a more integrated adjustment by regulating these interacting subsystems, consequently eliciting a more economical motor pattern in volleyball self-bump passing.

In broad agreement with theoretical assumptions, the effects of visual specificity and articulatory difficulty on misalignments were replicated in the present investigation and further extended. For example, it supports the findings of Borzucka *et al.* (2020) and Ardigò *et al.* (2020), which state that better postural control is associated with improved volleyball performance, achieved by enhancing balance, timing, and precision. Additionally, core balance training influences muscle synergy and motor efficiency (Jo *et al.*, 2022; Choi *et al.*, 2021). Despite earlier reports (Pramono *et al.*, 2023; Selmi, 2024), positive effects of training on agility in terms of reaction time and sporting performance, the results of the present study provide a nuanced view, showing that balance-oriented exercises could offer greater effects on fine motor control and stabilization tasks, as in the case of self-bump in volleyball.

From a researcher's perspective, the outcome highlights the pedagogical relevance of designing early sports programs promoting elementary motor abilities (also concerning postural stability and control). Controlled exercise training that challenges balance is proposed to develop neuromuscular coordination in the early stages of learning and may be particularly relevant for preadolescents, who are early beginners, as opposed to fast-moving agility drills. This insight not only guides the teaching sequence in PE but also promotes evidence-based interventions tailored to learners' actual motor skills.

The researcher observed that students who initially struggled with body coordination began showing more confident and deliberate movements as the intervention progressed. These observations reinforced the quantitative findings and underscored the transformative potential of structured postural control training. The simplicity and adaptability of these exercises were especially valuable in real-world PE settings, particularly in resource-limited schools. The intervention's consistency, feasibility, and positive reception among students further validated the inclusion of postural control as a core strategy in developing foundational movement skills.

In addition, the ease with which postural control exercises can be implemented (i.e., requiring minimal equipment) and adapted for various environments suggests that the strategy is feasible and inclusive for use in schools with diverse characteristics. Therefore, the novel findings of this study advance theory and practice by introducing postural control exercises as a more effective training intervention to improve novice PE students' volleyball self-bump passing compared to other interventions.

Conclusion

This study was conducted to evaluate the effectiveness of postural control exercises and agility drills on ball control in self-bump passing among Grade 8 students. Based on the findings, the study's objectives have been met. A postural control intervention yielded more favorable improvements in ball control compared to agility exercises.

In terms of the theoretical frameworks, the findings support the Motor Control Theory, which emphasizes the importance of neuromuscular coordination and proprioception, and the Dynamic Systems Theory, which highlights the interplay between motor, sensory, and cognitive systems in the acquisition of skills.

Identifying the layer of proprioceptive control and integrating it into early-age physical education has significant implications for future training. This provides valuable insight when developing curriculum and program delivery, as it highlights the effectiveness of a structured, skill-based approach to improving motor performance in youth.

To enhance practical application, it is recommended that physical education programs integrate both postural control and agility training in a complementary manner. While postural control develops foundational balance and stability, agility drills enhance dynamic responsiveness, both of which are crucial for executing skills in sports like volleyball. Educators may consider incorporating these interventions progressively and developmentally, tailoring them to match students' readiness levels.

Moreover, emphasizing proprioceptive and skill-based approaches in early education can yield long-term benefits for students' motor development, injury prevention, and overall physical literacy. Such strategies not only foster improved performance but also greater confidence and sustained participation in physical activity, ultimately contributing to lifelong health and well-being.

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AI Declaration: *This study utilized artificial intelligence tools to assist in preparing this article. Specifically, ChatGPT was used to convert the full thesis manuscript into a reduced journal article format with human supervision and editing, ensuring academic rigor and integrity. Additionally, Grammarly AI was used to enhance the language quality, clarity, and tone of the final manuscript. The author carefully reviewed and edited all outputs to maintain scholarly standards.*

Data Availability Statement: *The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. Requests for access will be evaluated in accordance with ethical guidelines and data privacy policies.*

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Table 1

Descriptive Statistics of Pretest and Posttest Scores by Performance Category for Postural Control Exercises and Agility Drills

			Group A **Postural Control Exercises**				Group B **Agility Drills**			
			Pretest		Posttest		Pretest		Posttest	
Range		**Description**	f	%	F	%	f	%	f	%
62	71	Outstanding	0	0	1	2.5	0	0	0	0
52	61	Very Good	0	0	4	10	0	0	0	0
24	51	Good	0	0	30	75	0	0	23	59
10	23	Fair	22	55	5	12.5	23	59	16	41
1	9	Poor	18	45	0	0	16	41	0	0
		TOTAL	40	100	40	100	39	100	39	100
		Mean	9.80		38.10		9.59		26.87	
		Description	Fair		Good		Fair		Good	
		Standard Deviation	4.75		10.72		4.16		7.93	

Table 2

Paired Samples T-test Results Comparing Pretest and Posttest Scores for Postural Control Exercises and Agility Drills

Groups	Pretest		Posttest		df	t	P
	M	SD	M	SD			
Postural Control Exercises	9.80	4.75	38.10	10.72	39	17.70*	<.001
Agility Drills	9.59	4.16	26.87	7.93	38	16.00*	<.001

** Significant at 0.05 level.*

Table 3

Analysis of Covariance Results for Posttest Scores Controlling for Pretest

Groups	Pretest		Posttest		F(1,76)	p	η^2_ρ
	M	SD	M	SD			
Postural Control Exercises	9.80	4.75	38.10	10.72	32.20*	<.001	0.30
Agility Drills	9.59	4.16	26.87	7.93			

**Significant at 0.05 level.*