The impact of part-whole passing training on passing accuracy in volleyball athletes aged 10–14 years

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Abstract

Background and Study Aim	Passing is one of the fundamental techniques for improving accuracy in young volleyball players. However, training methods that combine part and whole approaches are still understudied in the scientific literature. This study aimed to examine the effect of passing training using a combination of partial and full methods on passing accuracy in volleyball athletes aged 10–14 years, with respect to gender differences.
Material and Methods	This quasi-experimental study employed a pretest–posttest design. The sample was selected using total sampling and included all volleyball athletes aged 10–14 years in Sleman Regency, Indonesia, with a total of 60 athletes. The characteristics (mean±SD) of 30 male athletes were: age 11.9 ± 1.0 years, height 150.1 ± 6.7 cm, weight 44.4 ± 4.9 kg. For 30 female athletes, the characteristics were: age 11.7 ± 0.9 years, height 149.9 ± 7.2 cm, weight 42.5 ± 5.4 kg. Participants were randomly distributed into three groups: passing training with the part and whole method (Group 1), passing training without this method (Group 2), and a control group (Group 3). The intervention lasted 6 weeks (18 sessions). The Brady Volleyball Test was used to measure accuracy in both pretest and posttest.
Results	Paired t-test analysis revealed that passing training improved accuracy in all groups and in both genders ($p<0.05$). Independent t-test results showed that Group 1 had no significant gender differences in accuracy ($p=0.524>0.05$). In contrast, Groups 2 and 3 displayed substantial differences. One-Way ANOVA results ($p=0.000<0.05$), followed by LSD Post Hoc tests, confirmed that Group 1 achieved the highest passing accuracy. Group 2 ranked second, followed by the control group (Group 3).
Conclusions	The part and whole training method significantly enhances passing accuracy in volleyball athletes aged 10–14 years. Moreover, gender differences did not influence the outcomes when this method was applied. These findings have important implications for designing effective and inclusive volleyball training programs, particularly for young athletes in the foundational stages of skill development.
Keywords:	volleyball training, passing accuracy, part-whole method, youth athletes

Introduction

Volleyball is a team sport that requires the integration of technical, tactical, and physical abilities for effective performance. Passing has a central role in initiating offensive actions and maintaining the consistency of team play. Accuracy in passing is important at the early stages of athletic development, as it provides the foundation for skill progression and tactical execution. For young athletes, mastering passing is both a technical task and a factor that influences confidence, cooperation within the team, and continued participation in the sport.

Volleyball is among the most widely practiced sports worldwide, particularly among adolescents and adults. Success in this sport depends heavily on fundamental technical skills, with passing regarded as one of the most critical elements [1]. Accurate passing forms the basis for constructing effective attacks and maintaining control of the game [2]. Consequently, structured training programs designed to enhance passing performance are essential for junior athletes who are still in the early stages of skill development [3]. Despite the common use of passing training by coaches, its scientific investigation remains limited, particularly regarding the effectiveness of the part–whole training method [4, 5].

Proper passing technique directly contributes to improved accuracy in volleyball [6]. Accuracy is especially important for athletes aged 10–14 years, a developmental stage characterized by motor skill acquisition [7, 8]. Enhancing accuracy supports the development of control and coordination [9]. This, in turn, provides the foundation for mastering more complex skills in the future. Accurate passing and other fundamental techniques also enable young players to contribute more effectively to team performance. At the same time, they foster motivation and self-confidence, which directly

influence decision-making [10]. Improved accuracy helps reduce errors during matches and enhances both competitive outcomes and the learning experience [11]. Developing accuracy from an early age therefore prepares athletes for higher levels of competition, where precision and consistency are important for success.

Athletic success is also influenced by structured and systematic training programs. A training approach that combines part and whole methods has been widely applied in volleyball to improve athletes' technical abilities. The part–whole method involves learning a skill by breaking it into smaller components (part) and then reintegrating them into the complete movement (whole) [12]. This approach allows athletes to focus on specific details and correct technical errors more effectively. It also supports gradual learning that strengthens skill comprehension [5]. In contrast, general passing training emphasizes holistic execution from the outset, without separating skills into smaller parts [13]. In this method, athletes practice skills directly in a game context, which helps them understand their application in competitive situations [9]. General passing training also relies on intuition and adaptability, which can contribute to the development of decision-making and quick responses [6]. The choice of training method depends on both program objectives and athletes' specific needs.

Published scientific literature reviews have demonstrated the effectiveness of the part–whole method in improving volleyball skills. For example, this method improved forearm passing ability by 14.41% in 15 athletes aged 12–14 years [13]. It also had a positive influence on smash ability among novice players aged 11–12 years [5]. By contrast, the mini-game method was reported to be more effective than part–whole training for enhancing forearm passing [4]. Improvements in passing accuracy have also been observed with alternative approaches. These include target-based training with the net [6], the drill-based method [9], and pair training with teammates [14, 15]. Given evidence that manipulative movement skills in adolescents may vary by gender [16, 17], it is important to examine whether the effectiveness of training methods differs between male and female athletes.

Analysis of research findings has shown that different training approaches, including the part–whole method, mini-game exercises, and drill-based techniques, contribute to the development of technical skills in young volleyball players. Researchers emphasize that accuracy in passing is closely linked to overall performance, influencing both individual progress and team effectiveness. They also highlight that manipulative movement skills in adolescents may vary by gender, which adds complexity to the training process. At the same time,

certain aspects of applying structured methods to passing accuracy in athletes aged 10–14 years remain insufficiently clarified, which continues to limit the optimization of training strategies. These considerations form the basis for the present investigation. This study aimed to examine the effect of passing training using a combination of partial and full methods on passing accuracy in volleyball athletes aged 10–14 years, with respect to gender differences.

Material and Methods

Participants

The study population consisted of volleyball athletes in Sleman Regency, Indonesia. Total sampling was employed, including all athletes aged 10–14 years, with an average training experience of 1.6±0.4 years. A total of 60 athletes participated. They were divided equally between males (n=30; age 11.9±1.0 years; height 150.1±6.7 cm; weight 44.4±4.9 kg) and females (n=30; age 11.7±0.9 years; height 149.9±7.2 cm; weight 42.5±5.4 kg).

Participants were recruited from local volleyball clubs and schools affiliated with youth sports programs in Sleman Regency. Inclusion criteria included being aged between 10 and 14 years, actively participating in volleyball training at least twice per week, and having no injuries or medical conditions limiting physical activity. Exclusion criteria involved any recent musculoskeletal injury within the past six months or non-compliance with the training schedule.

Ethical approval for the study was obtained under letter number B/1935/UN34.16/PT.01.10/2024. Informed consent was obtained from all participants and their legal guardians prior to participation, in accordance with institutional ethical standards and the Declaration of Helsinki.

No participants dropped out during the intervention, and all 60 completed the pretest and posttest assessments. Random allocation into three groups was performed after recruitment, and descriptive analysis confirmed that there were no significant baseline differences in demographic characteristics between groups (p > 0.05).

Research Design

This study employed a quasi-experimental design, which allows the evaluation of interventions under natural conditions [18]. A pretest–posttest approach was applied, where passing accuracy was measured before and after the intervention. Participants were randomly distributed into three groups to reduce bias (Figure 1). Group 1 received passing training using the part–whole method. Group 2 received passing training without the part–whole method. Group 3 served as the control group and did not receive a specific training intervention. Passing accuracy was assessed using

the Brady Volleyball Test, which has demonstrated strong validity (0.862–0.904) and reliability (0.797–0.879) [19]. This instrument has also been used in volleyball-related studies to evaluate passing accuracy [20, 21].

The intervention lasted six weeks and consisted of 18 sessions conducted three times per week. Each session lasted approximately 90 minutes and included structured warm-up, targeted technical training, and cool-down phases. Training intensity was standardized across all groups at 60%–85% of perceived exertion, with 10–15 repetitions per drill, 3–5 sets per session, 30–60 seconds of rest between sets, and 1–2 minutes between exercise blocks.

Randomization was performed using block allocation stratified by gender to ensure balanced group composition. Although the trainers and participants were not blinded due to the nature of the intervention, performance assessment was conducted by evaluators blinded to group allocation to reduce potential observer bias. All training and assessments were conducted on indoor courts under similar environmental and scheduling conditions to ensure consistency and minimize confounding variables.
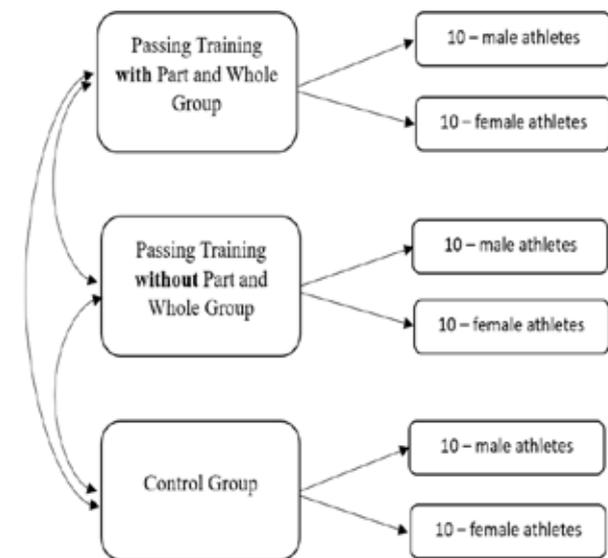

Figure 1. Research Design

Training Program

The passing training program that applied the part–whole method (Group 1) consisted of structured exercises performed both with and without the ball, in collaboration with teammates. This approach integrated two components: non-ball exercises and ball-based exercises.

The non-ball (part-training) model emphasized fundamental movement patterns. These included stepping forward, stepping sideways while touching the floor with the fingers, stepping backward with fingers reaching the ground, arm-swing drills, and repeated forward steps.

The whole-training model provided more integrated tasks. These included underhand passing followed by catching the ball individually, repeated underhand passing practice, underhand passing combined with forward movement, and underhand passing combined with sideways movement. Additional non-ball activities included pushing the arms followed by straight leg swings, forward stepping with arm extension, sideways stepping with straight arm pushes, pushing the arms upward with leg extension, and combinations of forward or sideways steps with simultaneous extension of the arms and legs.

The ball-oriented part and whole exercises involved tossing and catching, catching and tossing while moving forward, sideways, or backward, stepping forward with hands positioned above the head, pushing the arms upward with simultaneous leg extension, and combinations of forward or sideways steps with catching and pushing the ball upward. These drills also included overhead passing combined with forward and sideways steps.

For comparison, Group 2 completed free passing practices with teammates without applying the part–whole method. In contrast, the control group (Group 3) engaged in unstructured practice sessions directly supervised by the researcher.

The intervention for all three groups lasted six weeks, with 18 training sessions conducted three times a week in the afternoon. Training intensity across groups was standardized at 60%–85%, with three to five sets, recovery periods of 30–60 seconds, intervals of one to two minutes, 10–15 repetitions, and a session duration of approximately 90 minutes.

Statistical Analysis

Data were analysed using paired t-tests and one-way ANOVA to evaluate differences between pretest and posttest results. Statistical significance was set at $p < 0.05$. Tests of normality and homogeneity were conducted beforehand to confirm that statistical assumptions were met ($p > 0.05$). All analyses were performed using SPSS version 27, which is widely applied in research for accurate and efficient data processing [22].

Normality of the data was tested using the Shapiro–Wilk test, as group sizes were below 50. Homogeneity of variances across groups was assessed using Levene's test before conducting ANOVA. When significant group differences were found, post hoc analysis was carried out using the Least Significant Difference (LSD) method to identify specific intergroup differences.

Independent samples t-tests were used to assess differences in post-intervention performance between male and female participants within each group. Effect sizes were not reported, which limits the interpretation of practical significance despite statistical differences.

Results

The results of data collection through the pretest–posttest design for volleyball athletes aged 10–14 years are presented below. The first analysis tested data distribution using the Shapiro–Wilk test, as each gender group consisted of 10 athletes. The results are summarized in Table 1.

As shown in Table 1, all groups (male and female, across Groups 1–3) yielded significance values of $p > 0.05$. Thus, the data were normally distributed. This confirmed that the assumptions for parametric testing were satisfied. Therefore, the paired t-test was applied to assess pretest–posttest differences in passing accuracy.

The paired t-test was used to evaluate pretest–posttest differences in passing accuracy for each group. The results are presented in Table 2.

As shown in Table 2, significant improvements were observed in all groups. For Group 1 (part–whole method), both male ($p = 0.000$) and female athletes ($p = 0.000$) demonstrated significant improvements in passing accuracy. In Group 2 (training without the part–whole method), male athletes ($p = 0.001$) and female athletes ($p = 0.000$) also improved,

though the gains were smaller compared with Group 1. In the control group (Group 3), male ($p = 0.010$) and female athletes ($p = 0.013$) showed only minor improvements, but the results remained statistically significant.

The third analysis tested gender differences in passing accuracy among volleyball athletes aged 10–14 years in each group, using an independent t-test. The results are presented in Table 3.

As shown in Table 3, Levene's Test values in all three groups were >0.05, confirming that the samples were homogeneous and that the independent t-test assumptions were met. In Group 1, the p-value was 0.524 (>0.05), indicating no significant difference in passing accuracy between male and female athletes when the part–whole training method was applied. In Group 2, the p-value was 0.001 (<0.05), showing a significant gender difference in passing accuracy. In Group 3, the p-value was 0.000 (<0.05), also indicating a significant difference between male and female athletes in the control group.

The fourth analysis used a One-Way ANOVA test to compare differences among the three groups. In SPSS, the researcher selected the One-Way ANOVA

Table 1. Normality test results

Group	Kolmogorov–Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Group 1 (Male) – Pretest	0.153	10	0.200*	0.932	10	0.473
Group 1 (Male) – Posttest	0.132	10	0.200*	0.965	10	0.841
Group 1 (Female) – Pretest	0.168	10	0.200*	0.908	10	0.268
Group 1 (Female) – Posttest	0.146	10	0.200*	0.948	10	0.646
Group 2 (Male) – Pretest	0.172	10	0.200*	0.944	10	0.596
Group 2 (Male) – Posttest	0.134	10	0.200*	0.952	10	0.690
Group 2 (Female) – Pretest	0.168	10	0.200*	0.908	10	0.268
Group 2 (Female) – Posttest	0.159	10	0.200*	0.936	10	0.508
Group 3 (Male) – Pretest	0.202	10	0.200*	0.938	10	0.532
Group 3 (Male) – Posttest	0.153	10	0.200*	0.969	10	0.882
Group 3 (Female) – Pretest	0.160	10	0.200*	0.942	10	0.575
Group 3 (Female) – Posttest	0.143	10	0.200*	0.934	10	0.487

Note. *p < 0.05

Table 2. Pretest–posttest results after treatment

Group	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Group 1 (Male)	–21.800	1.229	0.389	–22.679	–20.921	–56.080	9	0.000
Group 1 (Female)	–25.500	1.434	0.453	–26.526	–24.474	–56.244	9	0.000
Group 2 (Male)	–5.700	3.529	1.116	–8.225	–3.175	–5.107	9	0.001
Group 2 (Female)	–4.800	2.860	0.904	–6.846	–2.754	–5.308	9	0.000
Group 3 (Male)	–2.200	2.150	0.680	–3.738	–0.662	–3.236	9	0.010
Group 3 (Female)	–1.400	1.430	0.452	–2.423	–0.377	–3.096	9	0.013

procedure with the option for a homogeneity of variance test. The LSD (Least Significant Difference) Post Hoc test was also applied to examine pairwise group differences.

For clarity, the homogeneity test table is not presented here. However, the results showed a homogeneity value of 0.083 (>0.05), indicating that the data across the groups were homogeneous and came from the same population. The results of the One-Way ANOVA test are presented in Table 4.

As shown in Table 4, the significance value was 0.000 (<0.05), confirming that there were significant differences among the three groups. Therefore, Post Hoc test results were used for further analysis.

The Post Hoc analysis was performed using the LSD test to identify pairwise differences among the three groups. The results are presented in Table 5.

As shown in Table 5, the mean difference between Group 1 and Group 2 was 18.850 (p = 0.000), indicating a statistically significant advantage for Group 1. The difference between Group 1 and Group

3 was 22.350 (p = 0.000), confirming a significant advantage for Group 1 as well. Between Group 2 and Group 3, the mean difference was 3.500 (p = 0.000), showing that Group 2 outperformed Group 3.

Overall, the LSD Post Hoc test demonstrated statistically significant differences in passing accuracy among the three groups. The group trained with the part–whole method (Group 1) achieved the highest passing accuracy, followed by Group 2 (training without the part–whole method), while the control group (Group 3) had the lowest passing accuracy.

Discussion

This study aimed to examine the effect of passing training using a combination of partial and full methods on passing accuracy in volleyball athletes aged 10–14 years, with respect to gender differences. The findings revealed significant improvements in passing accuracy across all groups (Group 1,

Table 3. Differences in training methods by gender

Group		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Group 1	Equal variances assumed	0.035	0.853	0.650	18	0.524	0.500	0.770
Group 2	Equal variances assumed	0.480	0.497	3.785	18	0.001	4.200	1.110
Group 3	Equal variances assumed	0.171	0.684	4.516	18	0.000	3.600	0.797

Table 4. One-Way ANOVA test based on three groups

Accuracy Ability	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5780.633	2	2890.317	438.685	0.000
Within Groups	375.550	57	6.589		
Total	6156.183	59			

Table 5. Post Hoc Test on One-Way ANOVA

Dependent Variable: Accuracy Ability

(I) Group			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Group 1	Group 2	18.850*	0.812	0.000	17.22	20.48
		Group 3	22.350*	0.812	0.000	20.72	23.98
	Group 2	Group 1	-18.850*	0.812	0.000	-20.48	-17.22
		Group 3	3.500*	0.812	0.000	1.87	5.13
	Group 3	Group 1	-22.350*	0.812	0.000	-23.98	-20.72
		Group 2	-3.500*	0.812	0.000	-5.13	-1.87

Note. *p < 0.05 (LSD Post Hoc Test).

Group 2, and Group 3) for both male and female athletes. These results suggest that structured and systematic training, including appropriate duration, sets, volume, and intensity, positively contributes to accuracy development regardless of the method employed, which is consistent with previous recommendations [9]. The most substantial improvement, however, was observed in Group 1, which applied the part–whole method. This confirms earlier findings that the technique is effective in enhancing technical skills, as it enables athletes to focus on individual skill components separately before integrating them into complete movements [5].

Further analysis demonstrated that within Group 1, there were no significant gender-based differences in the effectiveness of the training method. This suggests that the part–whole approach can be applied effectively to both male and female athletes. By contrast, significant mean differences were found in Group 2 and Group 3. These differences may be related to biological and psychological variations between male and female athletes, which influence their responses to more general training methods [16]. Previous studies confirm that children aged 10–14 undergo rapid physical growth and marked hormonal changes [23]. Boys and girls progress through different stages of physical maturity, which affects their strength, coordination, balance, and flexibility [24]. Physical capacities such as muscle strength, endurance, and agility also vary, shaping how they respond to training intensity and type [25].

Psychological factors also play an important role in athletes' responses to training. Differences in motivation and interest, often shaped by social environments, may influence the extent of children's engagement in sports [26]. Individual learning styles, such as visual, auditory, or kinesthetic, affect how young athletes absorb new instructions and techniques [3]. Other psychological aspects, including self-efficacy and self-confidence, further determine their willingness to attempt new techniques and adapt to changes in training [27, 28]. Within the context of volleyball training for athletes aged 10–14 years, acknowledging these biological and psychological differences is essential for designing effective and inclusive programs [7]. Coaches should consider variations in physical growth and learning preferences to optimize skill development, particularly in improving passing accuracy [13]. By tailoring training methods to individual needs, coaches can support young athletes in developing both technical and mental capacities required for success in volleyball.

The analysis confirmed that athletes in Group 1, who trained using the part–whole method, achieved the greatest improvement in passing accuracy compared with Groups 2 and 3. By breaking down complex skills into smaller components, athletes were able to understand and master each element before applying them in game contexts. Previous studies have reported that children aged 10–14 often prefer training methods that divide skills into smaller steps [29]. As this age represents a critical phase of cognitive and motor development, athletes can more easily comprehend and master complex skills when they are simplified into sequential components [30, 31]. Segmenting skills into smaller parts enables them to focus on each element independently, reduces cognitive overload, and increases self-confidence as they recognize progress in mastering each stage [32, 33].

In volleyball, particularly in passing training, the part–whole method appears to be highly effective. By decomposing passing techniques into smaller elements, such as hand positioning, footwork, and timing, children can identify weaknesses more easily and make targeted corrections [5]. Once each component is mastered, they can reintegrate them into the complete movement with greater confidence and efficiency [12]. This method not only improves technical execution but also supports tactical understanding, which is important for overall performance in volleyball [34, 35]. In contrast, Group 2, which trained without the part–whole approach, showed only moderate improvement, while the control group (Group 3) demonstrated the lowest progress. These findings emphasize the value of structured training interventions.

The present findings provide evidence that systematic and well-structured training plays a central role in developing passing accuracy among young volleyball athletes. The part–whole method demonstrated particular effectiveness, as it not only improved technical execution but also supported confidence and tactical awareness. At the same time, the observed gender-related differences in other groups highlight the importance of considering biological and psychological factors when designing training strategies.

Limitations and Practical Implications

Despite its contributions, this study is not without limitations. The geographical scope was limited to Sleman Regency, meaning the results may not fully represent a broader population. In addition, the quasi-experimental design did not allow complete control over external variables that may have influenced outcomes, and measurements of passing accuracy were conducted under controlled conditions that may not entirely replicate competitive match environments.

Nevertheless, the study provides meaningful implications for the development of volleyball training programs. The part–whole training method proved effective in improving passing accuracy and

can be adopted by coaches seeking to enhance the technical skills of young athletes. Furthermore, the observed gender-based differences in Groups 2 and 3 highlight the importance of designing inclusive and individualized training programs. These findings also open opportunities for future studies to examine the effectiveness of the part–whole method across diverse populations and contexts.

Conclusions

This study demonstrates that the part–whole training method significantly enhances passing accuracy among volleyball athletes aged 10–14 years. The technique was equally effective for both male and female athletes, indicating that gender differences did not affect training outcomes when this structured approach was applied. In contrast, athletes who trained without the part–whole method, as well as those in the control group, showed only moderate improvements, underscoring the value of structured and systematic training. The findings highlight the importance of considering both biological and psychological differences when

designing training programs for young athletes. By breaking down skills into smaller, manageable components, coaches can help athletes master techniques more effectively, build confidence, and foster long-term development. Although this study was limited by its geographical scope and quasi-experimental design, the results provide valuable implications for volleyball training programs and demonstrate the potential of the part–whole method to support inclusive and effective athlete development. Future research should expand the investigation to broader populations and competitive contexts to strengthen the generalizability of these findings.

Acknowledgement

Conflict of Interest

The author declares no conflict of interest.

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