



The Effect Of Exercise Ball Training On Improving Handstand Ability In PERSANI Athletes In Makassar City

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ABSTRACT

Handstand is a fundamental skill in floor gymnastics that requires core stability, shoulder strength, arm support, balance, coordination, and precise body control. However, several PERSANI Kota Makassar athletes still experience difficulty maintaining correct body alignment and stability during handstand execution. Therefore, an appropriate training method is needed to improve the physical components that support handstand performance. This study aimed to determine the effect of exercise ball training on improving handstand ability among PERSANI Kota Makassar athletes. This research used a quantitative experimental method with a two-group pretest–posttest design. The sample consisted of 20 athletes selected through random sampling and divided into two balanced groups using ordinal pairing: the exercise ball training group and the control group, each consisting of 10 athletes. Handstand ability was measured using a movement skill assessment rubric with a score range of 1 to 3. The data were analyzed using descriptive statistics, normality test, homogeneity test, and paired sample t-test. The results showed that the exercise ball group increased from a pretest mean score of 1.40 to a posttest mean score of 2.40, with a mean difference of 1.000 and a significance value of $0.000 < 0.05$. The control group also improved from 1.20 to 1.70, with a significance value of $0.015 < 0.05$. However, the improvement in the exercise ball group was higher. It can be concluded that exercise ball training is effective in improving handstand ability among PERSANI Kota Makassar athletes.

INTRODUCTION

Floor gymnastics in Indonesia has shown meaningful development in recent years, particularly through school-based programs, community clubs, and regional athlete development systems. This progress has created wider opportunities for young athletes to learn, train, and compete in gymnastics from the early stages. In South Sulawesi, especially Makassar, the development of floor gymnastics has also grown through regular coaching programs, local competitions, and the institutional role of PERSANI Kota Makassar as a regional organization responsible for athlete development, coach education, and talent identification. However, this positive growth is still followed by practical challenges, including unequal access to adequate training facilities, limited training variation, and insufficient evidence-based conditioning programs for basic technical skills. In competitive gymnastics, technical mastery cannot be separated from physical preparation because every skill requires strength, balance, flexibility, coordination, and body control (FIG, 2025; Dongaz et al., 2024; Wijaya et al., 2024).



One of the fundamental skills that requires serious attention is the handstand. Handstand is an inverted body position in which the body is supported by both hands while the legs are extended vertically upward (Arfanda et al., 2024). Although it appears simple, handstand is a complex gymnastic element because it requires shoulder strength, arm support, wrist control, core stability, hip alignment, and precise postural balance. Previous biomechanical studies show that handstand performance depends on the ability to regulate center of pressure, muscle activation, and postural correction during an unstable inverted position (Kochanowicz et al., 2018; Milosis et al., 2023; Sabido et al., 2024). At the athlete-development level, many gymnasts still experience difficulty maintaining vertical alignment, controlling body sway, and sustaining the position for a sufficient duration. This condition indicates that handstand ability is not only a technical issue but also a physical-conditioning issue.

Current sports science literature emphasizes that core stability is a key component of athletic performance because it supports efficient force transfer, postural control, and movement precision (Dong et al., 2023; Rodríguez-Perea et al., 2023; Schulte et al., 2025). In gymnastics, core stability has a more specific function because athletes must control body segments in static, dynamic, and inverted positions. Core stabilization exercises have been reported to improve physical fitness parameters among child gymnasts, including balance, muscular endurance, flexibility, and movement control (Cabrejas et al., 2022; Dongaz et al., 2024; Wijaya et al., 2024). These findings are relevant to handstand because the movement demands a stable trunk, strong shoulder girdle, and coordinated neuromuscular control from the wrists to the hips.

Exercise ball training, also known as Swiss ball or stability ball training, is one training method that can challenge the core muscles through an unstable surface. The instability created by the ball requires athletes to activate deep and superficial trunk muscles, improve proprioception, and maintain balance during movement execution (Srivastav et al., 2016; Nuhmani, 2021; Gao et al., 2025). Studies on Swiss ball exercises have shown positive effects on core strength, core endurance, postural control, dynamic balance, and neuromuscular coordination (Nuhmani, 2021; Prasetyo et al., 2023; Rodríguez-Perea et al., 2023). In practical gymnastics training, exercise ball drills such as plank on ball, rollout, pike movement, shoulder stabilization, and assisted inverted-position drills may strengthen the abdominal muscles, lower back, shoulders, and arms that are directly involved in handstand performance (Asri et al., 2021; Tresnowati et al., 2022; Omorczyk et al., 2018).

Empirical evidence also suggests that handstand ability is influenced by postural-control strategy and fatigue. Sabido et al. (2024) reported that handstand balance requires continuous muscular coordination and motor control, while Kochanowicz et al. (2018) found that young and adult gymnasts show different muscle activation patterns during handstand performance. This means that training programs for developing athletes must not only repeat the handstand technique, but also strengthen the supporting physical components that determine successful execution. Although many studies have examined core stability, balance training, and Swiss ball exercises in different sports, research specifically investigating the effect of exercise ball training on handstand ability in gymnastics athletes remains limited, especially in the Indonesian regional context. Previous studies have mostly focused on general physical fitness, rehabilitation, student balance, or athletes from sports such as football, archery, volleyball, and swimming (Dong et al., 2023; Prasetyo et al., 2023; Yu et al., 2025; Rodríguez et al., 2025). Meanwhile, the transfer of exercise ball training to a specific gymnastics skill such as handstand has not been sufficiently explored.

In the context of PERSANI Kota Makassar, this gap becomes more important because regional athlete development needs practical, affordable, and scientifically grounded training models. Exercise ball training is relatively simple, low-cost, safe when properly supervised, and adaptable to different training levels. However, without empirical testing, coaches may not know whether this method significantly improves handstand performance. Therefore, a study that directly evaluates the effect of exercise ball training on handstand ability is necessary to bridge the gap between training theory and practical coaching needs. This study aims to determine the effect of exercise ball training on improving handstand ability among PERSANI Kota Makassar athletes. Conceptually, this study is based on the assumption that handstand performance depends on the interaction between core strength, shoulder stability, arm support, balance, flexibility, and neuromuscular control (Mulyono et al., 2021; Santoso et al., 2025; Schulte et al., 2025). Empirically, exercise ball training is expected to provide an unstable training stimulus that strengthens the trunk and upper-body muscles while improving balance control needed for maintaining the inverted vertical position.

The novelty of this study lies in its specific focus on exercise ball training as a conditioning method for handstand improvement in regional gymnastics athletes. Unlike general core-training studies, this research connects an unstable-surface training method with a specific floor-gymnastics skill. The findings are expected to contribute to the development of evidence-based training programs for gymnastics coaches, particularly in Makassar and South Sulawesi. In addition, this study may provide a practical reference for PERSANI Kota Makassar in designing systematic, progressive, and measurable training programs for young gymnasts.

In conclusion, handstand is a fundamental yet complex skill in floor gymnastics that requires strong physical and technical foundations. Exercise ball training offers a promising method to improve core stability, balance, shoulder strength, and body control, all of which are essential for handstand performance. Therefore, this study is important because it provides empirical evidence on whether exercise ball training can significantly improve the handstand ability of PERSANI Kota Makassar athletes and support the advancement of gymnastics coaching at the regional level.

METHODS

This study employed a quantitative experimental method using a two-group pretest–posttest design. An experimental approach was selected because the study aimed to examine the causal effect of exercise ball training on handstand ability after a structured treatment program. Experimental designs are appropriate in sport training research because they allow researchers to compare initial and final performance changes after a specific training stimulus (Creswell & Creswell, 2018; Thomas, Nelson, & Silverman, 2022). In line with recent gymnastics and core-stability studies, training interventions must be systematically planned, controlled, and evaluated through valid motor-performance indicators (Dongaz et al., 2024; Wijaya et al., 2024). The population of this study consisted of PERSANI Kota Makassar athletes. The sample included 20 athletes selected through random sampling. Before treatment, all participants completed a handstand pretest to determine their initial ability. The pretest scores were then ranked and paired using the A-B-B-A ordinal pairing technique to form two balanced groups: the exercise ball training group and the control training group, each consisting of 10 athletes. This grouping technique was used to reduce initial performance bias between groups and to ensure fair comparison during the intervention.

The treatment group received exercise ball training designed to improve core strength, shoulder stability, balance, and body control, which are essential components of handstand performance (Srivastav et al., 2016; Nuhmani, 2021; Setyawan et al., 2021). The control group followed conventional gymnastics training without specific exercise ball drills. Handstand ability was measured through a basic handstand movement skill assessment rubric. The scoring scale ranged from 1 to 3: score 1 indicated incorrect movement execution, score 2 indicated nearly correct execution, and score 3 indicated correct execution. Data were collected through pretest and posttest scores from both groups. The data were analyzed using descriptive statistics and inferential statistics. Before hypothesis testing, normality and homogeneity tests were conducted to ensure that the data met parametric assumptions. The paired sample t-test was used to examine within-group differences between pretest and posttest scores, while comparison between groups was used to determine the relative effectiveness of the exercise ball intervention. The decision criterion was set at a significance level of $p < .05$. If the significance value was below .05, the treatment was considered to have a statistically significant effect on improving handstand ability.

RESULTS AND DISCUSSION

Results

This section presents the empirical findings on the effect of exercise ball training on improving handstand ability among PERSANI Kota Makassar athletes. The data analysis consisted of descriptive statistics, prerequisite tests, and hypothesis testing. The study involved two groups: the exercise ball training group and the control group, with 10 athletes in each group.

Descriptive Analysis

The descriptive analysis was conducted to describe the pretest and posttest scores of handstand ability in both groups. The results are presented in Table 1.

Table 1. Descriptive Statistics of Handstand Ability

Variable	N	Range	Min.	Max.	Sum	Mean	Sdv
Pretest handstand ability: exercise ball group	10	1	1	2	14	1.40	0.516
Posttest handstand ability: exercise ball group	10	1	2	3	24	2.40	0.516
Pretest handstand ability: control group	10	2	0	2	12	1.20	0.632
Posttest handstand ability: control group	10	2	1	3	17	1.70	0.823

Based on Table 1, the exercise ball group showed an increase in the mean score from 1.40 in the pretest to 2.40 in the posttest, with a mean improvement of 1.00 point. This indicates that athletes who received exercise ball training demonstrated better handstand performance after the treatment. The standard deviation remained stable at 0.516, showing that the improvement occurred relatively consistently among the athletes.

In the control group, the mean score increased from 1.20 in the pretest to 1.70 in the posttest, with a mean improvement of 0.50 point. Although the control group also experienced improvement, the increase was lower than that of the exercise ball group. This suggests that conventional training may improve handstand ability, but its effect was not as strong as the exercise ball training program.

Prerequisite Tests

Before hypothesis testing, normality and homogeneity tests were conducted to ensure that the data met the assumptions for parametric statistical analysis.

Normality Test

The normality test was conducted using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The results are shown in Table 2.

Table 2. Normality Test Results

Variable	Kolmogorov-Smirnov		Shapiro-Wilk		α	Interpretation
	Statistic	Sig.	Statistic	Sig.		
Handstand exercise ball group	0.151	0.200	0.950	0.673	0.05	Normal
Control group	0.205	0.200	0.929	0.436	0.05	Normal

Table 2 shows that the significance values of both groups were greater than 0.05. In the exercise ball group, the Kolmogorov-Smirnov significance value was 0.200 and the Shapiro-Wilk significance value was 0.673. In the control group, the Kolmogorov-Smirnov significance value was 0.200 and the Shapiro-Wilk significance value was 0.436. Therefore, the data from both groups were normally distributed.

Homogeneity Test

The homogeneity test was conducted using Levene's test to determine whether the variance between the exercise ball group and the control group was homogeneous.

Table 3. Homogeneity Test Results

Group Comparison	Levene Statistic	Sig.	α	Interpretation
Exercise ball group and control group	0.985	0.411	0.05	Homogeneous

Based on Table 3, the Levene statistic value was 0.985 with a significance value of 0.411. Since $0.411 > 0.05$, the variance between the two groups was homogeneous. Therefore, the data met the requirements for further hypothesis testing.

Hypothesis Testing

After the prerequisite tests confirmed that the data were normally distributed and homogeneous, hypothesis testing was conducted using t-test analysis.

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Table 4. Paired Sample t-Test of the Exercise Ball Group

Group	Test	Mean	Mean Difference	t-count	df	Sig. (2-tailed)	t-table	Interpretation
Exercise ball group	Posttest	2.40	1.000	6.708	9	0.000	1.833	Significant
	Pretest	1.40						

Table 4 shows that the exercise ball group obtained a t-count value of 6.708, which was greater than the t-table value of 1.833. The significance value was 0.000, which was lower than 0.05. Therefore, the null hypothesis was rejected. This result indicates that exercise ball training had a significant effect on improving handstand ability among PERSANI Kota Makassar athletes.

The Effect of Control Training on Handstand Ability

Table 5. Paired Sample t-Test of the Control Group

Group	Test	Mean	Mean Difference	t-count	df	Sig. (2-tailed)	t-table	Interpretation
Control group	Posttest	1.70	0.500	3.000	9	0.015	1.833	Significant
	Pretest	1.20						

Table 5 shows that the control group obtained a t-count value of 3.000, which was greater than the t-table value of 1.833. The significance value was 0.015, which was lower than 0.05. Therefore, the null hypothesis was rejected. This means that the control group also showed a significant improvement in handstand ability. However, the magnitude of improvement was smaller than that of the exercise ball group.

Comparison Between the Exercise Ball Group and the Control Group

Table 6. Comparison of Posttest Scores Between Groups

Variable	Group	N	Mean	Mean Difference	Interpretation
Handstand ability	Exercise ball group	10	2.40	0.70	Higher improvement
	Control group	10	1.70		Lower improvement

Based on Table 6, the posttest mean score of the exercise ball group was 2.40, while the posttest mean score of the control group was 1.70. The mean difference between the two groups was 0.70 point. This finding indicates that exercise ball training produced a greater improvement in handstand ability than conventional control training. Conceptually, the greater improvement in the exercise ball group can be explained by the training characteristics of the exercise ball itself. Exercise ball exercises require athletes to maintain body stability on an unstable surface, which stimulates core activation, shoulder control, arm support, and balance regulation. These physical components are directly related to successful handstand performance because athletes must control the body in an inverted position while maintaining alignment from the wrists, shoulders, trunk, hips, and legs. Empirically, the results support the hypothesis that exercise ball training is effective in improving handstand ability among PERSANI Kota Makassar athletes. The increase from 1.40 to 2.40 in the exercise ball group demonstrates a stronger training effect than the increase from 1.20 to 1.70 in the control group. Therefore, exercise ball training can be considered an effective supporting method for improving basic handstand skills in gymnastics athletes.

Discussion

The results of this study demonstrate that exercise ball training had a significant effect on improving handstand ability among PERSANI Kota Makassar athletes. Empirically, the exercise ball group improved from a pretest mean score of 1.40 to a posttest mean score of 2.40, with a mean difference of 1.000 point. The paired sample t-test showed a significance value of 0.000, which was lower than 0.05, indicating that the intervention produced a statistically significant improvement. This finding confirms that exercise ball training can be used as an effective supporting method to improve handstand performance in gymnastics athletes. Conceptually, the improvement can be explained by the specific physical demands of the handstand. Handstand is not merely an inverted static position, but a complex motor skill that requires shoulder strength, arm support, wrist control, core stability, hip alignment, balance, and neuromuscular coordination (Kochanowicz et al., 2018; Kochanowicz et al., 2019; Milosis et al., 2023; Sabido et al., 2024; MacDonald et al., 2025). During handstand execution, athletes must maintain a vertical body line while controlling body sway through coordinated muscle activation. Therefore, any training method that improves trunk stability, shoulder control, and postural adjustment has strong relevance to handstand performance.

Exercise ball training provides an unstable surface that requires the body to activate stabilizing muscles continuously. This instability stimulates the abdominal muscles, lower back muscles, shoulder girdle, hip

stabilizers, and deep core muscles to work together in maintaining balance and body alignment (Srivastav et al., 2016; Nuhmani, 2021; Gao et al., 2025; Schulte et al., 2025). This mechanism is highly relevant to handstand because athletes must stabilize the body in an inverted position with a narrow base of support. The finding of this study is in line with previous research showing that core stability training improves dynamic balance, trunk endurance, and sport-specific movement control (Szafraniec et al., 2020; Dong et al., 2023; Rodríguez-Perea et al., 2023; Gong et al., 2024).

From a gymnastics perspective, core stability is a fundamental component for successful movement execution. Cabrejas et al. (2022) found that functional core training improved core stability in young rhythmic gymnasts, while Dongaz et al. (2024) reported that core stabilization exercises enhanced several physical fitness parameters in child gymnasts. Similarly, Wijaya et al. (2024) emphasized that static and dynamic core stabilization can improve balance, flexibility, and strength in gymnastics athletes. These findings support the present study because the exercise ball program used in this research was directed toward strengthening the same physical components needed for handstand performance. The significant improvement in the exercise ball group also indicates that the training stimulus was more specific than conventional training. Exercise ball drills such as plank variations, rollout, pike movement, shoulder stabilization, and body-control exercises require athletes to maintain posture while responding to instability. This condition develops proprioception, coordination, and reflexive postural correction (Omorczyk et al., 2018; Asri et al., 2021; Tresnowati et al., 2022; Prasetyo et al., 2023). In handstand, these abilities help athletes control the relationship between the wrists, shoulders, trunk, hips, and legs. Therefore, the 1.000-point improvement in the exercise ball group can be interpreted as the result of improved physical readiness and better technical control.

The control group also showed a significant improvement, with the mean score increasing from 1.20 to 1.70 and a significance value of 0.015. This means that conventional gymnastics training still contributed to handstand improvement. However, the magnitude of improvement was smaller than that of the exercise ball group. This result is logical because repeated practice of handstand techniques can improve movement familiarity, confidence, and basic coordination (Chrisnanda, 2018; Nugraha et al., 2023; Arfanda et al., 2024). Nevertheless, without a specific instability-based core training stimulus, the control group may not have developed trunk stability and postural control as effectively as the exercise ball group. The difference between the two groups confirms that exercise ball training offers additional benefits beyond ordinary technical repetition. In gymnastics coaching, technical training must be supported by physical conditioning that strengthens the muscles responsible for movement control (Mulyono et al., 2021; Santoso et al., 2025). The exercise ball helps athletes train balance under unstable conditions, which is closer to the postural challenge experienced during handstand. This finding is also consistent with Indonesian studies showing that core stability exercises improve balance and movement performance in athletes and students (Syapitri, 2017; Gustaman, 2019; Pratama et al., 2020; Setyawan et al., 2022; Rozaq et al., 2022; Fadli et al., 2026).

The practical implication of this study is that PERSANI Kota Makassar coaches should integrate exercise ball training into handstand development programs, especially for athletes who still have difficulty maintaining body alignment, controlling balance, or sustaining the inverted position. Exercise ball training is relatively simple, affordable, and adaptable to different athlete levels. However, it must be implemented progressively, starting from basic core activation and moving toward more complex handstand-specific drills. Progressive loading is important to avoid excessive pressure on the wrists, shoulders, and lower back. Overall, the findings show that exercise ball training is empirically effective and conceptually relevant for improving handstand ability. The greater improvement in the exercise ball group demonstrates that unstable-surface training can strengthen core stability, shoulder support, balance, coordination, and body control. Therefore, exercise ball training can be recommended as an evidence-based supplementary training method for improving handstand skills among PERSANI Kota Makassar athletes.

CONCLUSION

Based on the results of the study, it can be concluded that exercise ball training has a significant effect on improving handstand ability among PERSANI Kota Makassar athletes. Empirically, the exercise ball group showed a clear improvement from a pretest mean score of 1.40 to a posttest mean score of 2.40, with a mean difference of 1.000 point. The paired sample t-test result showed a significance value of 0.000, which was

lower than 0.05, indicating that the treatment produced a statistically significant improvement. This finding confirms that exercise ball training is effective in developing the physical components required for handstand performance, particularly core stability, shoulder strength, balance, coordination, and body control.

The control group also experienced improvement, with the mean score increasing from 1.20 to 1.70 and a significance value of 0.015. However, the increase was smaller than that of the exercise ball group. This indicates that conventional training can improve handstand ability, but exercise ball training provides a stronger training stimulus. Conceptually, the unstable surface of the exercise ball encourages athletes to activate stabilizing muscles and maintain postural control, which are essential for performing a correct handstand. Therefore, exercise ball training can be recommended as an effective supplementary method in gymnastics training programs.

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