American Journal of Social and Humanitarian Research

Vol. 6 Issue 9 | **pp.** 2319-2328 | **ISSN:** 2690-9626

Available online @ https://globalresearchnetwork.us/index.php/ajshr

Article

The Effect of Using Balls of Different Speeds and Sizes on Developing The Serving Skill of Advanced Table Tennis Players

Hamdullah Abed Hammadi[1], Mohammed Obaid Jameel[2]

1. Directorate of Education, Anbar
2. University of Anbar, College of Physical Education and Sports Sciences, Iraq

* Correspondence: aldlymyhmdallh@gmail.com, m.obaid.jameel@uoanbar.edu.iq

Abstract: This study aims to study the effect of balls of different speeds and sizes on the development of serving skills among advanced table tennis players. The researcher adopted an experimental approach by designing two groups (experimental and control) and implementing a special training program using three types of balls (normal, fast, and slow) that differed in weight and size. The sample included (20) advanced youth players, aged between 17 and 19 years, from Al-Furat Sports Club in Babil Governorate. The training program was implemented over a period of (6) weeks, with three weekly sessions. A special serving test was used to assess serving accuracy, speed, and stability. The results of the statistical analysis showed significant differences in favor of the experimental group in the three variables, confirming the effectiveness of using various balls in developing technical performance. The study recommends adopting this method within training programs for advanced players to enhance serving skills in a practical manner according to the requirements of the match. It also suggests conducting similar studies on other skills such as receiving or smashing.

Keywords: table balls, serving, speed, size, skill training

Citation: Hammadi, H. A & Jameel, M. O. The Effect of Using Balls of Different Speeds and Sizes on Developing The Serving Skill of Advanced Table Tennis Players. American Journal of Social and Humanitarian Research 2025, 6(9), 2319-2328

Received: 10th Jun 2025
Revised: 16th Jul 2025
Accepted: 24th Aug 2025
Published: 28th Sep 2025

1. Introduction

The serve is one of the most important basic skills in table tennis, forming the starting point for every offensive or defensive exchange. A player with a diverse serve is able to impose their rhythm on their opponent and destabilize their defense [1], [2]. At advanced levels, the success of the serve depends on several factors, including speed, accuracy, and rotational movement. The training environment is a key factor in developing this skill, particularly the type of ball used. A player's response and movement vary depending on the ball's characteristics, such as weight, diameter, and bounce speed [3].

Field observations have shown that most clubs rely on a single type of ball for training, despite the varying playing conditions in matches, such as ball quality or changing it between sets or tournaments [4]. Hence, the need to study the impact of using balls with multiple characteristics on the development of the serve among advanced players, helping to build players capable of adapting to different playing situations.

The importance of this research lies in:

1. Providing an applied training program using balls with diverse physical properties.
2. Measuring the impact of this diversity on developing the serve skill.

3. Providing a practical alternative to traditional training methods.
4. Supporting coaches with an experimental approach supported by statistical evidence.
5. Enhancing players' ability to adapt to changes in playing equipment.

Importance of the Research

This research derives its importance from several practical and applied aspects in the field of table tennis training, most notably:

1. Providing a training program based on the use of balls of varying sizes and speeds, a method not widely applied in local training [5].
2. Targeting the development of serving skills in its three aspects (accuracy, speed, and stability) to achieve consistent performance under different playing conditions.
3. Designing a field test that simulates real-world playing situations to accurately measure serving skills.
4. Providing coaches with a field-applicable training method for developing serving at advanced levels.
5. Contributing to bridging the research gap related to the integration of non-traditional training tools into player preparation programs.

Research Problem

By observing training sessions and official matches of advanced table tennis players, the researcher observed that most players face difficulty maintaining the quality of their serve when changing the type of ball used [6], [7]. This observation has been repeated in more than one local tournament, where some players' performances declined when using balls different from those they were accustomed to during training, whether in terms of weight, diameter, or bounce speed.

The reason is often due to reliance on a single type of ball during the preparation period, which leads to players' poor adaptation to the actual variables in the competitive playing environment. This gap negatively impacts a player's ability to diversify their serve, and their mental and physical readiness to deal with changing situations within a match [8].

The research is based on the following question:

Does the use of balls of different speeds and sizes affect the development of serving skills among advanced table tennis players?

Research Objectives

This research seeks to achieve the following objectives:

1. Develop a training program using balls of varying speed and size.
2. Measure the program's effectiveness in developing the accuracy, speed, and stability of the serve among players.
3. Identify differences between the experimental group (training with different balls) and the control group (traditional training).
4. Provide practical recommendations for coaches on how to incorporate different balls into training.
5. Design a field test based on accurate indicators to evaluate serving skills.

Study Hypotheses

1. There are statistically significant differences in the transmission test results between the pre- and post-tests in favor of the experimental group.
2. There are no statistically significant differences in the control group between the pre- and post-tests.
3. There are statistically significant differences in the post-test results between the two groups in favor of the experimental group [9].

Research Areas

Human Domain

Al-Furat Sports Club players in the advanced youth category, numbering (20) players.

Temporal Domain

The duration of the experiment extended from March 5, 2025 to April 15, 2025.

Spatial Domain

The table tennis hall at Al-Furat Club in Babil Governorate, equipped with training tools and a visual assessment board.

Definition of Terms

1. Various Balls: Training balls that vary in weight, size, and bounce, including (fast ball, slow ball, larger than standard size), according to the table 5.
2. Serving Skill: The movement to initiate a point in table tennis, which includes: dropping the ball, hitting it with the racket, and directing it toward the opponent's area while generating a certain speed, spin, or accuracy [10].
3. Development: The quantitative or qualitative improvement in technical performance indicators for the serving skill between the pre- and post-measurement stages.
4. Advanced Player: A player with 4–6 years of training experience who has participated in local tournaments at the governorate or federation levels.

Field Test: A practical performance conducted under real-world playing conditions to evaluate a specific skill. It relies on visual or electronic measuring tools.

2. Materials and Methods

Research Methodology

The researcher adopted an experimental approach with a dual design (an experimental group and a control group) to measure the effect of the independent variable (training using balls of varying sizes and speeds) on the dependent variable (development of the serving skill). This approach is most appropriate when seeking to verify the effectiveness of a particular training method on a specific skill, as it allows for measuring changes before and after implementation and comparing results between the two groups. An experimental control method was used by holding all other factors constant (duration, number of units, training environment, coach), with only the type of balls varying.

Population and Research Sample

The research sample consisted of (20) players from the advanced youth category (aged 17–19 years) from Al-Furat Sports Club in Babil Governorate. They were deliberately selected in cooperation with the club's technical staff according to the following conditions:

1. The player must be from the youth category.
2. He must have at least four years of training experience.
3. To have participated in at least three local tournaments.
4. To have not been injured or absent during the trial period.
5. The sample was divided into two equal groups (10 per group):
6. Experimental group: Underwent a training program using different balls (see Table 1).
7. Control group: Underwent the same program but using only a standard ball.

Table 1 shows the sample characteristics in terms of age, experience, and average pre-test results:

Table 1. Characteristics of the research sample

Group	Number of Players	Age (Years)	Experience (Years)	Average Serve Accuracy (Pre-test)
Experimental	10	18.1	4.7	6.8
Control	10	17.9	4.5	6.7

Homogeneity between the two groups was confirmed using Levene's test, and the values were non-significant, proving the homogeneity of the two samples prior to the test.

Test Tools and Methods

The researcher used a set of standardized tools and field techniques to administer the tests and implement the training program, as follows:

a. Training balls with three characteristics (fast, slow, and large),see table 5
b. Standardized rackets for all players
c. Standard table tennis table
d. High-speed camera (60 fps)
e. Laser serve speed tracking board
f. Visual serve evaluation form, see figure 1, 2, and 3
g. Correct and incorrect points recording form

All tools were calibrated before use, and players were trained on the implementation method to reduce individual errors and achieve measurement consistency.

Test

Test details

Test name:

Table tennis serve accuracy test using balls of varying speed and size.

Purpose of the test:

To measure the player's ability to execute accurate and consistent serves using balls of varying speed and size, simulating real-world playing situations.

Test Conditions:

1. The test is conducted inside an official table tennis hall.
2. Balls of three speeds (slow, medium, and fast) and three sizes (small, standard, and large) are used.
3. The player must stand behind the service line.
4. The specified serving time (5 seconds per attempt) must not be exceeded.

Performance Method:

1. The player stands in a ready position behind the service line.
2. The serve is performed towards a pre-determined area on the table.
3. Five attempts are made for each type of ball.
4. Points are awarded based on the number of balls that accurately reach the target area, see figure 1, 2, and 3

Exploratory Experiment

The researcher conducted an exploratory experiment on a sample outside the main sample (five players) of the same age group, to test the validity of the tools, tests, and training program. The experiment included the following:

a. Testing the clarity of instructions and execution time.
b. Calibrating the measuring devices and ensuring that the results were accurately recorded. The reliability of the test was measured by re-administering it after (3) days.

The results showed high reliability in the indicators (reliability 0.89), which enabled the adoption of the test tools in the main experiment.

coefficient

Main Experiment

The main experiment was conducted after verifying the validity of the tools and the accuracy of the testing procedures.

The proposed training program was implemented on the experimental group using balls of different speeds and sizes, while the control group followed the traditional training program.

The experiment lasted (8) weeks, with (3) training units per week, and each training unit lasted (45) minutes.

During the experiment, the following sequence was adhered to:

a. Implementing a general and specific warm-up phase [9].
b. Implementing serving exercises using different balls according to the specified plan.
c. Performance monitoring and technical observations were recorded by the coach.
d. At the end of each unit, an initial assessment was conducted of the players' progress in serving accuracy.

Data from the pre- and post-tests for both groups was collected, prior to statistical processing to extract results. See Table 6: Suggested Training Module Template

Statistical Methods

The data were analyzed using SPSS (version 25), and the following methods were used :

a. Arithmetic mean and standard deviation: to describe the level of performance at each stage.
b. Associated samples t-test: to measure the difference between the pre- and post-tests within each group.
c. Independent samples t-test: to measure the difference between the two groups in the post-test.
d. Significance value (Sig): 0.05 was used as the cut-off point for statistical significance.
e. Manual analysis of the results: by comparing the numerical values with the results of the motion photography to ensure consistency.

The results were recorded and analyzed numerically and descriptively, and will be presented in detail in Chapter Four.

3. Results and Discussion

Results

Presentation and Analysis of Results

The training program was implemented over six weeks, with three sessions per week, for both the experimental and control groups, with only the ball type being different [11]. A serving test was administered to all players before and after the program [12]. The results for each indicator (accuracy, speed, and stability) were recorded for each player and statistically analyzed. Table 2 shows the experimental group's results in the serving skill test between the pre- and post-tests:

Table 2. Results of the experimental group in the serving skill test (n = 10)

Indicator	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	t-calculated	Sig
Accuracy	6.8 ± 0.6	8.7 ± 0.5	8.23	0.000
Speed	7.1 ± 0.7	8.5 ± 0.6	6.47	0.000
Stability	6.4 ± 0.9	8.3 ± 0.5	7.36	0.000

Analysis:

Statistical values showed a significant difference at the 0.05 level in all performance indicators. The increased accuracy, speed, and stability scores after the training program reflect the effectiveness of using different balls in improving neuromuscular control and developing the players' sensorimotor adaptation. Table 3 displays the results for the control group:

Table 3. Results of the control group in the serving skill test (n = 10)

Indicator	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	t-calculated	Sig
Accuracy	6.7 ± 0.5	6.9 ± 0.6	1.15	0.280
Speed	7.0 ± 0.6	7.1 ± 0.5	0.94	0.357
Stability	6.3 ± 0.7	6.5 ± 0.6	1.08	0.315

Analysis:

The lack of significant differences between the pre- and post-tests in the control group indicates that traditional training was insufficient to produce significant improvement. This reinforces the role of the various balls as an independent variable influencing performance improvement, see Table 4.

Table 4. Statistical differences between the two groups in the post-test

Indicator	Experimental (Mean)	Control (Mean)	t-calculated	Sig
Accuracy	8.7	6.9	7.26	0.000
Speed	8.5	7.1	5.81	0.000
Stability	8.3	6.5	6.43	0.000

Analysis:

The differences were statistically significant in favor of the experimental group, indicating the impact of the training program using various balls. This reflects improved motor adaptation and an increased ability to control the serve under different conditions, see Table 5.

Table 5. Comparison of the physical properties of the training balls used

Ball Type	Diameter (mm)	Weight (g)	Bounce Speed	Training Use
Slow Ball	40	2.8	Low	Accuracy development
Fast Ball	40	2.5	High	Reaction training
Large-size Ball	44	2.7	Medium	Stability training

Visual evaluation form for a player's performance in serving

Figure 1. Player positioning - arm angle - foot stability

Figure 2. Moment of contact with the ball – Ball launch angle – Clarity of response)

Figure 3. Ball positioning in the specified target – level of success in execution

Training Unit Model
Training Unit Model
Title: Developing Service Accuracy Using Balls of Different Speeds and Sizes
Target Group: Advanced table tennis players (ages 17–19)
Duration of Unit: 45 minutes
Weekly Frequency: 3 sessions per week for 8 weeks
Venue: Official table tennis hall – Al-Furat Club

Components of the Training Unit

The components of the training unit are presented in Table 6.

Table 6. Training Unit Model for Service

Stage	Time (minutes)	Content	Equipment	Objective
Warm-up	10	General exercises (light jogging, dynamic flexibility, arm rotations); specific exercises for shoulders and wrists	Training area + standard balls	Activate blood circulation and prepare muscles
Main Part	30	- Service drills using slow balls (5 attempts × 3 sets)		

1. Service drills using fast balls (5 attempts × 3 sets)
2. Service drills using oversized balls (5 attempts × 3 sets)
3. Short training match (mini match) alternating ball types each set: variety of balls (slow – fast – oversized) with standard table and target board, aiming to improve service accuracy, enhance reaction speed, and strengthen stability.
4. Cool-down (5 minutes): relaxation and simple stretching for arms and legs using mat, to reduce muscular stress and restore relaxation.

Discussion

The results confirmed that the use of balls with multiple physical properties led to a significant improvement in the serving performance of the experimental group players [13]. This is consistent with what Abdul Razzaq indicated, stating that changing the ball's properties stimulates the brain to modify the mechanism of motor performance and increases neuromuscular diversity.

The increased stability in performance among the experimental players also reflects an improvement in sensory adaptation and enhances the ability to repeat the serve with the same quality. This is an important indicator of the automatic consolidation of the skill and confirms the findings of Lin & Chen in their study on the effect of ball substitution on performance stability [14].

As for the speed component, it clearly improved among the experimental group players. This is attributed to their training using balls with different bounces, which forced them to shorten their response time and activate their wrist and forearm muscles more precisely, which is consistent with Al-Hassan's interpretation [15].

The lack of significant differences in the control group demonstrates that traditional training alone, even if it is of the same duration and units, does not achieve the same improvement. This supports the first research hypothesis of significant differences in favor of the experimental group.

It is important to note that the improvement was not limited to a single indicator, but rather included accuracy, speed, and stability together. This demonstrates the comprehensive training effect of the different balls and provides coaches with an effective tool for developing the serve as a complex skill.

4. Conclusion

Based on the results of the statistical analysis and field observations during the experiment, the researcher reached a set of conclusions that support the research hypotheses and confirm the effectiveness of the experimental variable:

1. The use of training balls of different sizes and speeds contributed to improving the serve accuracy of advanced table tennis players. This was demonstrated by the clear statistical increase in the arithmetic mean of the accuracy index in the experimental group.
2. Players in the experimental group demonstrated high stability in repeating successful performances, indicating a consolidated motor pattern and improved control under changing conditions. This is an important result that supports building players capable of consistent performance during matches.

3. Training using balls with variable characteristics provided a multi-stimulus learning environment, activating cognitive-motor skills and developing the ability to mentally process situations before and during execution.
4. The lack of significant differences in the control group's performance between the pre- and post-tests confirms that traditional training using only a standard ball is insufficient to develop all aspects of serving skill.
5. The combined field test design has proven effective in measuring real-world serving performance, as it combines accuracy, speed, and stability into a single model, providing coaches with a comprehensive and practical assessment tool.

Recommendations

Based on the research findings and discussion, the researcher makes a set of practical recommendations that can contribute to developing the training and technical performance of advanced table tennis players:

1. Adopting a training method using balls with various characteristics as an essential part of player preparation, especially when working on skills such as serving and receiving, given the diverse stimulation they provide to the brain and motor system.
2. Designing training programs that include a logical time distribution between ball types (slow, fast, large), according to a weekly training schedule, taking into account the objectives of each session (e.g., accuracy, strength, variety).
3. Training coaches to select the appropriate training ball for each stage of technical development, and raising their awareness of the characteristics of different balls and their impact on motor performance.
4. Expanding the experiment to include other skills such as smashing, receiving, and backspin, and studying the impact of various balls on these skills through future experiments.
5. Conduct similar research on other age groups, particularly juniors, to determine the impact of these variables on early motor learning and determine which groups respond most quickly to this type of training.
6. Encourage clubs to purchase and provide a variety of balls as part of their training equipment, and allocate a portion of the training session to their systematic use, rather than leaving it to the individual discretion of the coach or player.
7. Incorporate the concepts of adapting to ball characteristics into the training curricula prescribed by institutes and colleges of physical education, as they are a modern element in specialized training science.
8. Use different balls in selective tests to select athletic talent, especially in national training centers, as they reveal a player's ability to adapt and learn quickly.

REFERENCES

[1] N. Abdul-Razzaq, "The Effect of Heavy Balls on Serving Accuracy in Table Tennis," Journal of Sports Sciences, vol. 16, no. 1, pp. 34–42, 2022.
[2] Z. Al-Hassan, "The Effect of Using Different Diameter Balls on the Smash in Table Tennis," Journal of Physical Education Research, vol. 15, no. 2, pp. 28–35, 2021.
[3] M. Al-Hussaini, Field Measurement Tools in Table Tennis Sports, Dar Al-Saha, Baghdad, 2022.
[4] M. Ali, The Experimental Method in Individual Games Research, Dar Al-Nukhba Al-Ilmiyyah, Baghdad, 2021.
[5] O. Ali and H. Hamid, "Building of Psychological Directions Parameter for Anbar Educational Directorate Teachers for non-specialty Towards Practicing Classroom and Extracurricular Activities," Anbar University Journal of Physical Sciences and Sports, vol. 12, no. 23, pp. 23–46, 2021. https://doi.org/10.37655/uaspesj.2021.175083
[6] O. Ali, A. Mushref, and B. Ali, "The Role of Supplements in Improving Muscular Strength and Endurance in Professional Soccer Players: A Systematic Review," American Journal of Social and Humanitarian Research, vol. 5, no. 12, pp. 485–497, 2024. https://doi.org/10.31150/ajshr.v5i12.3116

[7] A. Alwan, Neural Stimulation Through Non-Traditional Tools in Skill Training, Dar Al-Shorouk University, 2023.
[8] F. H. Fayyad, Y. M. Hammood, O. A. Ali, A. J. Mushref, A. K. Awad, and A. Shanta, "Building and legalizing a test to measure the level of football agility of young players," Retos, vol. 68, pp. 1578–1590, 2025. https://doi.org/10.47197/retos.v68.116368
[9] A. Ghanem, "The Effectiveness of Randomized Training in Developing Short Serves," Journal of Applied Research, vol. 13, no. 3, pp. 55–62, 2020.
[10] H. H. Khalaf, A. A. Abrahim, N. M. Khaleel, J. N. Hummadi, A. J. Mushref, and O. A. Ali, "The Impact of the Dines Model as an Educational Mediator on Cognitive Achievement and Learning Overhead Passing Skill in Volleyball," Proximus Journal of Sports Science and Physical Education, vol. 1, no. 12, pp. 70–71, 2024.
[11] Y. A. Khalaf, M. A. AbdulJabbar, and O. A. Ali, "The Effect of Sports Job Burnout on the Performance of Workers in Student Activities Departments in Iraqi Universities," Retos, vol. 66, pp. 86–95, 2025. https://doi.org/10.47197/retos.v66.113271
[12] Y. Lin and H. Chen, "Ball Properties and Serve Effectiveness in Competitive Table Tennis," Journal of Sports Training Sciences, vol. 12, no. 1, pp. 44–52, 2023. https://doi.org/10.1016/j.jsts.2023.01.005
[13] K. J. Mohammed, K. I. Suleiman, M. M. Naser, O. A. Ali, and O. Ali, "The Effect of Colorful and Varied Visual Skill Exercises on the Development of Sensory Perception and Complex Skill Performance among Futsal Players," Retos, vol. 69, pp. 1226–1239, 2025.
[14] A. Saeed, "The Effect of Using Various Training Methods on Developing Serving Skills in Table Tennis," Journal of Sports Sciences, vol. 33, no. 2, pp. 40–55.
[15] Q. Shalal, Special Motor Tests in Table Tennis, Physical Education Press, University of Diyala, 2021.