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**Original Article**

# Validity and reliability of topspin accuracy tests in table tennis

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**Abstract:**
**Problem:** The progress of the development of athletes' ability to play table tennis can be observed by regularly conducting tests on these athletes. The initial and final tests given to athletes will reveal the development they have experienced, demonstrating the extent of their improvement through the test data. A table tennis coach truly needs a topspin accuracy test to assess their training; however, finding such a test remains challenging. **Purpose:** This study aimed to design a topspin accuracy test in table tennis. **Method**: The following steps have been carried out in this study: (1) analyze potential problems in the topspin technique test, (2) literature search and discussion with table tennis coaches, and (3) test design. Subsequently, the test was validated with experts. Finally, during the design revision stage, the expert recommendations were used to improve the test. At the end reliability of the designed test was established. The population in this study consisted of 33 table tennis students (Age: 21,09±0,84; Height: 166,30±5,81; Weight: 61,97±9,64). **Result:** The results showed high validity (88%) as well as reliability (0.85) of the topspin accuracy test respectively. **Conclusion:** Accordingly, this test can be used by coaches to measure the topspin accuracy of their athletes. A trainer will be able to evaluate the training progress of their athletes with this topspin accuracy test. Continuous evaluation will produce regular athlete progress data and it is needed by coaches to provide an appropriate training intensity that suits the needs of their athletes. Future research, nevertheless, is needed to test the effectiveness of products with experimental designs and compare them, in addition, the use of large samples for professional table tennis athletes is also needed in the future.
**Keywords: topspin stroke, table tennis Instrument, accuracy test, racket sport**

## Introduction

Ping-pong, also known as table tennis, is a popular game in which two to four players use rackets to hit a light ball back and forth across a table (Faral, 2011; Heaton, 2012; Zhang, 2017). The opponent's half of the rectangular table must be reached by hitting the ball across the net that divides it during play. When an opponent player fails to return the ball under the regulations of the game, points are scored (Hopper, 2002; Jia et al., 2019; Mohammed et al., 2021). A table, rackets, and a ball are required to play table tennis. To hit the ball back and forth, rackets made of wood or composite materials are utilized. Typically, plastic or celluloid is used to create the ball, which is roughly the size of 40 millimeters (Alexander & Honish, 2009). The game of table tennis is played fast (McAfee, 2009; Michalski et al., 2019; Van Biesen et al., 2010; Sung, 2019; Maheshwari et al., 2023), and it requires accuracy when hitting the ball to win a match (Marinovic et al., 2004; Rusdorf et al., 2006; Mülling et al., 2011). This game is played by two people facing each other at a table tennis table. The right stroke toward the desired target will benefit the player. Therefore players who can do this will have a great chance of winning (Gao et al., 2022). The right shot toward the target will make it difficult for the opponent to return the ball (Wang et al., 2017).

In table tennis, accuracy is crucial since it enables you to place your strokes precisely and increases the difficulty of your opponent's return (Williams et al., 2002; Raab et al., 2005; Irawan et al., 2021). Accuracy is crucial for successfully implementing these strategies because players in table tennis attempt to outmaneuver their rivals by positioning the ball in tactical areas of the table (Tian et al., 2019; Vincze et al., 2022; Mitchell et al., 2020). The general tempo and rhythm of the game are also influenced by accuracy. While less accurate players may need to hit more defensive shots or concede the point, players who can regularly take precise shots can maintain the rally and force their opponents to hit harder shots. Accuracy is crucial for safety in addition to tactical purposes (Wei, 2017; Malagoli Lanzoni et al., 2014).

For the ability to hit the ball to be accurate, practice is needed. Long practice will improve skills in hitting


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technique (Myer et al., 2011; Cropley et al., 2007). Hitting techniques that are trained over a long period and well programmed will certainly improve the quality of these strokes (I. Aziz et al., 2023). The role of the coach in training the athlete is to improve the accuracy of the various hitting techniques of the athlete (Hardy et al., 2018). Repetition during exercise and adequate rest will improve athlete's performance and their ability to utilize a coach's feedback (Umar et al., 2023; N. A. A. Aziz et al., 2023; Sujana Wahyuri et al., 2023).

To track the training progress, standardized tests are necessary. With measurable progress, athletes and coaches can see the results of the training they have been doing. Tests can also be used to categorize the ability, skill, and fitness levels of both students and trained athletes. With a good test, a coach will be able to assess the weaknesses and strengths of their athletes (Semsem & Martin, 2022). In addition, the test will also improve practice during training so that athlete performance can be optimized (Afonso & Mesquita, 2011).

The use of measurement tools to analyze the ability of athletes is increasingly being applied (Francis & Jones, 2014). Athletes will know their abilities if an assessment of their respective abilities is carried out, thus their weaknesses will be known and can be improved by providing sufficient training (Yudiana et al., 2022). The test is a component that cannot be separated from other elements of the exercise because if the results of the exercise are not evaluated, the progress cannot be seen in detail (Raiola et al., 2018). This evaluation is also difficult to separate from the progress of athlete achievement both individually and as a team. Achievement is influenced by many factors and to be able to analyze it, you can use tests to provide information on the strengths and weaknesses of the athlete and adjust the training accordingly (Nughes et al., 2017). The information obtained from the results of these assessments or measurements is very valuable for the progress of athletes and clubs. The trainer will be able to provide valid recommendations based on the data obtained from the test results (D'Isanto et al., 2019).

Previous studies have addressed reaction speed, displacement speed, skill speed, and ocular-manual coordination (Katsikadelis et al., 2014). Other research used sensors on the net to detect balls that hit the net during service (Firdaus & Mario, 2022) and the use of robots to assist in teaching table tennis in school (Tahki et al., 2022). In addition, a push stroke technique skill test has been designed for table tennis (Haryanto & Denay, 2022). Tests of the effectiveness of hitting techniques in table tennis have also been designed (Belli et al., 2019). Such a test will certainly give viable information to the players who will perform it. Tests of hitting technique skills have also started to be developed by researchers recently (Faber et al., 2021). The accuracy and speed of the ball in tennis have also been evaluated and the results of the study revealed that the accuracy of the ball correlates with the skill level of the player as well as when players do backhand strokes (González-González et al., 2018). Studies in the field of sports biomechanics reveal that athletes must be good at adjusting the height of the ball when hitting as well as the athlete's ability to adjust the angle of the racket when in contact with the ball A recent study further created a table tennis training program based on artificial intelligence (AI). This AI can create various Training programs with various player conditions (Han et al., 2022). The development of tools to help table tennis players is also done by developing a sensor-based evaluation system, which can evaluate forehand movement errors that have been programmed in the system so that people who are just learning to play table tennis can learn independently at home and be corrected by the system (Tabrizi et al., 2021). The development of training tools that can categorize the level of ability of players in performing neural network-based forehand loop hitting techniques have also been developed, this training tool will be very useful for players and coaches to collect data on the ability of trained players (Wu et al., 2021). A test to assess the accuracy of topspin stroke, however, has not been developed. So, it needs to be designed in order to help athletes and coaches in sports performance evaluation. The purpose of this study, therefore, was to determine the validity and reliability of a topspin accuracy test in table tennis.

## Materials & Methods

### Research design

This research uses a research and development method to develop a topspin accuracy test in table tennis. This research was conducted from September to November 2022 at the Faculty of Sport Science, Universitas Negeri Padang (UNP).

### Participants

The study population consisted of all students who were taking table tennis courses, which resulted in 33 participants. Participants were non-athletes, who took a table tennis course for a semester, which is a compulsory subject in the faculty of sports science. The characteristics of the research sample can be seen in Table 1.

### Validity and reliability assessment

This study aimed to develop a topspin accuracy test in table tennis. Content validity was determined by giving the designed instrument to five experts, including a test and measurement expert, a table tennis coach, and a table tennis lecturer. All experts gave their assessment of the instrument being used by filling out a questionnaire and providing recommendations for improvement. The experts were asked to assess the accuracy of the topspin test by using various indicators in the questionnaire including clarity, safety, implementation, and accuracy. The questionnaire used a Likert scale that consisted of five answer choices; from not measuring the theoretical concept at all to a very strong measure for the theoretical concept. The scores were totaled with a

higher score indicating good test performance. If 80% of the experts agree that the aspects that are considered valid then the test can be said to be valid (Almanasreh et al., 2019).

After determining instrument validity, the next step was to establish instrument reliability using a test-re-test design. Participants completed the test on two different days respectively to avoid the learning effect of the sample.

Table 1. Characteristics of The Research Sample

| | Age (years) | Height (cm) | Body weight (kg) | Experience (Years of play) |
|---|---|---|---|---|
| Male (n=7) | 21,00± 0,82 | 159,57±5,06 | 58,57±4,76 | 2,14±0,90 |
| Female (n=26) | 21,12±0,86 | 168,12±4,57 | 62,88±10,46 | 2,62±0,64 |
| Total (N=33) | 21,09±0,84 | 166,30±5,81 | 61,97±9,64 | 2,52±0,71 |

**Data analysis**

Pearson product-moment correlation was used to determine the reliability of the top spin technique test.

**Results**

**Construction stage**

The topspin accuracy test was designed by considering areas that were difficult for players to reach when they wanted to return a ball using the topspin technique. The researcher also traced the forms of tests that already existed in the sport of table tennis as a consideration in designing the shape of the table tennis topspin accuracy test area.

**Expert assessment stage**

The validation results from the experts can be seen in Table 2. The experts provided an assessment of the top spin accuracy test. Based on the results of the assessment given by experts, the average percentage of expert judgment is 88%, which means that all experts agree that the designed topspin accuracy test instrument is a valid instrument to measure top spin accuracy in table tennis. Nevertheless, there were some suggestions for improving the instrument including the location of the athlete which was originally on the right or left side of the field; it was, however, advised to change it to the middle position of the field. Moreover, the target area was also divided into four areas on the right and left of the table with points 0, 1, 2, and 3.

**Revision stage**

The suggestions given by the experts helped to improve the test, with the suggestions given the researcher decided to revise the initial design of the test that had been made by adding the suggestions of the experts by those in the notes on the questionnaire.

**The final result of the top spin accuracy test**

Figure 1 shows the final design of the topspin accuracy test. This test aimed to assess the topspin accuracy in table tennis. This test used a table tennis table, ten balls, a ball launcher, and the bat/racket. To carry out this test, the ball launcher shot 10 times toward the testee. The testee performed a topspin towards the target and a judge assessed the validity of the top spin technique performed by the testee along with the direction ball's fall and mentioned it to the scorer. A ball that is hit without using the topspin technique will be given a score of 0. A ball that is hit with the correct topspin technique will get a score starting from 0, 1, 2, and will get a maximum score of 3 (see Figure 1). The ball that is hit with the correct topspin technique but does not aim at the target area is given a score of 0, including the ball that goes off the table or gets caught in the net.

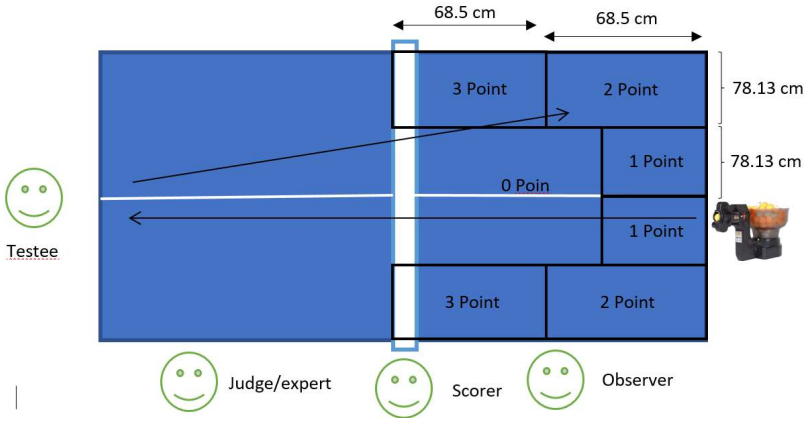


**Figure 1.** The Final Design of The Topspin Accuracy Test

Table 2. Aspects of Instruments Assessed by Experts and Validation Result

| Aspect | Judgments | Expert 1 | Expert 2 | Expert 3 | Expert 4 | Expert 5 |
|---|---|---|---|---|---|---|
| Clarity | Clarity of top spin accuracy test implementation instructions | 5 | 4 | 4 | 4 | 4 |
| Security | The topspin accuracy test is safe to apply | 5 | 4 | 5 | 4 | 5 |
| Execution | The topspin accuracy test can be applied to table tennis players | 4 | 4 | 4 | 4 | 4 |
| | The topspin accuracy test is easy to apply for table tennis players | 4 | 5 | 5 | 4 | 5 |
| Accuracy | The topspin accuracy test is right for the characteristics of table tennis players | 4 | 4 | 4 | 5 | 4 |
| | The topspin accuracy test is right for measuring the top spin stoke accuracy of table tennis players | 5 | 4 | 5 | 5 | 5 |
| | **Percentage (%)** | **90** | **83** | **90** | **87** | **90** |
| | **Average Percentage (%)** | | | **88** | | |

Table 3. Reliability Test Result

| | Mean and Standard Deviation | Pearson correlation value |
|---|---|---|
| First-day test (Test) | 18,09 ± 4,16 | 0,85 |
| Second-day test (Retest) | 19,64 ± 3,53 | |

**Discussion**

The results of this study indicated that 88% of the experts agreed that the topspin accuracy test can be used to assess the topspin accuracy of table tennis. This follows several previous studies which stated that this level of validity is a high level of validity so it is suitable to be used as a tool to assess the topspin accuracy of table tennis athletes (Hudah et al., 2022). Instruments that have a high level of validity can be used to measure variables. Valid instruments also usually measure what should be measured according to the purpose of making the instrument. Instruments that have a high level of validity will certainly be able to measure validly too (Zagatto et al., 2008), (Widodo & Nahimana, 2021). So, this topspin accuracy test can be used to assess the level of topspin accuracy in table tennis players.

The purpose of the expert's assessment was to provide input and evaluate the designed test to improve the test design The results of the test-retest also indicated good reliability of the topspin accuracy test. Accordingly, it can be used to assess the topspin accuracy of table tennis players. These findings support those of earlier studies that looked at the validity of test instruments created for use in sports (Hudah et al., 2022). Tests that can be easily carried out by players or students can be categorized as good tests and they can have an impact on the training process (Mohd & Ahmad, 2005). Tests that specifically measure technical skills are necessary to support athlete development. Accurate tests will offer valuable insights to both players and coaches, enabling them to assist athletes in reaching their peak performance. Results with a high level of validity and reliability will also enhance the talent search process, aiding in the identification of athletes with the potential for success at the highest level.

In the game of table tennis, numerous factors are essential during the coaching process. The development of proficiency in table tennis is supported by adequate equipment and facilities, effective training methods, well-structured training programs, efficient talent scouting processes, evaluation or assessment of training results, sufficient funds, the proficiency of trainers, effective management, and strong organizational support. In addition to the training program, evaluation also plays a crucial role in the athlete development process. Any training program cannot be separated from evaluation because, through evaluation, the trainer finds it easier to provide input, correct mistakes, and assess the success of the athletes' training process. The process of honing stroke abilities requires specific information on what needs to be focused on. Assessments are interrelated, so if no assessment instruments are used as the basis for evaluation in the training process, the training process is less than optimal.

Despite efforts to maximize implementation, this research still has weaknesses. The participants involved in this study were students attending a table tennis course. However, their abilities differed from those of professional athletes, and therefore, the results of this study cannot be generalized to professional athletes. Additionally, the number of participants involved was small.

**Conclusion**

The topspin accuracy test in table tennis can be used to determine the accuracy of the topspin technique in competitive table tennis players, and the test provides good validity and reliability for measuring topspin accuracy. This test can be used by teachers, lecturers, coaches, and table tennis players to determine the accuracy of their topspin strokes. Accuracy in table tennis is necessary as players must be able to direct their strokes

precisely toward targets that are difficult to reach by opponents. Stokes that are difficult to expect by the opponent will also be difficult to return, therefore accuracy in hitting the ball is necessary. Topspin is an attack technique that is widely used by the world's top players to generate points, if a player can attack quickly and accurately it will be easy to generate points and win matches. With this test, practitioners can expand the accuracy of topspin periodically to favor the progress of the topspin accuracy of athletes trained. Given the lack of available tests, the presented tests provide viable information for educators and coaches when training in table tennis topspin techniques. Due to the limited number of tests available to evaluate the proficiency of various stroke techniques future researchers must work together across disciplines to make technology-based test kits widely available, and conduct the research with a large number of participants, especially table tennis athletes.

**Conflicts of Interest**

We state that there were no conflicts of interest in this study.

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