Validation of the Diamond Dispatch Challenge Test for Softball Overhand Throwing Accuracy

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ABSTRACT

The necessity for a valid and reliable measure of overhand throwing accuracy in softball is critical due to the significant reliance on accurate throws for game performance. Existing tests often lack applicability to actual game conditions and fail to address all the kinematic factors that influence throw effectiveness. This study validates a game-based test designed to mimic real softball game scenarios to measure overhand throwing accuracy more effectively. The test, referred to as the *Diamond Dispatch Challenge*, incorporates various throwing targets and conditions to simulate game situations and includes a scoring system that evaluates the accuracy, velocity, and consistency of throws. Participants in the pilot study included eighteen female beginner students, and fifteen female trained players from a state university in Lanao del Sur, Philippines, providing a diverse group across different levels of softball experience. The psychometric properties of the test were evaluated through a psychometric research design focused on known-group validity and internal consistency. Results indicated significant differences in throwing accuracy between the beginners and trained players, with a Cohen's d value of 3.518, suggesting a substantial effect size. The Spearman-Brown prophecy formula yielded a reliability coefficient of 0.90, indicating high internal consistency. The findings support the use of the *Diamond Dispatch Challenge* in both academic and athletic settings, providing a robust tool for coaches and researchers to measure and improve overhand throwing accuracy in softball. This study contributes to the existing literature by offering a game-based, validated testing instrument that can be used to enhance training and player development in softball.

Keywords: *Diamond Dispatch Challenge*, overhand throwing accuracy, softball performance, psychometric validation, known-group validity

INTRODUCTION

Softball relies heavily on the overhand throw, and players must throw balls with precision to win (Donaldson et al., 2020; Phulkar, 2017; Weisberg et al., 2022). Though a few research studies have created overhand throwing accuracy tests, concerns about the generalizability of the results, along with multiple issues in the methodology and data analysis (Phulkar, 2017), make it challenging for researchers to adopt tests for academic instruction and research use. In addition, those tests were not designed to be adjusted to actual game situations (Cahyati & Suherman, 2020; Mustofa et al., 2019; Phulkar, 2017; Prabhakar, 2019). Studies that are pushing for the development of conditioning programs specifically adapted to the needs of throwing (Friesen et al., 2020) and based on exact kinematic information (Weisberg et al., 2022), require tests that are

based on real-time game scenarios. Cahyati and Suherman (2020) recommended developing novel testing instruments for real-time measurement of throwing accuracy.

There is a strong relationship between the kinematics of the lower extremities, including the flexion of the knee and trunk during the stride, and the velocity of the throw when teenage softball players overhand throw (Donaldson et al., 2020). Additionally, stride length has a significant impact on the overhand thrower's ability to generate propulsion and bracing ground response forces, leading to improved balance and, ultimately, more control and power during the throw (Ramsey & Crotin, 2019). Similarly, throwing with the non-throwing arm improves total throw coordination, which in turn increases ball velocity (Weisberg et al., 2022). This further emphasizes the need for full-body engagement to make the most of overhand throws.

When playing softball, an overhand throw is executed when the player stands with their feet shoulder-width apart, hands on the ball, and grips it across its seams (Donaldson et al., 2020; Todd et al., 2020). The athlete strides forward with the opposing foot while simultaneously bringing the throwing arm back with the elbow up. Then, they twist their hips toward the target (Donaldson et al., 2020; Sertic et al., 2021). As the arm whips forward, the ball is released with a wrist snap. Then, the arm completes a follow-through, and the weight shifts onto the front foot (Friesen et al., 2020; Ramsey & Crotin, 2019; Weisberg et al., 2022). For strong, lengthy throws to the infield, outfielders employ this strategy, whereas infielders concentrate on making base plays with fast, precise throws (Cüre et al., 2020). To achieve successful and accurate throws, players need strength, coordination, and practice (Donaldson et al., 2020; Downs et al., 2021; Friesen et al., 2020).

Several essential components must be present in a psychomotor exam before it can be used to evaluate the accuracy of softball overhand throws in a game setting. The goal of the test is to mimic varied throwing conditions by simulating game scenarios with several targets at varying distances, such as bases or designated zones (Cahyati & Suherman, 2020; Mansor & Koh, 2019). With conventional dimensions of the softball pitch and gear, the setting should reflect real-game circumstances (Donaldson et al., 2020; Irawan, 2020; Sertic et al., 2021). Throws to home plate, first base, and the infield should all be part of the scenarios, and for realism's sake, live runners or markers might be incorporated. Accuracy, velocity, and consistency should be the focal elements of the measurement criteria, with a point system in place to reward successful throws (Cahyati & Suherman, 2020; Todd et al., 2020). Assessors need to watch the player's (Friesen et al., 2020) grip, wind-up, stride, release, and follow-through (Donaldson et al., 2020) and give them a score according to established standards (Sertic et al., 2021). It would be much better if the simulation had game-like pressure, time limits, and decision-making situations (Sertic et al., 2021; Todd et al., 2020). Players are able to assess their performance thanks to the incorporation of both quick feedback and a reflection component (Cahyati & Suherman, 2020; Sertic et al., 2021; Weisberg et al., 2022). In order to avoid injuries, it is crucial to follow safety standards, which include a warm-up session (Downs et al., 2021; Friesen et al., 2020). Taking all of these factors into account ensures that the test gives an accurate picture of how well a player does in real-life overhand throwing scenarios.

This study uses a psychometric research approach to assess the psychometric properties of the real-game setting overhand throwing accuracy test. Students from a state university in Lanao del Sur participated in the pilot study. Creating and administering a psychomotor test that mimics game conditions allows this pilot study to help collect validity and reliability metrics. The overarching goal of this study is to improve softball training and performance by developing standardized criteria and scoring systems for assessing students' overhand throwing accuracy skills.

METHODS

This study employs a psychometric research design with the stated goals of validating a softball overhand throwing accuracy test for known-group validity, and internal consistency. The pilot study compares the test scores between college beginners and softball trained players to determine known-group validity (Howell et al., 2016). Comparing the test scores of two distinct groups allows the researchers to determine whether an

instrument has known-group validity, which means it can distinguish between groups that are known to differ on the measured variable (Cook, 2015; Howell et al., 2016; Jewsbury & Bowden, 2014). In order to prove that the test can differentiate between various skill levels and developmental phases, this validity component is essential (Cook, 2015). According to Paradis and colleagues (2014) trained players are expected to have the highest scores because of their advanced training and experience. Beginners are expected to have inferior scores because of their inexperience.

The test was also subjected to internal consistency to ensure that it consistently assesses the same construct of overhand throwing accuracy. Specifically, the pilot test evaluated the internal consistency by calculating Cronbach's alpha across five trials. Um (2017) emphasizes that this strategy, especially for small samples, uses the Spearman-Brown formula. Educational assessments are often deemed valid when their split-half reliability coefficient, as adjusted using the Spearman-Brown method, is 0.70 or more (Sarwiningsih, 2017).

Eighteen female beginners and fifteen female trained players participated in the study. The groups received orientation regarding the purpose and the voluntary nature of the data-gathering process. They signed informed consent forms and were given enough chance to ask questions regarding the study. They were assured of privacy and confidentiality, which ensured their safety and well-being.

Moreover, a state university in Lanao del Sur, Philippines, hosted the pilot test. Located at an impressive 2000 meters above sea level, this site provides a distinct high-altitude setting that may impact physical performance. The college's state-of-the-art sports facilities make it a perfect location for pilot experiments. These establishments furnish the essential framework for conducting professional-level assessments of overhand throwing accuracy in a controlled setting.

As to the test, the ***Diamond Dispatch Challenge Test*** evaluates the accuracy of overhand throwing softballs from the catcher's box. The main goal is to see how well the test performer can accurately throw the softball to the pitcher, first base, second base, third base, and a moving and unpredictable shortstop roaming around the field. To the researcher, a player's defensive skills, such as accuracy, can be better understood by testing their throwing accuracy to both stationary and moving targets in a game-like environment.

The resources and materials for this research comprise a variety of tools and people needed to carry out the accuracy test of overhand throwing. To maintain uniform throwing performance, the study utilized high-quality softballs that adhere to official size and weight requirements. The pitcher, bases, and moving shortstop were marked with cones or markers, and the catcher's box had its borders delineated. Each player received a pair of gloves to help them catch the balls, and the test was tracked using score sheets and clipboards.

As far as human resources are concerned, the pilot study needed participants to do the actual throwing, help set up the field, measure distances, collect balls, and watch and score the throws so that we could ensure everyone followed the rules. The researchers supervised the administration of the test, commented on or clarified it, and ensured everyone followed the regulations.

The participants simulated a real-life in-game situation by throwing from the catcher's box to targets set at different distances. To ensure the test findings are relevant and applicable to real gaming, the distances are established using conventional measurements for softball fields.

The test administrator briefed the participants on the goals and importance of the test, emphasizing its role in measuring throwing accuracy from the catcher's position to various field targets. The test administrator went over safety procedures, ensuring all participants and staff know how to proceed safely and what to do in case of an emergency.

Participants started with 5-10 minutes of light aerobic exercise, such as jogging around the field, to increase heart rate and blood flow to muscles. They focused on dynamic stretches, particularly for the shoulders,

arms, neck, back, and legs, to prepare for the throwing motions. Participants performed light throws to build up to the intensity required for the test gradually.

Participants were allowed to throw several practice overhand throws to each target without scoring. This helps them get used to the distances and the feel of the field. Coaches may provide feedback on throwing mechanics, assisting participants to adjust their technique to optimize accuracy and power.

Each participant throws to the five designated targets (pitcher, first base, second base, third base, and moving shortstop) in a specified order. To investigate the internal consistency, each participant performed ten throws (two rounds). The shortstop target moves dynamically around within a defined range. When it is time to throw to the shortstop, the test performer waits until the shortstop target is in a ready position. There are ten positions for the shortstop. However, for every participant, the shortstop changed position unpredictably. For example, positions 1-5, 6-9, 3-8, and so on.

Observers used score sheets to record the outcomes of each throw. The test protocol elaborates on a point system for throwing to the target based on the indicators. Then, the test administrator summarized the day's results, highlighting exceptional performances and areas for improvement.

Furthermore, this unified scoring procedure for combined air and ground dimensions evaluates each throw based on where the ball lands or is caught in relation to a combined target area that includes both ground and air dimensions.

2 Points The ball is either caught or lands within a radius of 0.5 meters (diameter = 1 meter). This highest score is awarded when the ball is precisely where intended, whether caught in the air or landed on the ground, requiring no or minimal movement (non-locomotor adjustments) from the target receiver.

1 Point The ball is either caught or lands within a radius of 1 meter but outside the 0.5-meter radius (diameter = 2 meters). This score is given when the ball is close enough to the intended target that the receiver or fielder needs to make some effort with minimal locomotor movements (like reaching, bending, stepping, or a small jump) to catch or retrieve the ball.

0 Points The ball is either caught or lands outside the 1-meter radius. This indicates a throw that is off the mark, requiring significant effort and locomotor movements (such as sprinting, running, or extensive reaching) to catch or retrieve the ball.

The maximum total points for each round are 10, while the minimum is 0. The overall score is calculated as the sum of the total points from all two rounds. The maximum score is 20, while the minimum is 0.

RESULT AND DISCUSSION

The evaluation of overhand throwing accuracy is a critical component in assessing athletic performance, particularly in sports such as softball. Understanding the validity and reliability of assessment tools used for this purpose is essential to ensure accurate measurement and meaningful comparisons across different groups of athletes. This study aims to investigate the known-group validity of the Diamond Dispatch Challenge Test by comparing the overhand throwing accuracy of trained players and physical education (PE) students. Additionally, the study evaluates the reliability of the test when expanded to include more trials, employing statistical method, such as the Spearman-Brown prophecy formula. These analyses provide insights into the robustness of the test structure and its applicability in varied testing scenarios, contributing to the overall understanding of psychomotor skill assessment in sports.

The assumption for a known-group validity investigation is that there is a difference between two groups with varying athletic abilities (citation needed), advanced and beginners in this context. Hence, the null hypothesis states that there is no difference between the overhand throwing accuracy between the advanced

and beginner groups. Table 1 reveals the statistical analysis comparing the overhand throwing ability of 15 varsity female players and 18 female beginners.

Table 1. Result of the Kruskal-Walis and Post Hoc Test between the overhand throwing accuracy of trained players and beginners

Groups	**N**	**Mean**	**SD**	**Kruskal-Walis Test Statistic**	**p**		**Post hoc test**		
						Mean difference	**t**	**Cohen's d**	**p_{tukey}**
Trained players	15	14.933	1.831	24.057	<0.001	9.211	10.062	3.518	<0.001
Beginners	18	5.722	3.121						

The result for the trained players (14.9331.831) indicates that, on average, they have high throwing accuracy with relatively low variability among their scores. The low standard deviation suggests that their performance is consistently high. In the test, the description for a score that ranges from 13-16 is *'high accuracy.'* It is interpreted as *'showing reliable overhand throwing capabilities with occasional perfect throws and generally hits the target with minimal adjustments required, indicating a strong skill set effective in competitive scenarios.'* On the other hand, the result for beginners (5.7223.121) suggests that beginners, on average, have less throwing accuracy. The higher standard deviation in this group indicates more variability in their performance, with some students performing better or worse than this average. In the test, the range 5-8 is described as 'developing,' which means that the beginners *'struggle with consistency in hitting the target, and their throws often require significant adjustments by receivers, suggesting a need for improvement in accuracy and technique.'*

Moreover, the Kruskal-Wallis test, a non-parametric method for testing whether samples originate from the same distribution, yielded a test statistic of 24.057 with a p-value of <0.001. This p-value is highly significant and indicates strong evidence against the null hypothesis. Additionally, a post hoc test analysis is required, showing a mean difference of 9.211 between the groups. This large difference is significant and aligns with the descriptive statistics, reinforcing that trained players perform significantly better than beginners in terms of overhand throwing accuracy. The t-value of 10.062 in the post hoc analysis confirms the significant difference between the groups. Cohen's d, a measure of effect size, is 3.518, indicating a very large effect size, suggesting that the difference in performance between trained players and beginners is not only statistically significant but also practically significant. The very low p-value from the Tukey post hoc test (<0.001) confirms that the observed differences in mean scores between the groups are statistically significant even after adjusting for multiple comparisons.

Trained players demonstrate superior overhand throwing accuracy compared to beginners due to advanced visio-spatial skills, intensive targeted practice, and higher technical proficiency. Research suggests that varsity athletes possess enhanced hand-eye coordination and cognitive abilities crucial for precision in sports (Millard et al., 2021). Moreover, their consistent and rigorous training regimes, which are less common among beginners, significantly improve their decision-making and action execution under competitive pressures (Hendry et al., 2019). These factors not only lead to statistically significant differences in performance, as indicated by the Kruskal-Wallis and post hoc tests, but also contribute to the practical superiority of trained players in sports scenarios, distinguishing their skills from those of beginners (Koopmann et al., 2020).

Varsity softball players exhibit significantly better overhand throwing accuracy than non-athletes due to specialized training and biomechanical advantages. Programs that focus on autonomy support, enhanced expectancies, and external focus substantially improve accuracy, with athletes benefiting more due to higher self-efficacy and technique adoption (Sertic et al., 2021). Biomechanically, factors like throwing velocity and specific joint flexions correlate strongly with accuracy (Donaldson et al., 2020). Additionally, softball players develop greater shoulder and hip mobility and strength, which are essential for precise throws

(Downs et al., 2021). Moreover, psychological and cognitive training targeting specific throwing skills further separates their capabilities from those of non-athletes, who lack such comprehensive training (Friesen et al., 2020).

Moreover, the known-group difference method used in this study is pivotal in demonstrating construct validity in psychomotor tests by highlighting the tests' ability to differentiate between distinct groups as theoretically expected (Bessa et al., 2021; Schroeder et al., 2019). This method confirms that a test accurately measures specific psychomotor skills when it can distinguish between groups with known differences, such as typically developing individuals, versus those with developmental coordination disorder (Romero Martínez et al., 2018; Smits-Engelsman et al., 2020). For example, distinguishing based on variables like employment level, age, socioeconomic status, and physical activity level supports the validity of tests designed to assess barriers and facilitators in physical activities (Rodrigues et al., 2019). Such empirical evidence is crucial as it verifies that the tests not only assess the constructs they are intended to measure but also do so with the expected differentiation among predefined groups, thus reinforcing their theoretical foundations and applicational reliability.

In this study, the reliability of the Diamond Dispatch Challenge Test was rigorously evaluated to determine its consistency when expanded to include more trials. Initially, the reliability for the five-trial format yielded a Cronbach's alpha of 0.81, as detailed in Table 2. To assess the potential reliability if the number of trials was doubled to ten, the Spearman-Brown prophecy formula was employed. This formula is pivotal in understanding how extending a test affects its reliability, assuming the additional trials maintain the same difficulty level and do not significantly increase the physical or mental strain on participants (Baumgartner et al., 2015).

Table 2. Result of the participants' first trial scores in the Diamond Dispatch Challenge Test

Participant	**Overhand throwing accuracy scores**				
	To the pitcher	**To the first base**	**To the second base**	**To the third base**	**To the shortstop**
1	2	1	1	1	1
2	1	0	2	2	2
3	2	2	1	1	1
4	2	2	2	2	0
5	1	1	1	2	1
6	1	2	2	1	2
7	2	2	2	2	1
8	1	2	2	2	0
9	2	1	1	2	2
10	1	1	2	2	2
11	1	1	1	2	2
12	2	2	1	1	1
13	2	1	2	2	2
14	2	2	0	1	1
15	1	1	2	1	2
16	0	1	0	0	0
17	1	1	0	1	1
18	0	0	0	0	0
19	1	1	1	0	0
20	1	0	0	1	0
21	0	0	0	0	0

22	0	0	0	1	0
23	1	0	0	0	0
24	1	1	1	1	0
25	1	1	1	1	1
26	1	0	0	1	1
27	1	2	0	1	2
28	1	0	0	0	0
29	2	0	0	1	0
30	1	1	2	1	1
31	1	0	0	0	0
32	1	0	0	1	0
33	1	1	1	0	0
Chronbach's a	0.81				

Applying the Spearman-Brown formula:

$$r_{k,k} = \frac{k(r_{1,1})}{1 + (k-1)(r_{1,1})}$$

with reliability of a criterion score, $r_{1,1}$ = 0.81, and the number of times the test is increased in length, k=2, the estimated reliability of a criterion score based on ten trials $r_{k,k}$ is

$$r_{k,k} = \frac{k(r_{1,1})}{1 + (k-1)(r_{1,1})} = \frac{2(0.81)}{1 + (2-1)(0.81)} = \frac{1.62}{1.81} \approx 0.90$$

This estimated reliability of 0.90 for the extended test format significantly surpasses the threshold of 0.70 recommended for educational assessments to be considered valid (Sarwiningsih, 2017). Thus, the analysis confirms that the Diamond Dispatch Challenge Test not only maintains high reliability when expanded but also suggests that its structure is robust across increased trials, providing a stable measure of overhand throwing accuracy in varied testing scenarios.

Several factors stand out in assessing the high internal consistency of the Diamond Dispatch Challenge Test for overhand throwing accuracy in softball. The test's comprehensive design, which includes simulating real-game scenarios with various targets and conditions, covers a wide range of skills necessary for effective overhand throwing. This design ensures that all aspects of the skill are consistently measured across different scenarios, which is crucial for reliable performance assessment (Donaldson et al., 2020).

Furthermore, the uniformity of conditions in the test setup—including consistent distances to targets and controlled environmental conditions—minimizes external variability. This uniform setup ensures that the test reliably measures the same constructs across trials, thereby enhancing its internal consistency (Cahyati & Suherman, 2020). The scoring system of the test, which quantifies accuracy, velocity, and consistency, also plays a critical role. This robust scoring mechanism likely captures subtle variations in skill level effectively, contributing to a more accurate and consistent evaluation of throwing accuracy (Friesen et al., 2020; Weisberg et al., 2022).

Additionally, the application of the Spearman-Brown Prophecy Formula in evaluating the test's reliability confirms that extending the number of trials maintains or enhances its reliability. This statistical approach adjusts for potential reliability loss due to increased test length, ensuring stability and consistency across a greater number of trials (Um, 2017; Sarwiningsih, 2017).

Lastly, the use of a permutation approach for reliability estimation allows for a thorough examination of the test's internal consistency under various configurations. This method, which tests the reliability across multiple hypothetical splits of the test data, provides a robust estimation of internal consistency that supports the test's overall reliability in diverse settings (Baumgartner et al., 2015). Collectively, these factors underscore the Diamond Dispatch Challenge Test as a reliable tool for assessing overhand throwing accuracy, demonstrating its suitability for both academic research and athletic training contexts.

CONCLUSION

The results of this study clearly demonstrate the high overhand throwing accuracy of trained players compared to beginners, supporting the known-group validity of the Diamond Dispatch Challenge Test. The significant differences in performance between the two groups, as evidenced by the Kruskal-Wallis and post hoc tests, underscore the effectiveness of specialized training and advanced athletic abilities in enhancing throwing accuracy. Furthermore, the reliability analysis confirms that the test maintains high consistency when expanded, with the estimated reliability for the ten-trial format surpassing the recommended threshold for educational assessments. These findings not only validate the use of the Diamond Dispatch Challenge Test in evaluating overhand throwing accuracy but also highlight the importance of rigorous training and skill development in achieving superior athletic performance.

PRACTICAL RECOMMENDATIONS

Based on the conclusion, this study offers practical recommendations to research, training, and coaching. For research application, the Diamond Dispatch Challenge can be employed in research to evaluate the psychometric properties of throwing accuracy tests. Researchers can use it to confirm known-group validity by comparing performance between groups with different skill levels, such as trained players and beginners. Researchers can analyze the kinematics of the throwing motion, providing detailed insights into the biomechanics of effective throws. This can help identify key factors contributing to high accuracy and inform the development of training programs. The test can also be used to compare different training methods or interventions aimed at improving throwing accuracy. Researchers can measure the impact of specific drills, strength training, or cognitive strategies on performance outcomes.

In terms of training applications, coaches can use the Diamond Dispatch Challenge to assess the throwing accuracy of players at various stages of development. The test results can help identify strengths and weaknesses, allowing for tailored training programs that address specific needs. Regular use of the test can help track progress over time, providing objective data on improvements in throwing accuracy. This can motivate players and provide feedback on the effectiveness of training regimens. Additionally, coaches can offer targeted feedback to help players refine their technique, focusing on aspects such as grip, release, and follow-through.

For coaching applications, the Diamond Dispatch Challenge can simulate game-like conditions, including time constraints and dynamic targets. This helps players develop the ability to perform under pressure, an essential skill for competitive play. Incorporating the test into training routines can help identify potential biomechanical issues that might lead to injuries. Coaches can use this information to design conditioning programs that enhance strength, flexibility, and overall physical resilience. Lastly, the test can serve as a standardized tool for evaluating player performance during tryouts or assessments. It provides a clear, objective measure of throwing accuracy, which can be a critical factor in player selection and team composition.

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APPENDIX

Appendix A

Diamond Dispatch Challenge

A test for overhand throwing accuracy based on a real-game scenario

Developed by Oliver Napila Gomez[ac] and Nashroding Bashier[bc]

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Accurate throwing is a critical skill for softball catchers, impacting both defensive strategies and game outcomes. Evaluating throwing accuracy to stationary and moving targets provides valuable insights into a player's defensive capabilities, including arm strength, precision, and adaptability under game-like conditions.

Diamon Dispatch Challenge is a test designed to measure the accuracy of overhand throws from a catcher's position in a softball game. The primary objective is to evaluate the ability of participants to accurately throw to five critical targets on the field: the pitcher, first base, second base, third base, and a moving or unpredictable shortstop.

Materials and Resources

Materials

- **Softballs.** High-quality softballs that meet official size and weight specifications for consistent throwing performance.
- **Cones or Markers.** To designate the positions of the targets (pitcher, bases, and moving shortstop) and the boundaries of the catcher's box.
- **Measuring Tape**. To accurately measure the distances from the catcher's box to the various targets (in case a standard softball diamond is not accessible).
- **Field Chalk or Paint.** To mark the positions on the field clearly, including the catcher's box and the paths to each target.
- **Gloves for Receiving Players**. Ensure that all targets (personified by players or stand-ins) have gloves to catch the balls.
- **Clipboards and Score Sheets**. For recording the outcomes of each throw and any other observations during the test.
- **Drying Cloth**. In case of wet grass, use a cloth to dry balls before throwing.

Human Resources

- **Participants.** Test participants who will be performing the throws.
- **Assistants**. To help set up the field, measure distances, and collect balls during the test.

- **Observers or Scorers**. Individuals trained to accurately assess and score each throw based on its accuracy and adherence to the test protocols.
- **Coach or Test Administrator**. To oversee the test, ensure adherence to rules, and provide guidance or feedback.

Safety Equipment

- **First Aid Kit.** Always available on-site in case of any accidents or injuries.
- **Water and Snacks**. Keeping participants hydrated and energized is especially important during long testing sessions or hot weather.
- **Sunscreen and Hats**. If the test is conducted outdoors, protection from the sun is essential.

Test Setup

Participants will execute throws from the catcher's box to the designated targets placed at varying distances, simulating realistic in-game scenarios. The distances are set based on standard softball field measurements, ensuring the relevance and applicability of the test results to actual gameplay.

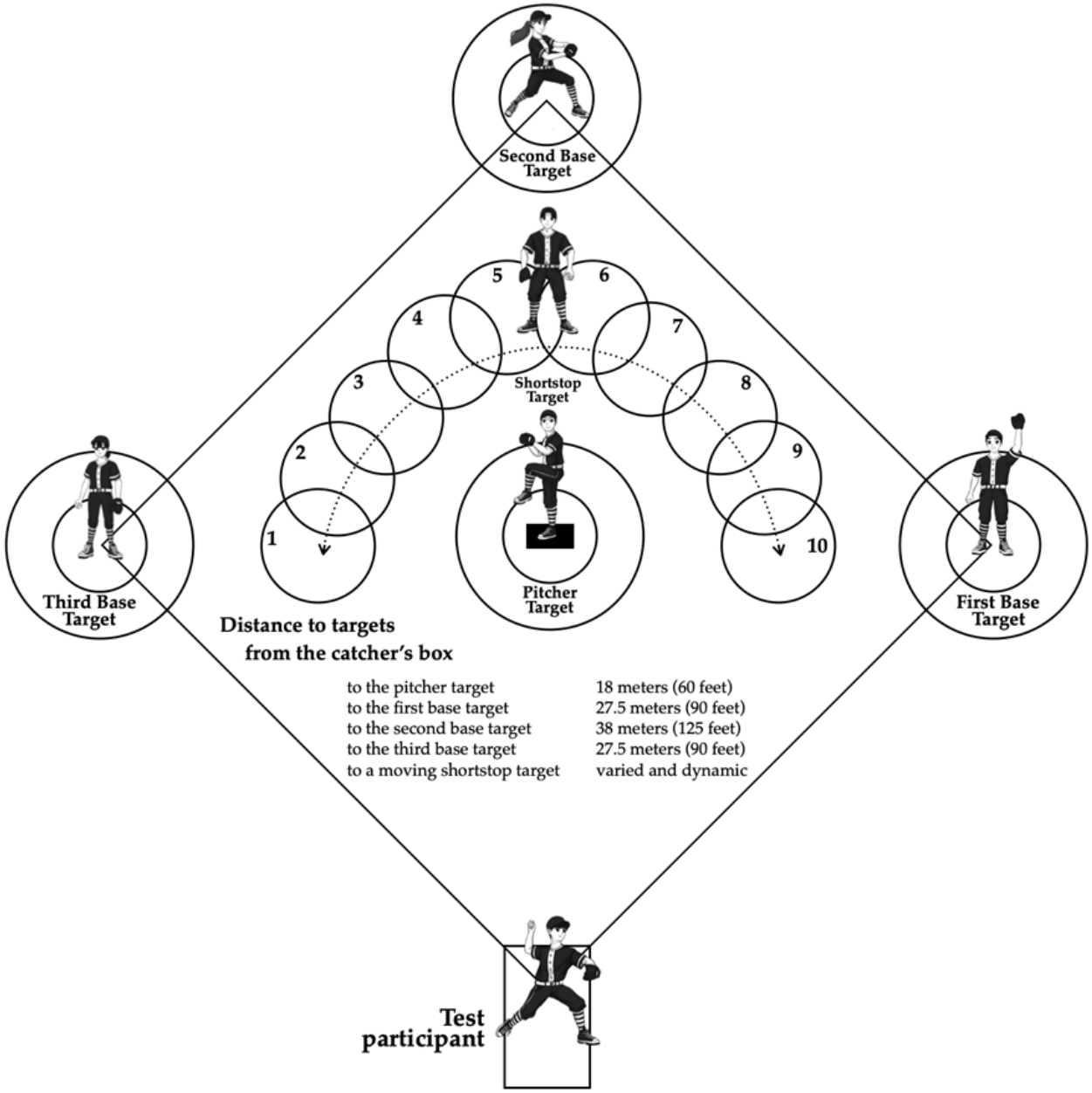

Figure 1. Test Setup and Dimensions

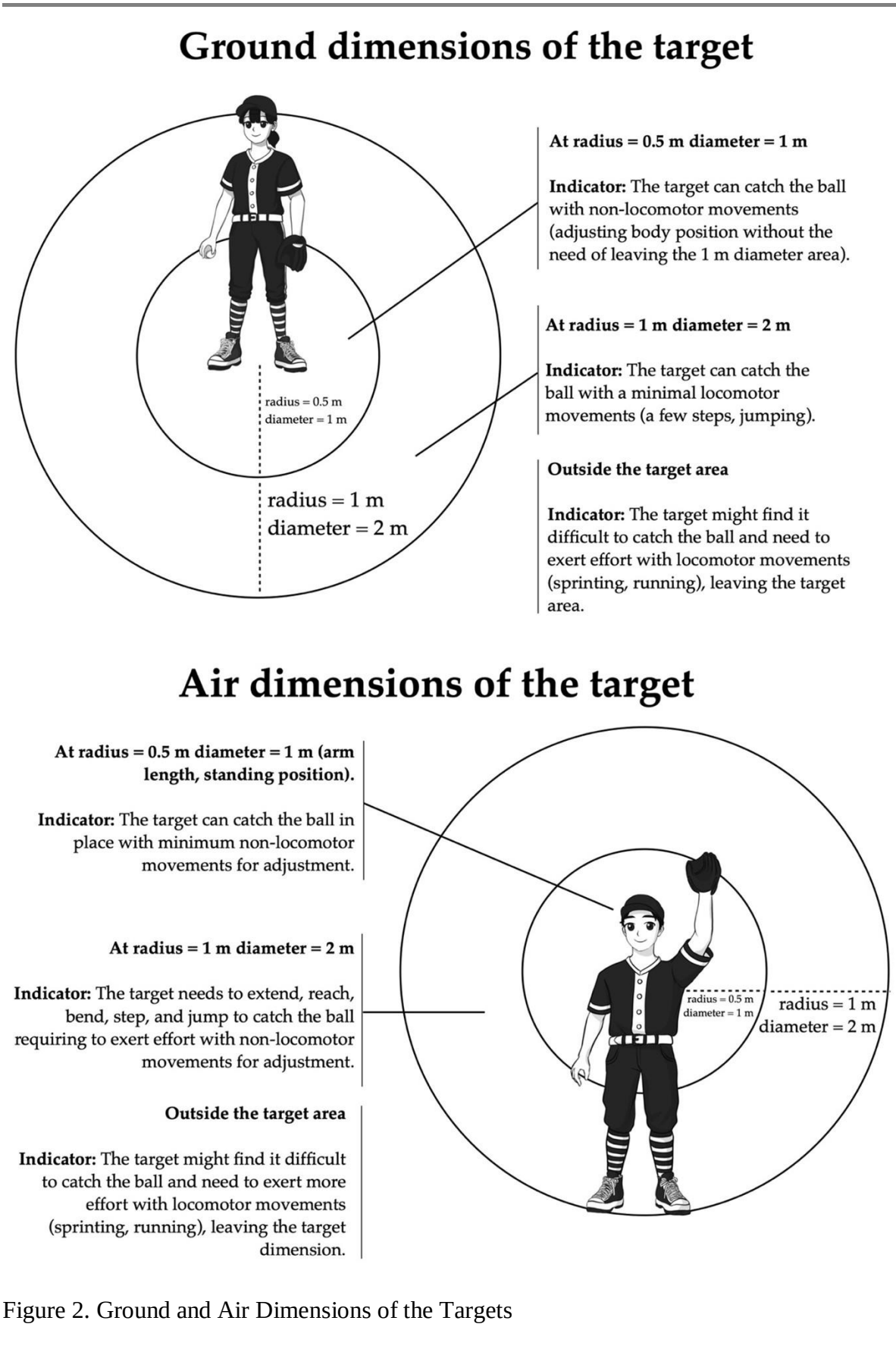

Figure 2. Ground and Air Dimensions of the Targets

Testing Protocol

Introduction

1. Brief the participants on the goals and importance of the test, emphasizing its role in measuring throwing accuracy from the catcher's position to various field targets.

2. Go over safety procedures, ensuring all participants and staff know how to proceed safely and what to do in case of an emergency.

Warm-Up

3. Start with 5-10 minutes of light aerobic exercise, such as jogging around the field, to increase heart rate and blood flow to muscles.
4. Focus on dynamic stretches, particularly for the shoulders, arms, neck, back, and legs to prepare for the throwing motions.
5. Participants should perform light throws to build up to the intensity required for the test gradually.

Throwing Practice

6. Allow participants to throw several practice overhand throws to each target without scoring. This helps them get used to the distances and the feel of the field.
7. Coaches provide feedback on throwing mechanics, helping participants adjust their technique to optimize accuracy and power.

Testing Phase

8. Each participant throws to the five designated targets (pitcher, first base, second base, third base, and moving shortstop) in a specified order. To ensure consistency of data, each participant should make three attempts per target.
9. Participants rotate through the stations in order to minimize fatigue and ensure fairness in variable conditions (e.g., wind).
10. The shortstop target moves dynamically around within a defined range. When it is time to throw to the shortstop, the test performer waits until the shortstop target is in a ready position. There are 10 positions for the shortstop. However, for every participant, the shortstop will change unpredictably. For example, positions 1-5-10, 2-6-9, 5-3-8, and so on.

Data Collection

11. Observers use score sheets to record the outcomes of each throw. A point system of throwing to the target based on the indicators described in Figure 2 is elaborated further in Figure 3.

Conclusion and Debrief

- Summarize the day's results, highlighting exceptional performances and areas for improvement.

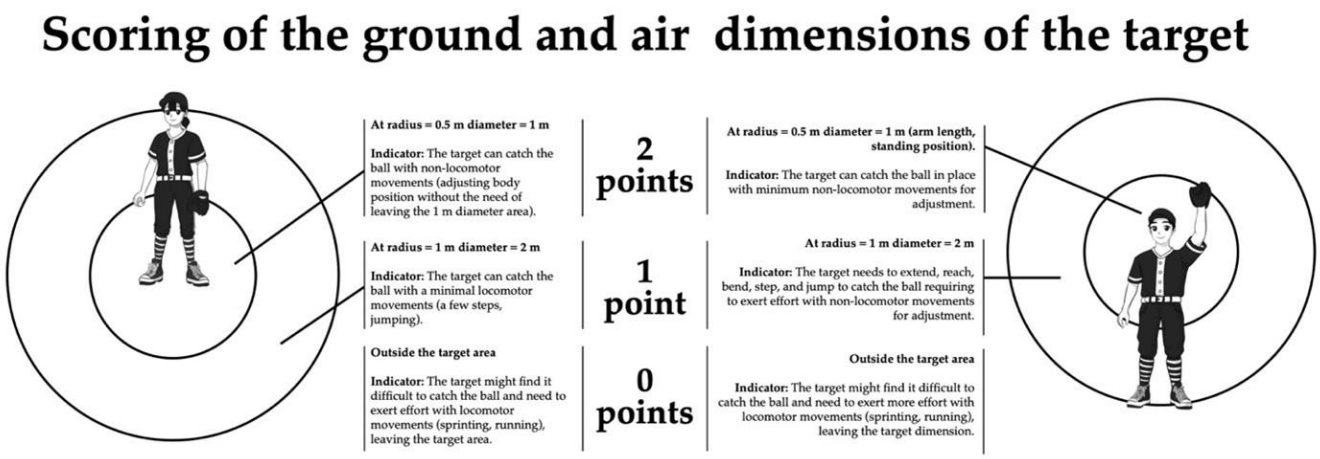

Figure 3. Point System of Throwing to the Target Based on Indicators

Scoring procedure

This unified scoring procedure for combined air and ground dimensions evaluates each throw based on where the ball lands or is caught in relation to a combined target area that includes both ground and air dimensions.

2 Points The ball is either caught or lands within a radius of 0.5 meters (diameter = 1 meter). This highest score is awarded when the ball is precisely where intended, whether caught in the air or landed on the ground, requiring no or minimal movement (non-locomotor adjustments) from the target receiver.

1 Point The ball is either caught or lands within a radius of 1 meter but outside the 0.5-meter radius (diameter = 2 meters). This score is given when the ball is close enough to the intended target that the receiver or fielder needs to make some effort with minimal locomotor movements (like reaching, bending, stepping, or a small jump) to catch or retrieve the ball.

0 Points The ball is either caught or lands outside the 1-meter radius. This indicates a throw that is off the mark, requiring significant effort and locomotor movements (such as sprinting, running, or extensive reaching) to catch or retrieve the ball.

Note that regardless of successfully catching the ball, as long as the above conditions are met, the point system remains applicable.

Moreover, each test participant is given 2 rounds. Table 1 shows the maximum and minimum scores for each throw in three rounds.

Table 1 Maximum and Minimum Score Ranges per Round for Each Target in Overhand Throwing Test

Throws	**ROUND 1**		**ROUND 2**	
	Maximum	Minimum	Maximum	Minimum
to the pitcher	2	0	2	0
to the first base	2	0	2	0
to the second base	2	0	2	0
to the third base	2	0	2	0
to a moving shortstop	2	0	2	0
TOTAL	10	0	10	0
OVERALL SCORE	**MAXIMUM**		**20**	
	MINIMUM		**0**	

The maximum total points for each round is 10 points, while 0 is the minimum. For the overall score, the sum of the total points from all three rounds is calculated. The maximum score is 20, while the minimum is 0.

Scoring interpretation

Range	Description	Interpretation
17-20	**Exceptional Precision**	Demonstrates excellent overhand throwing ability with precise control and consistency. Able to deliver the ball accurately under various conditions, showing advanced skills suitable for high-level competition.
13-16	**High Accuracy**	Shows reliable overhand throwing capabilities with occasional perfect throws. Generally hits the target with minimal adjustments required, indicating a strong skill set effective in competitive scenarios.
9-12	**Consistent**	Displays moderate overhand throwing skills. Consistently hits near the target area but often requires adjustments. Suitable for regular play, but further refinement of accuracy and control is needed.
5-8	**Developing**	Struggles with consistency in hitting the target. Throws often require significant adjustments by receivers, suggesting a need for improvement in accuracy and technique.
0-4	**Limited**	Has significant difficulties in achieving accuracy with throws regularly missing the intended target. Needs substantial improvement and training to develop effective throwing skills.