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The Relationship Between Static Balance and Dynamic Balance on Shooting Accuracy in Handball from a Stationary Position and Run-up Position

علاقة التوازن الثابت والتوازن المتحرك بدقة التصويب في كرة اليد من وضع ثابت ومن وضع الارتقاء

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Abstract:

The study aimed to identify the relationship between static balance and dynamic balance on shooting accuracy from a stationary position and from a (run-up) position among handball players under 13 years old. To achieve this, the study was conducted on a sample of 13 players from the wifak Ain Mlila team, active in the Oum El Bouaghi Regional Handball League. The descriptive approach was used with a correlational approach, and tests were used, namely the (Y) test for dynamic balance, the Stoke test for static balance, and shooting accuracy tests in handball, which were as follows: the stationary shooting test (seven-meter shooting) and the run-up shooting test. After collecting the data, the Pearson's simple linear correlation coefficient was calculated using SPSS, and the results of the study showed no statistically significant correlations between any of the studied balance and shooting variables.

Keywords: static balance; dynamic balance; stationary shooting; run-up shooting.

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Introduction:

balance is According to Hrysomallis. (2010) In sports where stability matters essential, and working on it alongside other conditioning sharpens your motor skills. The relation between balance abilities and athletic performance is less transparent. The relation between balance abilities and risk of sport injury has been confirmed in multiple cases. the balance ability was correlated with the level of competition leading athletes showed a higher level of this ability. Many performance indicators were strongly correlated with balance abilities. (Hrysomallis, 2010) .In an athlete the level of motor ability and success in team sports directly depends on static and dynamic balance. Balancing in an unchanged position such as standing quietly or being able to balance on a base of support with minimal sway is referred to as static balance, according to Hrisomallis (2011). granted Task Motion-ability to perform a task while in a stabilized position or regaining a balanced position on.(Pontaga et al., 2024)

Two teams, the main target is to score more goals than the opposition. In every sport, scoring a goal is a blend of rapidity and precision. In a goal oriented toss, one could execute it in many ways - tossing as fast as one can targetless, attempting to surprise an opponent as well as a goalkeeper, attempting to throw the goal. (Van Der Kamp, 2006). There has been a lot of training in handball to be able to refine various techniques and it comes as no surprise that shooting a handball is considered a unique art form. A player is able to shoot the ball in various directions such as the right and left hand corners along with the middle as well. The ball is able to be controlled with precision and thus, the player is able to shoot it with accuracy.(Belcic et al., 2023)

Analytic kinematic analysis on the standing throw in team handball has revealed that the timing on the maximal pelvic angle, the angular velocity on the interior shoulder turn when the ball is released, and the maximal elbow extension are principal contributors on the ball velocity (van den Tillaar and Ettema, 2004; 2007; Wagner and Müller, 2008).(Wagner et al., 2011) .How important it is from a mechanical standpoint is the way the muscles are organized concerning the kinematic chains. On both sides of the spindle and at the joints having two degrees of freedom, the muscles form four functional groups which are organized to move both at the same time and alternately.(van den Tillaar & Ettema, 2007). The speed of a handball throw depends on how the pelvis and trunk work together, and the most powerful shots usually come from a solid, balanced stance..(Wagner et al., 2011). Gomboș et al. (2017) confirmed that Poor balance affects throwing accuracy; improving balance may enhance 7-meter throws in handball.

Caballero et al. (2020) show that Traditional ways of measuring stillness don’t capture the real balance a handball player shows. Gomboș et al. (2017) confirmed that Poor balance affects throwing accuracy; improving balance may enhance 7-meter throws in handball. The study of Boubaker et al. (2025) recommend Add balance training to youth sports programs to help kids stay steady on their feet and cut the risk of injuries, such as the increased risk of ankle sprains during rapid directional changes.

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Previous studies show that balance plays a role in handball performance affecting things like throwing accuracy, yet most of that research has centered on adult or university-level players. e.g.,(Wagner et al., 2011),(Gomboș et al., 2017) not on youth athletes under 13 years old. Static balance or general balance training effects e.g., (Boubaker et al., 2025)(Pontaga et al., 2024), without directly linking static vs. dynamic balance to specific technical outcomes in handball. While we know how accurate 7-meter standing throws are, no one's compared that to shots taken with a run-up an important gap, since both matter when young players face real-game pressure. Use of mostly linear balance measures, whereas recent evidence Caballero et al. (2020) suggests In sports, a non-linear, adaptive approach to balance analysis can offer greater accuracy. So far, little is known about how static and dynamic balance each affect shooting accuracy in handball for kids under 13, or whether the type of balance matters when shots are taken in different situations. this study fills this gap by targeting a youth population and comparing two shooting contexts while linking them with static and dynamic balance abilities.

This study matters because it focuses on a key stage kids under 13 when motor skills, coordination, and balance are still taking shape and can be sharpened quickly. We looked at how static and dynamic balance connect to shooting accuracy in handball, testing it in two realistic situations holding still in a set position versus moving. In the run-up, the research digs into how balance affects shooting accuracy in young athletes, using those findings to shape training plans, boost performance, prevent injuries.

Balance is a core motor skill and a key part of athletic performance, especially in sports like handball where you've got to under conditions that range from static postures to dynamic game situations. For athletes younger than 13, a time when their bodies are learning to move with precision, developing solid balance can shape how cleanly they land a jump or control a pass. In handball, shooting accuracy can make or break a game, whether you're firing from a still stance or charging forward; each demands its own kind of balance.

This study aims to investigate the specific Relationship of both static and dynamic balance to the shooting performance of youth handball players, providing valuable insights for training program design.

1. To examine the relationship between static balance and shooting accuracy from a stationary position in handball players under 13 years old.
2. To examine the relationship between static balance and shooting accuracy from a run-up position in handball players under 13 years old.
3. To examine the relationship between dynamic balance and shooting accuracy from a stationary position in handball players under 13 years old.
4. To examine the relationship between dynamic balance and shooting accuracy from a run-up position in handball players under 13 years old.

1. Method:

1.1 Participants:

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All participants (n = 13 males aged under 13 years) were members of the Wifak Ain M'lila regional youth handball team, which is affiliated with the Oum El Bouaghi Regional Handball League. Participants were recruited based on their affiliation with a provincial youth team sharing similar training schedules (i.e., a frequency of 3–4 sessions per week), competitive level (i.e., regional), and age category. All participants and their parents or legal guardians were informed of the potential risks, study objectives, and testing protocols. Written informed consent was obtained from both the participants and their parents or legal guardians prior to the commencement of the study. Exclusion criteria included any injury that prevented participation in training or matches during the two weeks preceding the tests, as well as vestibular, visual, or proprioceptive impairments.

1.2 Instruments:

The test was conducted on three different testing days. All tests were conducted at the same time in the evening in the team's training room. The testing team, comprised of highly experienced assessors, took anthropometric measurements on the first day. Static and dynamic balance tests were then conducted on the second day, and shooting from a standing position and a take-off shot were conducted on the third day. Standardized verbal instructions were given before each test, and standardized warm-up exercises were performed, including 5 minutes of submaximal running, followed by various functional exercises and work with elastic bands. In addition, standardized ball passing techniques were performed using Olympic handballs according to the throw size before the throwing attempts.

1.3 Procedures:

1.3.1 Anthropometric Assessment:

Body weight was assessed using a digital scale. Standing height was assessed using a linear stadiometer without shoes. Participants were asked to lean on the device with their feet flat on the floor and look straight ahead. Height was measured in centimeters from the floor to the top of their head. Additionally, the participants' years of training and playing handball were determined.

1.3.2 Y-Balance Test Performance Evaluation:

In the Y-Balance Test (LQ-YBT), subjects reached in three directions—anterior, posteromedial, and posterolateral—following the standard steps given.(Rao et al., 2024) Standardized verbal instructions were provided to all participants prior to the test, and an experimenter conducted a demonstration trial before the test. All participants assumed the test position. From this position, participants moved the cursor with their free leg in the directions shown in (Figure 1). All three reach directions were to be performed without pause, maintaining a balanced body position. The trial was stopped if the participant did not maintain the correct position for the exercise. After each completed attempt, a 30-second rest period was given before completing the next trial. Upon completion of the three attempt, a composite score (CS) was calculated as the average of the mean maximum distances in all three reach directions.(Bauer et al., 2020)

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Figure 1: Explains how to conduct a **Y-Balance Test**

1.3.3 Static Balance Test Performance Evaluation:

We measured static balance using the Stork Standing Protocol, in which one foot is raised off the floor and the foot remains stationary. In the Stork Standing Test, participants rested both hands on their hips and gently pressed the sole of one foot against the inner portion of the opposite knee shown in (Figure 2). Upon cue, the participant raised their heel, keeping their toes on the floor, and attempted to hold their position for as long as possible. The trial ended once their hands were removed from their hips, their foot slipped from its normal position, or their heel touched the floor with a light tap. Participants' test times were recorded using a stopwatch, and the time was recorded in seconds.(RAOUF & URS GRANACHER, ISSAM MAKHLOUF, DAVID G. BEHM, 2016)



Figure 2: Explains how to conduct a **Stork test**

1.3.4 Stationary Shooting Evaluation:

The accuracy of throwing was assessed with the athletes positioned 7 meters from the goal line and situated in the center of the cage.(Sinka et al., 2024).the Purpose of the test is To measure shooting accuracy from a standing position. The player stands behind a 7-meter line holding the ball in his hand. Upon receiving the instruction, the player shoots at the square targets suspended at the corners of the legal target, starting from the upper right, then the left, then the lower right, and then the left. The action is repeated twice as illustrated in Figure .3 The scorer calls the students' names and records the scores according to the following points: Inside the square (1) point, Outside the square (0) points, Moving the pivot foot (0) points, if not executed within the legal time (0) points.

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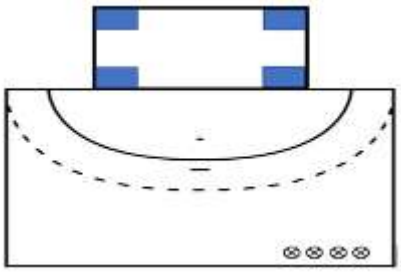


Figure 3: Illustrates a Stationary Shooting in handball goal.

1.3.5 shooting accuracy from a (run-up) position:

An assessment to evaluate shooting accuracy following a forward hop from the goal area line. The purpose of the test is to assess the precision of shooting following a forward jump from the goal area line during a rapid offensive by handball players. Equipment: a handball court, a handball goal, twelve handballs, four signposts, a whistle, a sto pwatch, and a precision shooting apparatus consisting of two rectangles constructed from a ho llow iron frame with a thickness of eight square centimeters. Equipment required includes a handball pitch, a handball goal, twelve handballs, four signposts, a whistle, a stopwatch, and a precision shooting apparatus. This apparatus consists of two rectangles formed from a hollow iron frame with a thickness of eight square centimeters, comparable to the thickness of the goal structure. The total length of the apparatus is two meters, and its width measures sixty-six centimeters from the outer edge. It features six shooting zones, three of which are interconnected and positioned on the left side of the first rectangular goal, while the remaining three are located on the right side of the goal. Each zone is further divided into three square shooting areas, one located above and another below, with dimensions of fifty by fifty centimeters from the inner edge of the tool. The central area is rectangular, measuring fifty by eighty-four centimeters from the inner edge, as illustrated in Figure 4. The player is required to repeat the aforementioned process twice, ensuring that the shooting sequence progresses from shooting area number one to area number six within the goal. A positive rest period of fifteen seconds is mandated between each shot. (Fathi, 2022)

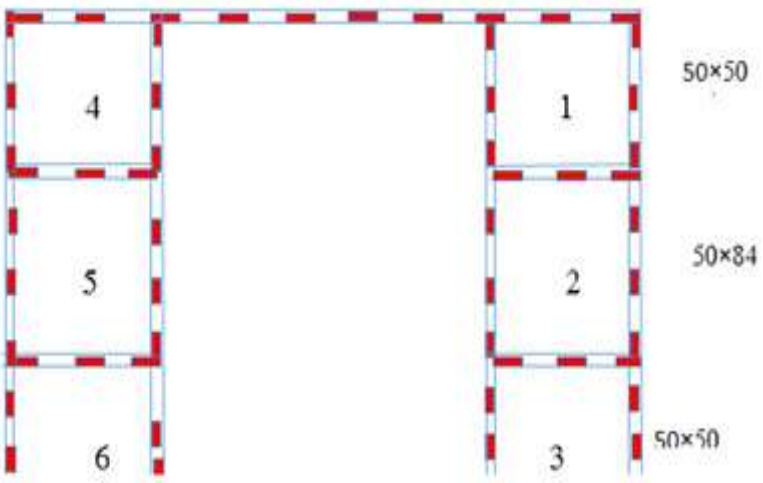


Figure 4: Illustrates a precision shooting device affixed to a handball goal.(Fathi, 2022)

1.3.6 Statistical Analysis:

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Studying the relationship between balance (static and dynamic) and shooting performance among young handball players requires the use of a set of statistical methods appropriate to the nature of the data and research questions. The data underwent statistical analysis utilizing SPSS Statistics version 25. The researcher used Mean, Standard Deviation and Pearson Correlation Coefficient to determine whether there is a Correlation or not and to know its type, The Shapiro-Wilk Test was used to assess the normal distribution of the data. The level for statistical significance was established at $P \leq 0.05$.

2. RESULTS:

Table1 correlations between balance Static, Dynamic Balance and Stationary, run-up Shooting

Independent Variable	Dependent Variable	reference value	Correlation Coefficient (r)	(p-value)	significance
Static Balance	Shooting Stationary	4.12 ± 0.84	0.202	0.57	Not Significant
Static Balance	(Run-up) Shooting	4.12 ± 0.84	0.346	0,32	Not Significant
Dynamic Balance	Shooting Stationary	76.40 ± 6.40	0.004	0.99	Not Significant
Dynamic Balance	(Run-up) Shooting	76.40 ± 6.40	0.594	0.07	Not Significant

Table1 illustrates mean, standard deviations values, correlation coefficient (r), (p-value). The study revealed no statistically significant correlations between any of the studied balance and shooting variables. Specifically, there was no significant correlation between static balance and stationary shooting accuracy ($r = 0.202$, $p = 0.57$). Furthermore, no significant correlation was found between static balance and run-up shooting accuracy ($r = 0.346$, $p = 0.32$). Similarly, the analysis recorded no significant correlation between dynamic balance and stationary shooting accuracy ($r = 0.004$, $p = 0.99$). Finally, although the highest correlation value was observed between dynamic balance and run-up shooting accuracy ($r = 0.594$), this relationship did not reach the threshold for statistical significance ($p = 0.07$).

3. Discussion:

The first purpose of this study was to assess whether there are Relationship between both static and dynamic balance to the shooting performance of youth handball players. According to our findings, there is no correlation between any type of balance under study and shooting accuracy.

the absence of statistically significant correlations between static/dynamic balance and shooting accuracy presents an intriguing puzzle. At first glance, it seems to contradict the conventional coaching wisdom that better balance leads to better shooting. However, a nuanced discussion integrating the other studies reveals that this relationship is far more complex and context dependent than a simple direct correlation.

our results find strong, direct support in the work of (Gomboș et al., 2017), who also found "no significant statistical correlation" between static postural balance (measured by center of pressure metrics) and 7-meter throw accuracy. This parallel finding across two independent studies significantly strengthens the argument that static balance, in isolation, is

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not a primary direct predictor of shooting accuracy in handball players, at least in the context of a controlled test environment.

Furthermore, the study by (ERKUT et al., 2014) adds an important layer of context. They found no significant differences in balance abilities between handball and soccer players. This suggests that while balance is a fundamental athletic attribute, it may not be the unique differentiator for sport-specific skills like handball shooting. Their finding that handball players had greater leg muscle mass but not better balance implies that other factors (strength, power, technique) are more directly trained by the sport.

Why Other Studies Found a Benefit This raises a critical question: if balance doesn't directly correlate with accuracy, why did the first study on eccentric hamstring training show a 13.5% improvement in dynamic balance that benefited post-PHV players?

The key is in the type and context of the balance measure and the mechanism of improvement.

- our study and Gombos's measured *static* or isolated dynamic balance.
- The eccentric training study improved *dynamic balance* in a context that directly enhances functional performance specifically, the ability to control the body under the high mechanical loads of hamstring deceleration. This type of balance is less about holding a still position and more about efficiently managing momentum and force.

The improvement in shooting performance from other studies is likely not due to balance directly influencing aim, but rather freeing up cognitive and mechanical resources for optimal technique execution. For example:

- (Šibila et al., 2003) and (Belcic et al., 2023) demonstrate that superior technique (JS1, three-step run-up) generates greater kinetic chain efficiency, leading to higher jumps and faster ball velocities. A player with poor functional balance must dedicate resources to simply stabilizing their base, compromising the kinetic chain. A player with excellent functional balance has a stable platform from which to generate maximum force from the legs, pelvis, and trunk—factors (Wagner et al., 2011) identified as the primary correlates of ball velocity.
- The player who doesn't have to worry about wobbling upon landing (JS2) or during a one-step run-up can focus entirely on the precise timing and coordination of the throw. Thus, balance acts as an enabler of good technique, not a direct cause of accuracy.

our finding of a strong, though not statistically significant, correlation between dynamic balance and run-up shooting accuracy ($r = 0.594$, $p = 0.07$) is particularly insightful. It points toward a meaningful relationship that may have reached significance with a larger sample size. This aligns perfectly with the kinematic literature:

- (Wagner et al., 2011) proved that the run-up is crucial for generating the highest ball velocities, as it contributes to the velocity of the center of mass.
- (Belcic et al., 2023) showed that a three-step run-up creates significantly different (and more powerful) kinematics than a one-step run-up.

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Managing this run-up requires exceptional dynamic balance to convert horizontal momentum into vertical lift and a stable throwing base. Therefore, it is logical that the relationship between balance and shooting would be strongest in the condition that places the highest demand on balance: the run-up shot.

5. Conclusion and suggestions:

our findings do not suggest that balance is unimportant for handball players. Instead, they clarify its role:

It is a Foundational, not a Direct, Skill: Balance, particularly as measured in static or isolated tests, does not directly determine shooting accuracy. Its value is foundational; it provides the stable mechanical and neuromuscular platform necessary to execute complex, sport-specific skills efficiently.

The Specificity of Training Matters: General balance training may not transfer to shooting accuracy. However, as the eccentric training study shows, targeted training that improves balance in a specific, functional context relevant to handball (e.g., deceleration, single-leg landing, shooting on the move) can lead to significant performance enhancements, likely by improving the entire kinetic chain.

Technique is Paramount: The primary determinants of shooting performance are technical factors: the efficiency of the kinetic chain (pelvis & trunk rotation), jump height, and release parameters. Balance supports the execution of these techniques, especially under dynamic, game-like conditions (run-ups, jumps, landings).

In summary, our research successfully demonstrates that we cannot assume a simple linear relationship between balance and accuracy. It calls for a more sophisticated understanding where balance is viewed as a critical component of the athletic framework that enables the technical prowess required for elite handball performance, rather than a standalone predictor of scoring success. Future research should focus on more sport-specific, dynamic balance tasks and their interaction with kinematic variables to further unravel this complex relationship.

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