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Analyses of Physical Fitness and Skill Performance in Pakistani Elite Male Handball Athletes: A Pilot Study

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Abstract

This research aimed to determine the physical fitness and skill performance variables that could offer coaches useful data when choosing young team handball players of outstanding ability. 16 elite players from the Faisalabad Handball Training Club, ages 18 to 22, were chosen for this study in 2023. Physical fitness tests (30-meter sprint, Illinois agility, vertical jump, push-ups, sit-and-reach tests), as well as skill performance testing (slalom dribbling and shooting accuracy test), were included in the battery. Test-retest reliability established the study tool's reliability, whereas descriptive statistics measured the mean ± standard deviation between groups. The test-retest methodology is used to assess the reliability of research instruments. All variables have intraclass correlations ranging from 0.699 to 0.970. This is the first study into the physical fitness variables and skill performance analysis of Pakistani elite male handball players. It was confirmed that the test procedure had high reliability and accurately reflected the performance of the participants. This will provide future researchers with a way to accurately measure. It is recommended that future research examine the importance of tests that measure specific skills and physical abilities.

Keywords: Handball Players, Physical Fitness, Handball Skills, Reliability.

Introduction

Handball has grown in popularity and is well-known for its acceleration (Ooraniyan & Murugavel, 2023). Professional and Olympic handball is played between two teams of seven players (one goalkeeper and six field players) on a 40 by 20 m court. The purpose of the game is to score more goals than the other team at the end of two 30-minute sessions. It is characterized by a lot of body contact along with rapid attacking and defensive moves

(Wagner et al., 2014; Michalsik et al., 2018). (Wagner et al., 2014; Michalsik et al., 2018). As a result, to defeat opponents and keep the game moving rapidly and intensely throughout a match, players need to be physically ready (Michalsik et al., 2018; Karcher et al., 2018). There are numerous playing positions in elite handball, each with a different function within the team. This results in different movement patterns and physical demands for each position. Specifically, players must perform different handball-specific skills (dribbling and shooting) in addition to different general movements (running, changing directions, jumping, and walking) during the games (Wagner et al., 2014; Karcher et al., 2018). A proficient handball player must be able to perform a variety of physical and technical skills, including rapid reactions, explosive jumping, dribbling, and accurate goal-aiming shooting.

According to Meier et al. (2020), this sport is highly captivating to watch since it is an intermittent activity that involves a lot of physical contact, opponent duels, and technical and tactical components meant to outwit the opposition. Since handball comprises many different actions that call for the effective activation of muscle fibers, it is evident that team sports demand strong explosive strength components (Keller et al., 2020). Dello Iacono et al. 's (2006) research indicates that in a single game, there are approximately 300 CODs (changes of direction) and slightly less than 500 high-intensity actions (Iacono, 2015; Iacono et al., 2016). Handball is a team sport where rate of force development (RFD) is very important. As a result, prior studies (Herrero et al., 2006; Hermassi et al., 2010) have shown that this is particularly evident in handball movements like feints (changes of direction) and jump shots (vertical jumps) (Ingebrigtsen et al., 2013; Wagner et al., 2014).

Therefore, specific information about these variables is crucial and may help with tracking, advising, and improving the physical performance of handball players. Studies on the connections between particular skill assessments and physical fitness have been done in several sports, including basketball (Gómez et al., 2015), volleyball (Cabral et al., 2016), hockey (Koley et al., 2012; Singh et al., 2010), and soccer (Silva et al., 2015). Alvares et al. (2014) also sought to gauge the effectiveness of handball players in this regard. However, the proven physical and specific skill performance characteristics of handball players using inexpensive procedures are still unknown.

Therefore, it is crucial to verify the physical and skill performance indices of the handball players and determine whether these factors are connected to any specific performance task. The current study examined these areas to gain a better understanding of the physical performance indicators (speed, agility, explosive power, endurance, and flexibility) and skills assessments (dribbling and shooting accuracy) of elite male handball athletes.

Methodology

Participants

The participants were selected randomly. Faisalabad handball clubs recruited sixteen male handball players (EG: age: 20.375 ± 1.597 years; body mass: 68.122 ± 2.695 kg; height: 177.250 ± 1.252 cm; BMI: 21.712 ± 0.917 kg/m2, CG: age: 20.250 ± 1.218 years; body mass: 67.750 ± 3.195 kg; height: 176.625 ± 2.875 cm; BMI: 21.525 ± 0.415 kg/m2). The participants were ≥18 years of age, without a chronic illness, and had not engaged in any form of physical training for at least 6 months before. They also had to have experienced no upper-extremity neuromuscular or musculoskeletal injuries within the two years before the study. All participants, or their legal representatives, gave written declarations of informed consent, and the Govt College University Lahore institutional ethics committee approved the testing protocol.

Procedures and Evaluations

Anthropometry

Measurements of anthropometry comprised standing height (Crosswell, Holtain stadiometer, Crymych, United Kingdom, Pembrokeshire) and measurements were taken to the nearest 0.1 cm, accordingly. With an index value of 0.1 kg, the weight measurement ranged from 8 to 200 kg. The body mass index (BMI) was computed using the body mass (kg) to body height squared (m2) ratio. It was requested that the participants take off their shoes and rest their heads, shoulders, and hips against the apparatus. To determine their weight and height, participants were instructed to bend their heads and extend their spines. Table 1 shows the anthropometric data of the subjects.

Physical Fitness

The athletes were assessed in the following tests using a randomized design to analyze physical performance variables: the Illinois Agility Test for agility; the 30-m sprint test for speed; for flexibility; the sit and reach test; and the push-up test for endurance. Exam batteries were used to evaluate the subjects' sports performance. The athletic performance test batteries were redone after two weeks. A record was kept of the three best attempts. In compliance with Gelen's (2010) recommendations, a dynamic warm-up technique was used to prepare the subjects before the measurements. Between each test, ten minutes were set aside for passive recovery.

Handball Skill

Dribbling: Participants dribbled a handball between 5 cones while running 15 meters back and forth. Three meters separated the first cone from the starting line and the rest of the cones. Each subject ran individually. The best of two trials was chosen.

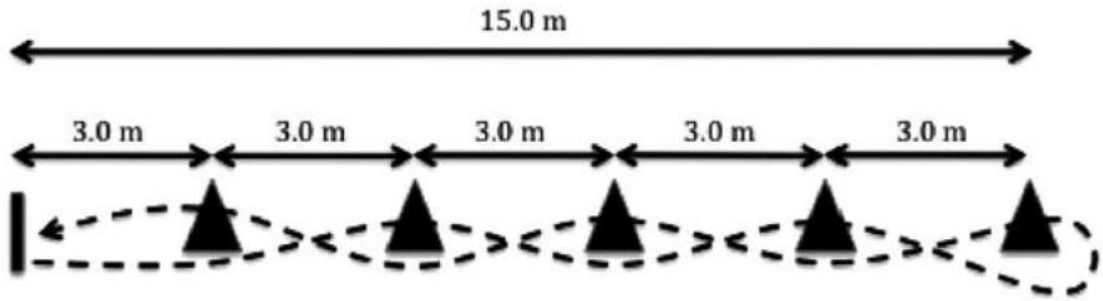

Figure 1. Course of the Slalom Sprint and Dribble Test (Lidor et al., 2005).

Shooting Accuracy: The goalpost was divided into eight sections, each 50 cm from the ground and the side. A total of five points were assigned to each of the four corner areas, three points to the rest of the field, and zero points to the center of the goalpost. Ten shots from the 7-meter penalty line were allowed for each player. The dominant arm had to be used to carry out the throw entirely. Just behind the firing line, players were told to keep their feet on the ground and use the proper methods. If a player did not perform, there were no points awarded. The player must shoot again if the ball lands on the string that divides the goal post during the three-step jump shot. The ball shoots outside the goalpost. The sum of the points scored for each goal is the score.

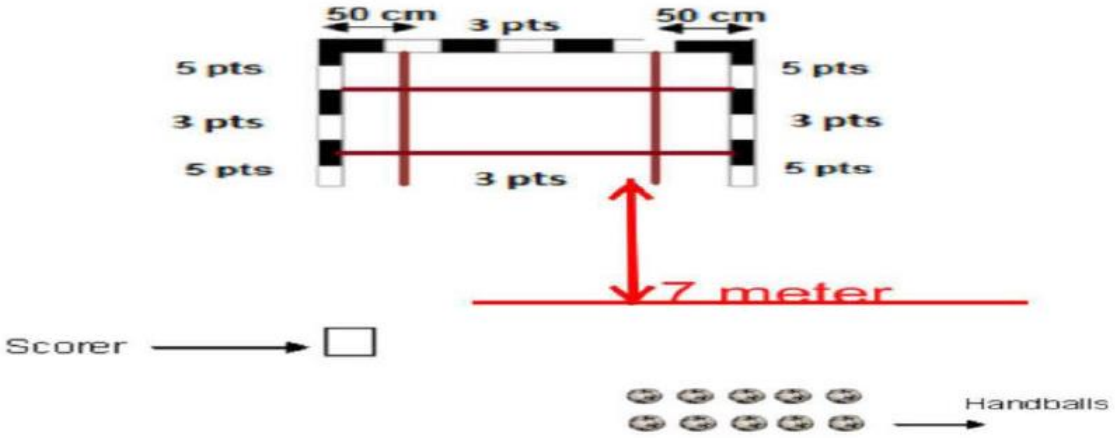

Figure 2: Shooting accuracy test Adopted from Kangane (2007).

Statistical Analysis

The t-test was used to investigate the homogeneity of variance assumption, and the Shapiro-Wilk test was used to confirm the normality assumption. An independent sample t-test was employed to compare the means. Physical literacy was found to be correlated with organized sports and self-organized physical activity using the Pearson product-moment correlation coefficient. Correlations were interpreted on the following basis: trivial (0–0.1), small (0.1–0.3), moderate (0.3–0.5), large (0.5–0.7), very large (0.7–0.9), nearly perfect (0.9), and perfect (1.0) (Hopkins et al., 2009). At a significance level of 0.05, the statistical analyses were performed with IBM® SPSS® Statistics, version 26.0, on Windows (SPSS Inc., Chicago, IL, USA).

Results

Normal Distribution and Variance

Homogeneity

Athletes were significantly different between groups in age [t(16) =0.173, p = 0.865], height [t(16) = 0.525, p = 0.608], weight [t(16) = 0.254, p = 0.803], and BMI [t(16) = 0.281, p = 0.783]. Regarding variance homogeneity, physical performance variables: 30m sprint [t(16) = -3.131, p = 0.448]; Illinois agility test [t(16) = -2.020, p = 0.128]; vertical jump test [t(16) = -0423, p = 0.524]; sit and reach test [t(16) = 2.049, p = 0.429]; and push-ups [t(16) = 1.080, p = 0.660], were homogenous in variance. Handball skills performance parameters p-values (slalom dribble test: [t(16) = -1. 264, p = 0.610]; shooting accuracy test: [t(16) = 0.427, p = 0.386)] show that the variances of the variables were not varied.

Reliability of Instruments

The intraclass correlation coefficient and the confidence interval method for all tests were inserted in Table 3. According to the analysis of the results, a correlation was found between selected variables of physical performance: 30m speed (ICC = 0.825–0.976), Illinois agility test (ICC = 0.819–0.981), explosive power (ICC = 0.883–0.986), flexibility (ICC = 0.679–0.966), and endurance (ICC = 0.820–0.976). The selected variables for skills also found a high correlation between dribbling (ICC = 0.741-0.964) and shooting accuracy (ICC = 0.578-0.837). All of the tests in both groups had correlation coefficients ranging from 0.699 to 0.970 for the extracted component, which was large to very large (Table 1).

Table 3
Test-retest Reliability of Instruments.

Variables	Measurement Method	Intra-class Correlation Coefficient	95% Confidence Interval	
			Lower Bound	Upper Bound
Physical Fitness				
Speed	30m	0.934	0.825	0.976
Agility	IAT	0.943	0.819	0.981
Explosive Power	VJ	0.970	0.883	0.986
Flexibility	SAR	0.899	0.679	0.966
Endurance	PU	0.933	0.820	0.976
Handball Skills				
Dribbling	SDT	0.901	0.741	0.964
Shooting accuracy	SAT	0.699	0.578	0.837

Noted: IAT: Illinois agility test; VJ: Vertical; SAR: sit and reach test; PU: push-ups; SDT: slalom dribble test; SAR: sit and reach test.

Discussion

The purpose of this study was to examine the physical fitness and specific handball skill performance of Pakistani elite male handball players. The findings were discussed as follows:

Physical Fitness

Short-distance sprints are essential for team handball. Players sprint for roughly 20–30 meters in several game conditions, such as during a fast break or while switching back to defense following a ball loss (Clanton, 1997). The tests' interrater reliability was assessed, and the 30-meter sprint test showed strong reliability with an ICC of 0.96 (0.86–0.99) (Hermassi et al., 2020). The study's 30-meter sprint findings for handball players revealed a high level of reliability (ICC 0.934). Previous studies have discovered that adult athletes' IAT scores had a good level of consistency (Hachana et al., 2013; Lockie et al., 2013; Sheppard and Young, 2006). The ICC across two trial reliability analyses in these investigations (Baker and Nance, 1999; Amiri-Khorasani et al., 2010) was greater than 0.90. The ICC reported by Pauole et al. (2000), Munro and Herrington (2011), and Sporis et al. (2010) were 0.98, 0.82, and 0.92, respectively. Hachana et al. (2013) and Lockie et al. (2013) found an ICC of 0.97 and 0.91 for the IAT score in young Tunisian and Australian soccer players (aged 23–37 years old, respectively). According to Negra et al. (2016), the ICC for handball and soccer players is 0.99 (0.98–0.99). For IAT scores, our study's comparable reliability can be assessed as excellent.

As to the values of the vertical jumping technique (VJ) related to other studies, it was observed a similarity in the ICC of this study (ICC = 0.970) to the studies performed by Vila et al. (2012), Dabhi & Rami, 2020, Elvira et al. (2001), Hoffman and Kang (2002), and to the correlation coefficients for the test and re-test measurements of ICC of 0.94, ICC of 0.97, ICC = 0.99, and ICC = 0.97, respectively. The results thus demonstrate the accuracy of the repeated vertical jump test measurements, as it appears that the test quality indicators support this reliability. The two trials' ICC for the push-ups test was 0.94 (95% CI: 0.79–0.98). According to reports of relative reliability value indices for endurance testing (Fawcett & DeBeliso, 2014; Hashim et al., 2018), this number scored within that range. Dabhi and Rami, 2020 found that push-ups had a high degree of reliability (ICC 0.99). According to previous studies, our study revealed push-up reliability values of ICC 0.933. The test-retest approach

revealed that the results obtained for basketball, soccer, and team handball players were dependable and ranged from 0.67 to 0.96 (Sporis et al., 2011). Studies conducted on adults ages 18–64, it was determined that the sit-and-reach test offered high test-rest reliability (ICC = 0.91–0.99) (Tsigilis et al., 2002; Lopez et al., 2007; Bozic et al., 2010; Kahraman et al., 2016; Ayala et al., 2012; Atamaz et al., 2011). The inter-trial confidence interval (ICC) for the flexibility test was 0.96 (95% CI: 0.93–0.99) in SAR. Gabbe et al. (2004) demonstrated comparable sit-and-reach intra-rater reliability, ICC 0.97–0.98, to our results. While the flexibility tests showed moderate to very high reliability (0.62–0.98), the Waldhelm and Li (2012) study found that the standard sit-and-reach test had the highest reliability (0.98).

Handball Skills

For skill performance, two variables were defined: dribbling and shooting accuracy. The researcher assessed the young, skilled handball players from Pakistan in this study. To assess skill performance accurately and effectively, the author examines a wide range of academic publications. The literature provides evidence that this study concurs with the findings of earlier studies on skill performance. While few studies have assessed skill-related characteristics in handball players, no thorough investigation has looked at these factors in players of different levels.

The test employed in this study was quite simple; the participant only needed to make their best shot. According to Dabhi and Rami (2020) and Chalie (2020), the shooting accuracy test was developed to assess shooting accuracy from a 7-meter distance by employing strategies that are frequently utilized in professional handball to score goals. For elite handball players, the ICC range was 0.93 (95% CI, 0.93 to 0.95), which is a high and consistent accuracy rate. Nonetheless, the shooting accuracy test employed in this study has a lot of benefits for handball players.

Thomas et al. (2015) reported that the measure has a comparable level of group discrimination to the idea of handball-specific dribbling; significantly faster dribble timings from groups with higher playing levels demonstrate the measurement's reliability. The slalom test was the only one that offered reasonably consistent data regarding the skill level of young team handball players. According to Belka et al. (2016), this was the only assessment where using team handball technical skills was necessary for the players. The test demonstrated a good level of player reliability throughout two testing times (ICC = 0.901). Among the elite handball players, the skill test proved to be a more reliable indication. Furthermore, the ICC results provide an excellent level of reliability that makes the slalom dribble results suitable for use in additional testing. These results are in line with past studies on handball players (Lidor et al., 2005; Dabhi & Rami, 2020) that found good reliability (ICC = 0.91).

Conclusion

The current study examines male handball players' physical fitness and skill performance. Overall, the most reliable measurements were the vertical jump, Illinois agility, and slalom dribble tests. The data analysis results showed that to make handball easier to learn, young athletes needed simple and clear directions to perform handball skill methods. There was a considerable overlap in the player outcomes across all other measurements. It is recommended that future research concentrate on the importance of assessments that measure a greater variety of skills and physical abilities. Furthermore, greater numbers of samples of both males and females should be included in future research, and more parameters are needed to substantiate our preliminary findings. Research such as this can

help us understand how young handball players develop because there isn't much information available about their skills and physical abilities.

Limitations

In ball games, coaches often used all of the tests that were given in this study. These assessments' primary goal is to give coaches insightful knowledge about the players' necessary physical abilities so they can help them become highly proficient in constrained situations. That is, using the information gathered from these tests, it is difficult to predict sports excellence. In every physical and skill test administered during our study, there was a statistically significant association between the outcomes of the EG and CG handball players. As a result, the information gained from these tests throughout the two weeks was very limited. Additionally, the relatively small sample sizes for each group (n = 8) may have hindered the external validation of our findings. Choosing representative samples of young people in numerous places in Pakistan is a challenging task due to the country's vast population.

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