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Relationship between Physical Fitness and Match-Play Performance among Youth Netball Players

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Abstract Physical fitness has long been shown to be crucial for athletes due to its contribution to decrease injury and health risks. In sport, physical fitness is important to increase athletes' ability to perform technical movement and follow coaches' tactical plan in the game. This study aims to investigate the anthropometric, physiological, and match-play performance of netball players and examine the relationship between physical fitness and game characteristics among netball players. Material and Methods: A total of ninety-one female netball players (mean ± SD: age 18.78 ± 5.41 years, height 1.60 ± 0.01 m, and weight 56.13 ± 6.40 kg) participated in this study. Participants underwent standard anthropometry measurement (height, weight, and body mass index) and physical fitness evaluation (standing long jump, 20-meter sprint, agility T-test, sit and reach test, and multistage fitness test). Results: The findings of anthropometric and physical fitness showed that qualified players had significantly superior performance in agility, flexibility, and VO_2 max components than non-qualified players, $p < .05$. For match-play performance, there was a significant difference in deflection, interception, goal attempts, and the number of goals scored between qualified and non-qualified teams, $p < .05$. The result of correlation test shows that the interceptions were significantly correlated with the agility component ($p < .05$), and the goal attempt and the number of goals scored were also significantly correlated with the estimated VO_2 max ($p < .05$). Conclusions: These findings suggest that a high level of physical fitness can influence successful performance, especially in-game characteristics of netball players. In conclusion, a specific training program that focuses on physical fitness may facilitate athletes to perform superior match-play performance in netball matches.

Keywords Physical Fitness, Match Performance, Netball, Performance Analysis, Anthropometric

1. Introduction

Netball is an intermittent team sport which requires an intensive effort of players to adapt to the changes of intensity of the game [1]. The physiological demands in netball involve various physiological components (agility,

speed, power, and strength) [2], and the anaerobic and aerobic sources act as the main energy supplier. It also requires a player to possess a high level of skills such as running, jumping, throwing, catching and changing of direction, together with technical and tactical skills [3, 4]. Besides, match-performance characteristics in netball such as guarding, defending, attacking, shuffling, and sprinting among players have been shown to affect the physiological demands and activity profiles of players during a netball game [5, 6]. The various match-play elements and court limitations also influence the physical needs of each netball position [7]. Therefore, understanding the physiological needs of netball players is essential for improving performance.

To develop performance profiles for various sports, knowledge of sport-specific game requirements is helpful. Hughes and Franks [8] suggested that physiological factors must be considered when analyzing the performance of the players because these factors can affect the performance of individuals and teams. Several sports have looked at the use of physiological and anthropometric evaluations of athletes to create physical performance profiles, including football [9], volleyball [10], and rugby [11]. Performance profiles have been proposed as a tool for athlete talent identification and player starting and non-starting decisions [6]. With an increase in playing level, physiological and anthropometric measurements are frequently shown to improve [12]. For example, in rugby, junior elite athletes outperformed their sub-elite counterparts in vertical jump height, speed, change-of-direction speed, and estimated maximal aerobic capacity [11].

Previous studies have documented the physiological demands among players across different positions in netball [1],[5],[6],[13]. The findings demonstrated that each position has different levels of physical fitness and physiological demands especially during training and competition. It was found that the frequency of movement for defending and attacking players (GK and GS) was slightly different compared to other positions [5, 14]. Besides, players in high grades showed superior performance in physical capabilities compared to players in low grades [6]. Steele [15] found that netball players need to possess at least 75 and 80% of maximal heart rate (HR) during match-play compared to training time (below 75% of HR). Other intermittent team sports such as rugby league also conducted a study related to physical characteristics with different playing positions and found that each position has specific game demands[12, 16].

In many sports, physiological characteristics can influence the successful performance of team sports such as futsal [16], football [17], basketball [18], rugby [19], and netball [14]. The information regarding physical performance provides coaches valuable information to design an appropriate training program for athletes to be physically prepared to succeed in netball matches. Although successful performances in sports are related to physical fitness characteristics, players also need to possess a high level of skills during a match so that they can play well under tiredness and pressure [20], [33, 34]. However, too few studies have investigated the relationship between physical characteristics and match-play performance in netball. Prior research has not investigated the relationship between physical fitness levels and match play factors, which could significantly influence netball performance. They mainly examined the players' physical fitness based on position [44] and the difference of match play variables between winning and losing teams [32]. Therefore, the study aimed to examine the anthropometrics, physiological, and game characteristics of winning and losing teams in netball matches. The current study also aimed to investigate the relationship between physical fitness and game characteristics in netball players.

2. Methods

The present study used a correlational research design to determine the relationship between anthropometric, physical fitness, and match-play performance of players in qualified and non-qualified teams. The relationship between physical fitness and match-play performance was determined using eta coefficients and stepwise multiple linear regression. We hypothesized that there was a positive relationship between physical fitness components (e.g., standing long jump, agility t-test, etc.) and match-play performance (e.g., turnover, successful pass, interception, etc.) among netball players who competed in the Netball Sabah Games (SAGA) 2019. We also hypothesized that the physical fitness of qualified teams was greater than non-qualified teams. This result could lead them to produce superior match-play performance during the tournament.

2.1. Participants

Ninety-one young netball players who competed in the 2019 Netball Sabah Games (SAGA) and had a mean age of 18.78, 5.41 years volunteered to take part in the study. They were selected using purposive sampling based on their participation in the netball tournament (SAGA). Participants represented eight of the participating teams in the competition, which were Kota Kinabalu, Kota Belud, Keningau, Lahad Datu, Sipitang, Tenom, Tongod, and Penampang. Teams were classified into two groups: qualified (teams that qualify into the semifinal) and non-qualified (teams that did not qualify into the semifinal). Teams that qualified into the semifinal were Keningau, Lahad Datu, Kota Kinabalu, and Tenom. Kota Belud, Sipitang, Penampang, and Tongod were the teams that were not able to advance to the semifinal. The Sabah Sports Council and the University of Malaysia Sabah's Ethics Committee both gave their approval to the study (MSNS: 800-5/9 klt27).

2.2. Anthropometric and Physical Fitness Test Procedure

Two weeks before the competition began, all participants took part in anthropometric and physical fitness evaluations. The session was carried out at indoor netball courts on a synthetic floor. The participants' anthropometrics were measured before they started the physical test. With the use of a portable stadiometer (Seca 217), height was calculated to the nearest 0.01 m. A certified electronic scale was used to measure weight to the closest 0.1 kg. The formula BMI = kg/m2 was used to get the body mass index (BMI).

Before the physical test started, participants were confirmed free from any injuries to participate in the test. The testing protocols included 15 minutes of warm-up, 15 minutes of cooling down, and roughly 70 minutes of testing. Participants completed all the physical tests that covered the test of speed, agility, power, flexibility, and aerobic endurance. The participants were familiar with the test, but yet a certified coach still briefed the instructions and demonstrated them the right way in every test. Participants got two trials to perform the test except for aerobic endurance because it took a long time to finish.

2.2.1. Power Test

The strength of the subjects' lower limbs was measured using a standing long jump (SLJ). This test was designed to determine the subject's lower limb's explosive and power [21]. This test's reliability and validity have already been documented in the literature [36]. This study demonstrated powerful test-retest reliability (intrasession) with $\alpha = 0.88$. The participant had both feet in parallel positions and was standing still behind a line. To gain momentum, they must bend one knee and swing both arms, then jump as far as they can. The measurement was made from the starting line to the area (behind the feet) where the feet touched the ground.

2.2.2. Speed Test

The speed was evaluated using a 20-meter sprint test. This test was designed to evaluate the athlete's acceleration, speed, and based horizontal velocity. A sprint is described as a mix of quickness and acceleration, maintaining speed, and reaching maximum speed [22]. Previous research has shown that the 20-meter sprint test has acceptable reliability (ICC = 0.95–0.99) [35]. Participants were required to run as fast as possible from the starting line until they passed the 20-meter mark line position. The participants' running time was recorded using a stopwatch.

2.2.3. Flexibility Test

The subjects' flexibility was evaluated using the common sit and reach test using Lemmink's [39] procedure. According to an earlier study, the sit and reach test has excellent reliability (ICC = 0.91–0.93) [37, 38]. Participants sat on the ground with their soles up against the box and one leg and one knee extended together. Together, the hands and arms of both participants were extended forward, and one hand was positioned on top of the other. Participants progressively extended their arms forward, sliding their hands as far as they could without bending their knees along the measurement scale. The individual received assistance from other participants to make sure their knees are fully stretched and not bent.

2.2.4. Agility Test

The agility of participants was assessed by the agility T-test. The test was designed to evaluate each participant's capacity to switch between forward, backward, and lateral movement. Running forward, backward, and to the side—movements that may be used in any sport—were part of the test [23]. A prior study found that the intraclass reliability of the agility-t test is an adequate 0.98 [40]. Four cones were used to design a T shape. The first and second cone was placed at 9.14 meters. The third and fourth cone was placed at the end of the second cone, 4.57 meter at both sides. The participant needs to sprint forward from the first cone to the second cone and touch the top of the cone with their right hand. Then, they need to shuffle to the right side and touch the cone (3rd cone) with their right hand and shuffle to the left side and touch the cone (4th cone) with their right hand and move again to the center (2nd cone), and running in backward to the starting point.

2.2.5. Aerobic Endurance Test

Aerobic endurance was assessed using a 20-meter multistage fitness test. The test aimed to determine the estimated maximal oxygen uptake (VO_2 max) of participants during the intense exercise [41, 42]. Briefly, participants had to run back and forth between 2 lines set 20 meters apart with an audio signal. The audio signals will determine the running pace of each stage for participants in which they need to complete as many stages as they can. The test ended when participants could not maintain the running pace due to exhaustion or when they failed to reach the end lines concurrent with the audio signal two consecutive times.

2.2.6. Match-Play Performance – Game Statistics

Researchers have recorded all the matches (16 matches) during the tournament. The notational analysis has followed the procedure from the previous study [32]. When employing percentage error to assess reliability, values of less than 5% are deemed sufficient for the observer's performance indicator evaluations [43]. The game statistics for the match-play performance were notated manually via video replay after the match ended. The game statistics used in the current study were defined as follows:

Table 1. Operational Definitions of Game Statistics for the Match-Play Performance Used Between Qualified and Non-Qualified Teams

Parameters	Definition
Successful passes	A successful pass from teammates that was flawlessly received without any opposition interception.
Turnovers	Situations in which a team regains possession of the ball from the opposition due to purposeful or unintentional collision, a defensive rebound, sloppy passing, or an interception during play. Foul play, such as footwork, offside, out-of-bounds, or replay, can also be regarded as a turnover in netball.
Interception	In open play, a player reclaims control of the ball from the opposition. It may occur when players intercept an opponent's pass since their teammate may not receive it while the game is in progress.
Deflection	A tactic used in defense to take the opponent's possession of the ball when players are outstretched.
Goal attempt	The total number of shots taken by offensive players (GA or GS), regardless of whether they were successful.
Goal	A successful attempt that has given the team a score.

2.2.7. Data Analysis

The normality of distributions was determined using the Kolmogorov-Smirnov test to ensure that the data of the study were normally distributed. The mean and standard deviation was reported as descriptive statistics. An independent sample t-test was carried out to determine the difference between team qualification status (qualified and non-qualified teams) and variables (anthropometric, physical fitness components, and match-play performance). A Pearson's correlation was used to determine the relationship between anthropometric and physical fitness with match-play performance characteristics. A value of $p < .05$ was considered as a significance level. Data analysis was conducted using statistical software SPSS version 22.0.

3. Result

3.1. Anthropometric and Physical Characteristics

The results of the Kolmogorov-Smirnov test confirmed that all variables in the current study were normally distributed; $p > .05$. Table 2 shows the players' anthropometric and physical characteristics between qualified and non-qualified teams. The netball players of qualified teams were shown to have significantly greater agility performance than the players of non-qualified teams (12.88 ± 0.99 vs. 13.91 ± 1.80). The players of qualified teams also produced significantly superior performance in flexibility (35.09 ± 5.70 vs. 31.74 ± 7.06) and aerobic endurance (32.96 ± 6.53 vs. 28.50 ± 5.67) than non-qualified teams. However, there was no significant difference in anthropometric measurement (height, weight, and BMI) and other physical components (speed and power) between qualified and non-qualified teams, $p > .05$.

Table 2. Anthropometric and Physical Characteristics between Qualified and Non-Qualified Players

Variables	Qualification Status		*F*	*P*
	Qualified	Non-qualified		
Height (m)	1.62 ±0.07	1.61 ±0.06	2.816	.835
Weight (kg)	56.92 ±9.82	55.34 ±8.39	1.012	.121
BMI (kg/m^2)	21.75 ±2.85	20.69 ±2.87	.921	.201
Speed (sec)	4.03 ±0.48	4.14 ±0.52	2.421	.325
Agility (sec)	12.88 ±0.99	13.91 ±1.80	2.857	.007*****
Power (m)	1.79 ±0.19	1.72 ±0.23	1.234	.093
Flexibility (cm)	35.09 ±5.70	31.74 ±7.06	3.142	.015*****
VO_2 max (ml/kg/min)	32.96 ±6.53	28.50 ±5.67	1.055	.008*****

*Significant value, $p < .05$.

3.2. Match-Play Performance – Game Characteristics

Table 3 displays the game characteristics between qualified and non-qualified teams during the tournament. The data was presented in number of times (n). From the results, we can observe that qualified teams had better interception and deflection than non-qualified teams, $p < .05$. Besides, qualified teams had significantly produced a greater number of goal attempts and many goal scores than non-qualified teams during the tournament, $p < .05$. Nevertheless, there was no significant difference in successful passes and turnovers between qualified and non-qualified teams, $p > .05$.

3.3. Relationship between Physiological Characteristics and Match-Play Performance

Tables 4 and 5 displayed the relationship between physiological characteristics (anthropometric and physical fitness) and match-play performance. The result in Table 4 shows that there was no significant correlation between anthropometric (height, weight, BMI) and match-play performance characteristics, $p > .05$. Next, the interceptions were significantly correlated with the agility component ($p < .05$). The goal attempt and goal scored were also significantly correlated with the estimated VO_2 max ($p < .05$).

Table 3. Game Statistics between Qualified and Non-Qualified Teams in Netball Sabah Games 2019

Parameters	Qualification status		*F*	*P*
	Qualified	Non-qualified		
Successful passes (n)	89.4 ±4.9	86.4 ±3.9	1.986	.066
Turnovers (n)	14.5 ±4.4	14.8 ±5.1	.035	.854
Interception (n)	13.1 ±5.4	7.0 ±4.0	8.130	.001*
Deflection (n)	25.0 ±6.3	14.0 ±5.0	4.088	.002*
Goal attempt (n)	81.0 ±18.2	51.0 ±11.8	9.423	.000*
Goal (n)	54.4 ±15.9	30.7 ±7.3	7.027	.000*

*Significant value, $p < .05$.

Table 4. Relationship between Anthropometric Characteristics and Match-Play Performance among Netball Players

	Height	Weight	BMI
Successful passes (n)	.143	.756	.076
Turnovers (n)	.230	.138	.353
Interception (n)	.543	.337	.321
Deflection (n)	.263	.134	.421
Goal attempt (n)	.177	.136	.686
Goal (n)	.133	.168	.774

*Significant value, $p < .05$.

Table 5. Relationship between Physical Fitness Components and Match-Play Performance among Netball Players

	Speed	Agility	Power	Flexibility	Estimated VO_2 max
Successful passes (n)	.346	.456	.121	.570	.955
Turnovers (n)	.898	.365	.172	.076	.365
Interception (n)	.334	.009*	.573	.108	.136
Deflection (n)	.431	.214	.438	.212	.201
Goal attempt(n)	.711	.139	.119	.911	.017*
Goal (n)	.114	.086	.164	.779	.007*

*Significant value, $p < .05$.

4. Discussion

The purpose of the current study was to investigate the anthropometric and physical fitness performance between qualified and non-qualified teams of youth netball players who competed in the Sabah Youth Netball Competition 2019. Besides, the present study wants to examine the relationship between physical fitness and match-performance characteristics in netball. Based on the results in Table 2, we can observe that the players of qualified teams have superior performance in agility, flexibility, and aerobic endurance (estimated VO_2 maximum) compared to players of non-qualified teams. It shows that the players who produced higher physical fitness levels get more advantages to perform better match-play performance during tournaments. A previous study also supported that a greater physical fitness level can contribute to effective playing abilities among athletes [20]. Besides, success in netball requires a high dependency on physical fitness characteristics [24]. Netball is a highly physically demanding game that requires players to acquire a high degree of agility, endurance, flexibility, speed, strength, and power[25, 26].

The present findings demonstrate that match-play performance characteristics (e.g., successful passes, turnovers, interception, deflection, goal attempt, and number of goals) are important to distinguish performance between winning and losing teams. Based on the results in Table 3, the qualified teams produced greater interceptions, deflections, goal attempts, and scored more goals than non-qualified teams. It demonstrates that greater physical fitness levels among qualified players have assisted them to perform well during the tournament. It also shows that qualified teams are adept at tactical play when they successfully intercept and deflect the ball. Because of their improved ability to switch from defense to offensive, they produced more goal attempts, which resulted in more goals. A good netball player who can generate superior aerobic and anaerobic performance will get the advantage to perform greater attacking and defending plays during a match [27]. These factors might influence players to make better court coverage and play efficiently all through the game. Additionally, athletes must be very aerobically fit in order to play continuously throughout the entire game and recover quickly from high-intensity attacks [28].

Based on the result in Table 5, there was a significant correlation between interception and agility that may be related to the anticipation of the ball from players. To make good agility, players must possess a superior ability in perceptual skills and change of direction [29]. Based on these factors, players might be able to make good anticipation during the match, thus increasing their interception of the opponent's ball. A successful interception also depends on a player's capacity to observe and foresee the opponent's movement [30]. The current research, however, contradicts previous research on football, which claimed that decision-making and physical capacity to make interception is not influenced by a person's level of physical fitness [31]. The estimation of VO_2 max has a significant correlation between goal attempts and the number of goals. From the results, we concluded that aerobic performance greatly influenced the overall outcome of the game, which led to the team defending well and making for a more attacking game that resulted in a higher number of goal attempts. A previous study has demonstrated that netball players need to generate at least 75 and 85% of maximal heart rate to play efficiently throughout netball matches [14, 15]. Further research is needed to examine how each position on the netball team performed during games and related it with physical fitness characteristics. Discovering which positions have performed well or poorly based on their game data might be beneficial for a team. The coaches can plan training programs well to prepare players for the demands of competition.

5. Conclusions

In conclusion, the current study has examined the anthropometric, physical fitness components, and match-play performance characteristics between qualified and non-qualified teams and investigated the relationship between physical fitness and match-play performances in a netball tournament. Some of the physical fitness components have shown a positive relationship with selected game characteristics such as VO_2 max and agility. These findings suggest that the physical fitness and match-play performance between qualified and non-qualified teams were different, and a high level of physical fitness can lead to a successful match-play performance. Identifying the performance indicators that can differentiate the performance of winning and losing teams is crucial for coaches and sports managers [32]. Finally, coaches can use these results from anthropometric, physical fitness evaluation, and game characteristics to design an appropriate training program for players to enhance players' potential for success.

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REFERENCES

[1] van Gogh, M.J., Wallace, L.K. and Coutts, A.J., “Positional demands and physical activity profiles of netball.” The Journal of Strength & Conditioning Research, 2020. 34(5): p. 1422-1430. DOI: 10.1519/JSC.0000000000002388

[2] McGrath, A.C. and Ozanne-Smith, J., "Attacking the goal of netball injury prevention: a review of the literature." 1998, Monash University Accident Research Centre Australia.

[3] Douda, H.T., Toubekis, A.G., Avloniti, A.A. and Tokmakidis, S.P., "Physiological and anthropometric determinants of rhythmic gymnastics performance." International Journal of Sports Physiology and Performance, 2008. 3(1): p. 41-54. DOI: 10.1123/ijspp.3.1.41

[4] Grobbelaar, H.W. and Eloff, M., "Psychological skills of provincial netball players in different playing positions." South African Journal for Research in Sport, Physical Education and Recreation, 2011. 33(2): p. 45-58. https://hdl.handle.net/10520/EJC108953

[5] Fox, A., Spittle, M., Otago, L. and Saunders, N., "Activity profiles of the Australian female netball team players during international competition: Implications for training practice." Journal of Sports Sciences, 2013. 31(14): p. 1588-1595. DOI: 10.1080/02640414.2013.792943

[6] McKenzie, C.R., Whatman, C. and Brughelli, M., "Performance profiling of female youth netball players." The Journal of Strength & Conditioning Research, 2020. 34(11): p. 3275-3283. DOI: 10.1519/JSC.0000000000002958

[7] Davidson, A. and Trewartha, G., "Understanding the physiological demands of netball: A time-motion investigation." International Journal of Performance Analysis in Sport, 2008. 8(3): p. 1-17. DOI: 10.1080/24748668.2008.11868443

[8] Hughes, M. and Franks, I., "The essentials of performance analysis: an introduction." 2007. Routledge.

[9] Manson, S.A., Brughelli, M. and Harris, N.K., "Physiological characteristics of international female soccer players." The Journal of Strength & Conditioning Research, 2014. 28(2): p. 308-318. DOI: 10.1519/JSC.0b013e31829b56b1

[10] Gabbett, T. and Georgieff, B., "Physiological and anthropometric characteristics of Australian junior national, state, and novice volleyball players." The Journal of Strength & Conditioning Research, 2007. 21(3): p. 902-908. DOI: 10.1519/R-20616.1

[11] Gabbett, T., Kelly, J., Ralph, S. and Driscoll, D., "Physiological and anthropometric characteristics of junior elite and sub-elite rugby league players, with special reference to starters and non-starters." Journal of science and medicine in sport, 2009. 12(1): p. 215-222. DOI: 10.1016/j.jsams.2007.06.008

[12] Gabbett, T.J., "Physiological characteristics of junior and senior rugby league players." British journal of sports medicine, 2002. 36(5): p. 334-339. DOI: 10.1136/bjsm.36.5.334

[13] Young, C.M., Gastin, P.B., Sanders, N., Mackey, L. and Dwyer, D.B., "Player load in elite netball: Match, training, and positional comparisons." International Journal of Sports Physiology and Performance, 2016. 11(8): p. 1074-1079. DOI: 10.1123/ijspp.2015-0156

[14] Chandler, P.T., Pinder, S.J., Curran, J.D. and Gabbett, T.J., "Physical demands of training and competition in collegiate netball players." The Journal of Strength & Conditioning Research, 2014. 28(10): p. 2732-2737. DOI: 10.1519/JSC.0000000000000486

[15] Steele, J.R., "Biomechanical factors affecting performance in netball: implications for improving performance and injury reduction." Sports Medicine, 1990. 10: p. 88-102. https://link.springer.com/article/10.2165/00007256-199010020-00003

[16] Smart, D., Hopkins, W.G., Quarrie, K.L. and Gill, N., "The relationship between physical fitness and game behaviours in rugby union players." European Journal of Sport Science, 2014. 14(sup1): p. S8-S17. DOI: 10.1080/17461391.2011.635812

[17] Mackenzie, R. and Cushion, C., "Performance analysis in football: A critical review and implications for future research." Journal of sports sciences, 2013. 31(6): p. 639-676. DOI: 10.1080/02640414.2012.746720

[18] Csataljay, G., O'Donoghue, P., Hughes, M. and Dancs, H., "Performance indicators that distinguish winning and losing teams in basketball." International Journal of Performance Analysis in Sport, 2009. 9(1): p. 60-66. DOI: 10.1080/24748668.2009.11868464

[19] Francis, J. and Jones, G., "Elite rugby union players perceptions of performance analysis." International Journal of Performance Analysis in Sport, 2014. 14(1): p. 188-207. DOI: 10.1080/24748668.2014.11868714

[20] Gabbett, T.I.M., Kelly, J. and Pezet, T., "Relationship between physical fitness and playing ability in rugby league players. The Journal of Strength & Conditioning Research, 2007. 21(4): p. 1126-1133. https://journals.lww.com/nsca-jscr/_layouts/15/oaks.journals/downloadpdf.aspx?trckng_src_pg=ArticleViewer&an=00124278-200711000-00025

[21] Moir, G., Button, C., Glaister, M. and Stone, M.H., "Influence of familiarization on the reliability of vertical jump and acceleration sprinting performance in physically active men." The Journal of Strength & Conditioning Research, 2004. 18(2): p. 276-280. https://journals.lww.com/nsca-jscr/_layouts/15/oaks.journals/downloadpdf.aspx?trckng_src_pg=ArticleViewer&an=00124278-200405000-00013

[22] Moir, G., Button, C., Glaister, M. and Stone, M.H., "The effect of periodized resistance training on accelerative sprint performance". Sports Biomechanics, 2007. 6(3): p. 285-300. DOI: 10.1080/14763140701489793

[23] Munro, A.G. and Herrington, L.C., "Between-session reliability of four hop tests and the agility T-test". The Journal of Strength & Conditioning Research, 2011. 25(5): p. 1470-1477. DOI: 10.1519/JSC.0b013e3181d83335

[24] Juliff, L.E., Halson, S.L., Bonetti, D.L., Versey, N.G., Driller, M.W. and Peiffer, J.J., "Influence of contrast shower and water immersion on recovery in elite netballers". The Journal of Strength & Conditioning Research, 2014. 28(8): p. 2353-2358. DOI: 10.1519/JSC.0000000000000417

[25] McManus, A., Stevenson, M.R. and Finch, C.F., "Incidence and risk factors for injury in non-elite netball". Journal of Science and Medicine in Sport, 2006. 9(1-2): p. 119-124. DOI: 10.1016/j.jsams.2006.03.005

[26] Venter, R.E., Fourie, L., Ferreira, S. and Terblanche, E., "Physical and physiological profiles of Boland netball players". South African Journal of Sports Medicine, 2005.

17(2): p. 3-7. DOI: 10.17159/5082

[27] Soh, K.G., Husain, R. and Soh, K.L., "Fitness Profile among Malaysian Netball Players: 馬來西亞投球選手的體適能". Asian Journal of Physical Education & Recreation, 2006. 12(2): p. 40-44. DOI: 10.24112/ajper.121141

[28] Thomas, C., Ismail, K.T., Simpson, R., Comfort, P., Jones, P.A. and Dos' Santos, T., "Physical profiles of female academy netball players by position". The Journal of Strength & Conditioning Research, 2019. 33(6): p. 1601-1608. DOI: 10.1519/JSC.0000000000001949

[29] Farrow, D., Young, W. and Bruce, L., "The development of a test of reactive agility for netball: a new methodology". Journal of Science and Medicine in Sport, 2005. 8(1): p. 52-60. DOI: 10.1016/S1440-2440(05)80024-6

[30] O'Donoghue, P., Mayes, A., Edwards, K.M. and Garland, J., "Performance norms for British national super league netball". International Journal of Sports Science & Coaching, 2008. 3(4): p. 501-511. DOI: 10.1260/1747954087871864

[31] Barte, J.C., Nieuwenhuys, A., Geurts, S.A. and Kompier, M.A., "Effects of fatigue on interception decisions in soccer". International Journal of Sport and Exercise Psychology, 2020. 18(1): p. 64-75. DOI: 10.1080/1612197X.2018.1478869

[32] Mastun, S.N., Madun, M.F. and Azmi, A.M.N., "Match performances between Winning and Losing teams in the 2019 Netball Sabah Games". Jurnal Sains Sukan & Pendidikan Jasmani, 2021. 10(2): p. 1-7. DOI: 10.37134/jsspj.vol10.2.1.2021

[33] Abd Rahim, M. A., Lee, E. L. Y., Abd Malek, N. F., Suwankhong, D., & Nadzalan, A. M. (2020). Relationship Between Physical Fitness and Long Jump Performance. International Journal of Scientific & Technology Research 9(4), p. 1795-1797.

[34] Abd Razak, A. N., & Hashim, A. (2017). Hubungan komponen kecergasan fizikal berasaskan sukan terhadap prestasi lari pecut 100 meter: Relationship between sport-specific physical fitness and 100 m sprint performances. Jurnal Sains Sukan & Pendidikan Jasmani, 6(2), p. 65-80.

[35] de Villiers, J. E., & Venter, R. E. (2014). Barefoot training improved ankle stability and agility in netball players. *International Journal of Sports Science & Coaching*, *9*(3), p. 485-495.

[36] Beato, M., De Keijzer, K. L., Leskauskas, Z., Allen, W. J., Iacono, A. D., & McErlain-Naylor, S. A. (2021). Effect of postactivation potentiation after medium vs. high inertia eccentric overload exercise on standing long jump, countermovement jump, and change of direction performance. The Journal of Strength & Conditioning Research, 35(9), p. 2616-2621. DOI: 10.1519/JSC.0000000000003214

[37] Ahsan, M., & Ali, M. F. (2021). An analysis of physical performance parameters among university netball and volleyball female players. Saudi Journal of Sports Medicine, 21(3), p. 107-114. DOI: 10.4103/sjsm.sjsm_29_21

[38] Pérez-Vigo, C., Sanchez-Lastra, M. A., Martínez-de-Quel, O., & Ayan, C. (2022). Reliability And Validity Of The V-Sit-And-Reach And Toe-Touch Tests In Preschoolers. Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte, 22(88). DOI: 10.15366/rimcafd2022.88.015

[39] Lemmink, K. A., Kemper, H. C., Greef, M. H., Rispens, P., & Stevens, M. (2003). The validity of the sit-and-reach test and the modified sit-and-reach test in middle-aged to older men and women. Research Quarterly for Exercise and Sport, 74(3), 331-336. DOI: 10.1080/02701367.2003.10609099

[40] Pauole, K., Madole, K., Garhammer, J., Lacourse, M., & Rozenek, R. (2000). Reliability and validity of the T-test as a measure of agility, leg power, and leg speed in college-aged men and women. The Journal of Strength & Conditioning Research, 14(4), p. 443-450.

[41] Bandyopadhyay, A. (2013). Validity of 20 meter multi-stage shuttle run test for estimation of maximum oxygen uptake in female university students. Indian J Physiol Pharmacol, 57(1), p. 77-83.

[42] Bandyopadhyay, A. (2011). Validity of 20 meter multi-stage shuttle run test for estimation of maximum oxygen uptake in male university students. Indian Journal of Physiology and Pharmacology, 55(3), p. 221-226.

[43] Sgrò, F., Barresi, M., & Lipoma, M. (2015). The analysis of discriminant factors related to team match performances in the 2012 European Football Championship. Journal of Physical Education & Sport, 15(3). DOI: 10.7752/jpes.2015.03069

[44] Mastun, S. N., Daud, D. M. A., & Nazarudin, M. N. (2020). Anthropometric and physical performance profiles of Sabah youth netball players. International Journal of Physical Education, Sports and Health, 7(4), p. 156-159.