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Physical Fitness of Female Soccer Players based on Playing Positions

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Abstract

The purpose of this study was to gain insight into female soccer players' physical performance profiles by observing their position in the field. The sample consisted of 17 athletes who were involved in the regional training at the Papua National Sports Week (PON) 2021. The players were divided into three subgroups based on their positions, including specific strikers, midfielders, and backs. The samples performed 10 item tests measuring physical performance components. Based on the playing position, there was no difference of BMI among the strikers, midfielders, and backs ($F = 0.174$, $p > 0.05$). The results of the bleep test showed no difference ($F = 0.466$, $p > 0.05$). The results of leg dynamometer ($F = 0.898$, $p > 0.05$), back dynamometer ($F = 1.350$, $p > 0.05$), and sit and reach ($F = 0.543$, $p > 0.05$) also showed no difference. There was also no difference in measurement results of hand dynamometer pull ($F = 0.028$, $p > 0.05$) and push ($F = 1.107$, $p > 0.05$). Moreover, the result of 50-meter sprint ($F = 0.404$, $p > 0.05$), sit up ($F = 0.493$, $p > 0.05$), push up ($F = 2.204$, $p > 0.05$), and shuttle run ($F = 0.991$, $p > 0.05$) also showed no difference. We believe that a female football player athletic ability is unaffected by their position in the field. The absence of variation in physical ability observed among female soccer players may be attributed to BMI. Coaches may use these results as reference data to classify strengths, select players, and monitor the preparation.

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INTRODUCTION

Women's football is one of the fastest-growing team sports in the world, which has 26 million participants worldwide and more professional leagues than ever before (M. A. Hammami et al., 2020). However, women's football is still underestimated by some parties and does not get enough attention. As occurred in 2015, Abby Wambach and Alex Morgan sued FIFA for gender discrimination regarding the use of the field during a women's football tournament (Allison, 2018). Moreover, related to research, there is a current lack of data and information related to women's football. Due to gender differences in the soccer results, the male cutoff cannot be used by females since using the same workout and/or applying the same training intensity may result in bad training outcomes (Perroni et al., 2018).

Research related to female soccer player physical performances have been carried out in the past few years in developed countries, such as the US and Europe (M. A. Hammami et al., 2020). Apart from what happened to men's football, scientific research on women's football is still lacking (Torre et al., 2007). Previous research concluded that male soccer players in various positions had distinctive physiological characteristics (Boone et al., 2012). A different study showed that, in women's soccer, there were small to significant velocity variations according to playing positions (Haugen et al., 2012). Anthropometry and physical health may become the considerations of the reason causing North African women's football teams did not qualify to the final stage of the world cup tournaments (M. A. Hammami et al., 2020). According to previous studies, anthropometric proportions of a soccer player had been shown to be a significant determinant of a playing role performance (Hencken & White, 2006). Besides, achieving an optimal BMI can produce improvements related to physical and anaerobic strengths and have an impact on improving performance (P. T. Nikolaidis, 2014). There is a need to explore a more detailed physiological profiles of female players to manage a better future for women's football coaching strategies (Torre et al., 2007).

All previous studies had mainly concentrated on the value of male soccer player physical health. Moreover, there is still a lack of evidence on female soccer player performances. For that reason, this study was intended to complete the puzzle of the information needs. The aim of this study was to gain insight into the physical fitness profiles of female soccer players by studying their positions in the field.

METHODS

This study used a quantitative analysis and a comparative approach. This study was an ex post facto study comparing the physical performance of female soccer players and their playing positions.

Subject

Seventeen (n = 17) of the twenty women soccer players participated in this study. They were women soccer players (age: 20.41 ± 6.07) from a team prepared to compete in the 20th National Sports Week (PON) in Papua. Three of the twenty players were unable to attend the data collection. Subjects were divided into 3 groups based on their positions in the field, including strikers (n = 3), Midfielders (n = 6), and backs (n = 8). The keepers were included into the backs group.

Procedure

Several measurement items, field fitness tests, and tools were used in data collection process. Before taking measurements and tests, the players warmed up first. The participants were evaluated in February 2020, in the competition preparation period. Experienced testers carried out all test and measurement procedures.

Anthropometry

Before administering the physical test, the height (± 0.1 cm) and body weight (± 0.1 kg) were determined using a scale (GEA ZT-120). An experienced tester assessed anthropometric measurements throughout the study. Body Mass Index (BMI) was calculated by dividing body weight in kilograms by height in square meters (kg/m2) (Firdausi & Simbolon, 2018).

Physical Performance Test

Sit-up and Push-up. Estimating the stomach muscle perseverance was conducted using a sit-up test (Widiastuti, 2015) (Nurhasan, 2017). Scoring was administered by counting the number of correct crunches in 60 seconds. The 60-second push-up test was carried out to measure the components of strength and endurance of the upper body, including the arm and shoulder muscles (extensor) (Nurhasan, 2017) (Widiastuti,

2015). The score was recorded by counting the number of correct push-up moves.

***Sit and Reach*.** Sit and reach or sit and reach table was used to measure the participants' waist and torso (Nurhasan, 2017). The score was recorded from the participant farthest reach from two experiments and measured in cm (Widiastuti, 2015).

Hand Dynamometer. Pull and push dynamometers were used to measure the hand muscle strength in pulling and pushing (Nurhasan, 2017). The best tensile strength and thrust scores from the two experiments were recorded as scores in kg with an accuracy level of 0.5 kg (Widiastuti, 2015).

Back and Leg Dynamometer. The back and leg dynamometer was used to measure the back and leg muscle strengths (Nurhasan, 2017). The best score of back and leg muscle pull strengths from two experiments was recorded as a score in kg with an accuracy level of 0.5 kg (Widiastuti, 2015).

Data Analysis

Microsoft Excel 2016 for Windows was used for all statistical analysis. Data were expressed in mean and standard deviation (SD). One-way analysis of variance (ANOVA) was used to examine physical fitness component differences among the groups (strikers, midfielders, and backs). The level of significance was set at 0.05.

RESULT

The overall height and weight mean of female soccer players were 156.06 ± 5.45 cm and 49.47 ± 6.03 kg. Based on the player's position, the means of height of the midfielders (157.33 ± 1.50 cm) and backs (157.66 ± 7.12 cm) were higher than the strikers 151.33 ± 3.78cm. Meanwhile, for the weight based on the player position, the mean of the midfielders (50.66 ± 6.40 kg) and backs (50.25 ± 6.11 kg) were higher than strikers (45 ± 4.58) kg. The means of weight and height are presented in Table 1.

The mean of Body Mass Index for female soccer players fell on the normal category (20.30 ± 2.13 kg/m2). The mean of Body Mass Index data, based on player positions, revealed that there was no difference among strikers (19.61 ± 1.07 kg/m2), midfielders (20.48 ± 2.71) kg/m2, and backs (20.42 ± 2.12 kg/m2), all of which were in the normal category. The mean of age of female soccer players was 20.41 ± 6.07 years. The mean of age of female soccer players, based on the player position, revealed that the means of age were 17.33 ± 1.15 years for strikers, 22.83 ± 8.72 years for midfielders, and 19.75 ± 4.46 years for backs.

Table 1. The Participant Characteristics

	All	**Strikers**	**Midfielders**	**Backs**
N	17	3	6	8
Age (years)	20.4±6.	17.3±1.1	22.8±8.7	19.7±4.4
Weight (kg)	49.4±6.	45±4.5	50.66±6.4	50.2±6.1
Height (cm)	156±5.4	151.3±3.7	157.3±1.5	157.6±7.1
BMI (kg/m^2)	20.3±2.1	19.61±1	20.4 ± 2.7	20.4 ±2.1

Notes: Values are mean ± SD.

Table 2. Physical Performances of Female Soccer Players

	All	**Strikers**	**Midfielders**	**Backs**
N	17	3	6	8
Sit-up	40± 9.3	38.6± 9.2	37.6± 6.6.	42.6± 11.4
Push-up	37.± 4.85	34.6± 5.5	35± 5	39.5± 3.7
Sit and Reach	11.5± 3.3	13.1± 2.5	11.7± 4.4	10.7± 2.5
Hand Dynamometer (pull)	20.2± 5.8	19.5± 10.6	20.3± 6.3	20.5± 3.9
Hand Dynamometer (push)	17.9±3.4	15.6± 1.1	17.6± 3.8	19.± 3.4
Back Dynamometer	81.7± 12.1	73± 15.3	80.5± 6.4	86± 13.6
Leg Dynamometer	72.7±15.4	66±12.7	69.1±22.1	85.1±9.2
50 Meter Sprint	8.2±15.4	8.16±0.3	8.4±0.5	8.1±0.52
Shuttle Run	16.2±0.5	15.9±0.4	16.47±0.6	16.2±0.5
Bleep test	36±3.1	35.3±3.7	35.2±2.2	36.8±3.7

Notes: Values are mean ± SD.

Table 3. Results of ANOVA Analysis

	F	*F crit*	*P-value*
BMI	0.174		0.842
Sit up	0.493		0.621
Push up	2.204		0.147
Sit and Reach	0.543		0.593
Hand Dynamometer (pull)	0.028		0.972
Hand Dynamometer (push)	1.107	3.739	0.358
Back Dynamometer	1.350		0.291
Leg Dynamometer	0.898		0.430
50 Meter Sprint	0.404		0.675
Shuttle Run	0.991		0.396
Bleep Test	0.446		0.649

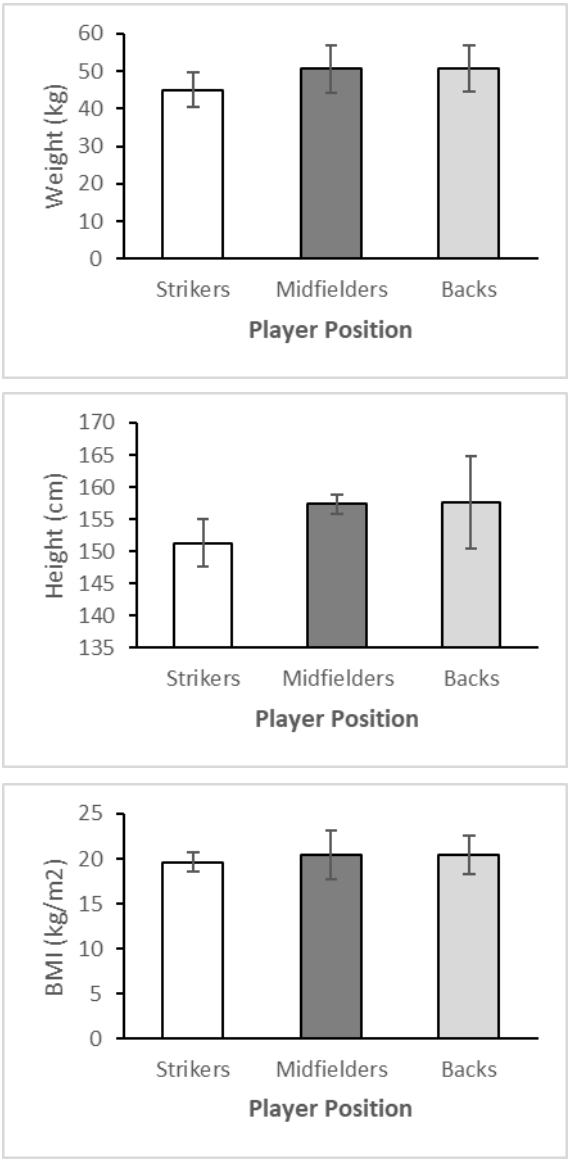

Figure 1. Variations of Total Body Weight, Height, and BMI based on The Player Positions

The mean of sit up data (abdominal muscle endurance) of female soccer players was 40.17 ± 9.38. Based on the player's position, the mean data revealed that the results of sit-up were 38.66 ± 9.29 for strikers, 37.66 ± 6.65 for midfielders, and 42.62 ± 11.47 for backs. The mean of push up data (strength and endurance of the upper body or extensor muscles) of female soccer players was 37.05 ± 4.85. Based on the player's position, the mean data revealed that the results of push-up were 34.66 ± 5.50 for strikers, 35 ± 5.09 for midfielders, and 39.5 ± 3.70 for backs.

The flexibility of waist and torso measured using sit and reach test revealed that female soccer players' overall mean data was 11.52 ± 3.38. Furthermore, based on the player position, the mean data revealed that the measurement results of waist and torso flexibility measurements were 13.16 ± 3.54 for strikers, 11.75 ± 4.43 for midfielders, and 10.75 ± 2.57 for backs. The hand muscle strength in pulling as measured using a hand dynamometer revealed that the overall mean data for female soccer players was 20.26 ± 5.86. Furthermore, based on the player position, the mean data revealed that the measurement results of hand muscle strength in pulling were 19.5 ± 10.82 for strikers, 20.33 ± 6.38 for midfielders, and 20.5 ± 3.95 for backs. Furthermore, the hand muscle strength in pushing, which was also measured by a hand dynamometer, revealed that the female soccer player overall mean data was 17.95 ± 3.40. Furthermore, based on the player position, the mean data revealed that the results of the hand muscle strength measurement in pushing were 19.5 ± 10.82 for strikers, 20.33 ± 6.38 for midfielders, and 20.5 ± 3.95 for backs.

The back muscle strength measured by a back dynamometer revealed that the female soccer player overall mean was 81.76 ± 12.17. Furthermore, based on the player position, the mean data revealed that the back muscle strength of the strikers was 73 ± 15.39. The back muscle strength of the midfielders was 80.5 ± 6.44, while the back muscle strength of the backs was 86 ± 13.66. The leg muscle strength measured using a leg dynamometer revealed that the female soccer player overall mean data was 72.76 ± 15.44. Furthermore, based on the player position, the mean data revealed that the results of leg muscle strength measurement were 66 ± 12.76 for strikers, 69.16 ± 22.19 for midfielders, and 85.14 ± 9.22 for backs.

Female soccer player speed measured using the 50

-meter sprint test revealed that the female soccer player overall mean data was 8.26 ± 0.48. Furthermore, based on the player position, the mean data revealed that the speed measurement results were 8.16 ± 0.32 for striker, 8.41 ± 0.54 for midfielders, and 8.18 ± 0.52 for backs.

The agility in changing direction of female soccer players, as measured by the shuttle run test, revealed that the female soccer player overall mean data was 16.26 ± 0.56. Furthermore, based on the player position, the mean data revealed that the agility in changing direction were 15.92 ± 0.43 for strikers, 16.47 ± 0.63 for midfielders, and 16.23 ± 0.54 for backs.

The maximum oxygen uptake of the female soccer players as measured by the bleep test revealed that the female soccer player overall mean data was 36 ± 3.17. Furthermore, based on the player position, the mean data revealed that the maximum oxygen uptake were 35.3 ± 3.74 for strikers, 35.28 ± 2.27 for midfielders, and 36.8 ± 3.74 for backs.

ANOVA was used to determine whether there was a heterogeneity in physical performance of female soccer player based on their playing positions in the field. The average of the player BMI was 20.30 (kg / m2), with no detectable BMI difference ($F = 0.174$, $p > 0.05$) among players based on their playing positions. There was no any significant difference in sit-ups ($F = 0.493$, $p > 0.05$), push-ups ($F = 2.204$, $p > 0.05$), and sit and reach ($F = 0.543$, $p > 0.05$) found among different player position groups. The results of the leg dynamometer ($F = 0.898$, $p > 0.05$), back dynamometer ($F = 1.350$, $p > 0.05$), hand dynamometer pull ($F = 0.028$, $p > 0.05$), and hand dynamometer push ($F = 1.107$, $p > 0.05$) also showed no significant difference. There was also no difference found in the results of the 50-meter sprint ($F = 0.404$, $p > 0.05$) and the shuttle run ($F = 0.991$, $p > 0.05$). The results of the bleep test of the players, based on their playing position in the field, also showed no difference ($F = 0.466$, $p > 0.05$).

DISCUSSION

This study was aimed at assessing physical performance and anthropometric characteristics of elite female soccer players and investigating possible differences in all measured variables among the three playing positions. The main finding of this study was that there was no physical performance difference among female soccer players based on their positions in the field (Figure 2). This finding was supported by the results of comparisons among the strikers, midfielders, and backs groups. In brief, we observed that, based on the player positions, there was no any physical performance difference in the female soccer players. Other findings showed different age group trends according to playing position in physical and technical performance in the Chinese Super League (Zhou et al., 2020). However, other studies support our findings that there was no difference in female football player physical fitness components based on the player position (Pantelis T. Nikolaidis, 2014). Another study also revealed the same finding that there was no significant difference between playing positions and the anthropometric or physiological variables measured (Ingebrigtsen et al., 2011). Another study conducted on female elite players in Norway revealed no significant differences in VO2max was observed across field positions or age categories (Haugen et al., 2014).

Data analysis shows that the body characteristics of strikers, midfielders, and backs were not different (Figure 1). Previous comparative studies had been conducted on elite Norwegian first and second-division female soccer players. The study revealed no differences in the characteristics of elite senior trained female soccer players aged 20.8 ± 3.7 years with 60.7 ± 6.6 kg body weight and 166 ± 5 cm height (Ingebrigtsen et al., 2011). Based on the result of the study, the characteristics of the current study players were low. The same results also revealed no heterogeneity in body characteristics based on the player positions (Lockie et al., 2018). Meanwhile, according to previous research, low and high body mass indexes were associated with the decreased performance (P. T. Nikolaidis, 2014). An increased incidence of injury was noted in players with a higher BMI. However, the risk factors for elite female soccer player injury are multifactorial, intertwined, and complex (Alahmad et al., 2020). The comparison between professional female futsal players and recreational female futsal players also did not show a difference in the BMI index (Campos et al., 2016). No significant BMI differences were also observed between age groups in young soccer players (Perroni et al., 2014). The main finding from other studies was the difference in height and weight, but not in BMI, of young soccer players according to their sex (Perroni et al., 2018). Previous studies revealed that the BMI scores for U14

players were lower than those obtained by U16 and U18 players in young elite soccer players (Torres-Luque et al., 2015). This might also be the factor of the absence of difference in the female soccer player physical performance in our findings. However, previous studies revealed that BMI, with body composition and physical fitness, has a very significant correlation (P. T. Nikolaidis, 2014). Within-position variance was shown to be high in some situations in this sample, suggesting that a team without the ability to select players based on their anthropometric characteristics may be at a disadvantage (Hencken & White, 2006).

The mean of sit up data (abdominal muscle endurance) of female soccer players was 40.17 ± 9.38. The mean of push up data (strength and endurance of the upper body or extensor muscles) of female soccer players was 37.05 ± 4.85. Similar results also stated that athletes performed 42 ± 14 sit-ups and 37 ± 9 push-ups (Marinho et al., 2016). Based on the research data mean, there was no visible difference in performance in the two test items.

This study reports that there was no significant difference in muscle strength performance based on playing positions. Other research reports suggested that there was no significant difference in the performance of isometric muscle strength between female soccer players with back pain and without back pain (Haag et al., 2016). Other studies suggested that BMI was correlated with isometric muscle strength and leg muscle strength (P. T. Nikolaidis, 2014). Another study suggested that there was no difference in the maximal muscle strength performance of leg extensors (concentric) and flexors (eccentrics) using isokinetic dynamometers in elite female soccer players (Jenkins et al., 2013). The absence of difference in muscle strength based on the female soccer player playing positions was also stated in previous research reports (Pantelis T. Nikolaidis, 2014).

This study revealed no significant difference in the 50-meter sprint performance based on the playing position. Previous studies had shown different results where there were differences in sprint performance based on playing positions and there was no difference in sprint performance based on the age category (Haugen et al., 2012). Previous studies had suggested that sprint performance and high-intensity running distance observed in senior female soccer players were better than in young players (Eustace et al., 2019). Other studies revealed that there was no comparison of aerobic and anaerobic capacity parameters between adult and young elite soccer players (Angius et al., 2012). Previous findings indicated the utility of individual sprint splits in determining specific sprint performance characteristics in female soccer players with various ages (Vescovi et al., 2011). In female soccer players, the explosive force in female soccer players may be necessary for the overall performance because the increased strength in the lower limbs can increase the acceleration and speed in essential skills, such as turning, sprinting, and accelerating (Torre et al., 2007).

Our results found that there was no difference ($F = 0.543$, $p > 0.05$) in the sit and reach test performance based on the playing position. However, previous research revealed different results where there were differences in performance based on playing positions in the sit and reach test (large effect size) (Pantelis T. Nikolaidis, 2014). Our results found that there was no difference ($F = 0.991$, $p > 0.05$) based on the playing position in the shuttle run test performance or agility in changing direction. Previous research also revealed that there was no difference in agility in changing direction in elite female soccer players based on playing positions (Lockie et al., 2018). However, other studies revealed that, based on the age category (12-21 years), there were differences in female soccer players (Vescovi et al., 2011).

The results of previous studies found a statistically significant direct relationship ($p < 0.05$) between physical fitness and psychological stress (Oliveira et al., 2019). Findings of previous studies indicate that physical fitness is relevant for mental health (Oliveira et al., 2019). Previous studies had recommended physical training programs focused on increasing strength and speed for international football competitions to Tunisian women's football (M. A. Hammami et al., 2020). The results of a study showed anthropometric parameters and physical fitness change during a one-season training program on soccer players during puberty (Mohamed Ali Hammami et al., 2013). Based on gender, male players were better than female players in dribbling agility performance (Perroni et al., 2018).

CONCLUSION

We concluded that there was no difference in physical performance among female football players based on their playing positions. BMI might also contribute to the absence of difference in physical performance of the female soccer players. These findings can be used as a reference data for coaches to identify talents, select players, and monitor trainings.

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