 ISSN: 2579-7298

Physical Activity of Referees and Assistant Referees at Indonesian Football League 2019/2020

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ARTICLE INFO

Article history:
Received 17 June 2022
Revised 04 Sept 2022
Accepted 01 Nov 2022

Keywords:
Physical activity,
Referee,
Indonesia

ABSTRACT

This study used an ex-postfacto descriptive study research method. The research instrument used a heart rate monitor based on the POLAR M600 smartwatch with Global Positioning System sensors to calculate the total distance traveled by the referee and the assistant referee, the average of the maximum speed, and analyze the physical intensity performed by the referee during leading a match to measure physical fitness. Data analysis used Normality Test and Norms Reference Assessment. The purpose of this study was to determine the physical activity profile of the referees and assistant referees when serving in Liga 1 Shopee 2019/2020. The physical activities of 5 referees (FIFA) and 7 assistant referees (FIFA) were analyzed in 12 shopee league 1 matches in the period January to March 2020 with the status of the top-ranked match. The results of the findings of this study indicate that the distance traveled by the referee is greater than that of the assistant referee. The average heart rate of the referee is higher than that of the assistant referee, and the maximum average heart rate of the referee is greater than that of the assistant referee. Then the maximum speed of the assistant referee is higher than the maximum speed of the referee. In general, the referee's average running speed is higher than the assistant referee's average speed. In conclusion, there is a difference between physical activity between the referee and the assistant referee. Therefore, a different fitness training program is needed to prepare them to lead the match..

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I. Introduction

In a football match, the most important thing that can determine the quality of a match is a quality referee. Many aspects affect the ability of the referee when leading a match, including understanding the rules of the game, mental ability, and most importantly the level of physical fitness, where the level of physical fitness of the referee and assistant referees will affect cognitive factors that are indirectly related to accuracy in making a decisions when leading a match [1]. In this study, the authors put more focus on the level of physical fitness of the referees and the assistant referees during the match, which can be monitored by the Polar M 600 smartwatch, a device worn on the wrist that is gaining popularity and its use is widespread in sports, both professional and amateur. With the smartwatch technology, the heart rate, which is an indicator of the cardiovascular pressure experienced by the referee and the assistant referee during the match, can be accurately determined using a polar [2]. It should be noted that the movement characteristics of the referee and assistant referees tend to be different from one another [3]. Besides, the movement patterns of the two competing teams will affect the total distance traveled by the referee and assistant referees during the match [4]. When FIFA referees and assistant referees take the lead at a higher level match, they can be sure that they have the appropriate fitness abilities to cope with the demands of high intensity matches [5].

From the explanation above, the authors have interests in knowing the level of physical activity of referees and assistant referees with FIFA license to be applied as a standard for referees and other assistant referees who work in football leagues in Indonesia, either Liga 1 or Liga 2, so that they can determine and recognize how to plan a training program in accordance with the characteristics and needs of the physical components in the actual match. The purpose of this study was to determine the

motor activity profile of the referees and assistant referees for the Liga Shopee 2019/2020. This study also revealed the distance covered by the referee and the assistant referee during the match, the difference in intensity between the referee and the assistant referee in each match, the average speed and maximum speed of the referee and the assistant referee during the match..

II. Methods

In this study, the authors wanted to reveal a description of the referees' and assistant referees' physical activity in the matches of Liga 1 Shopee 2019/2020, so the most appropriate method is descriptive method. To obtain the desired data in this study, the researchers first conducted a search for data, data sources, and populations. In statistics, the population is the entire collection from which a statistical sample is drawn. Population can refer to an entire group of people, objects, events, or measurements. Thus, the population can be said to be an aggregate observation of grouped subjects [6]. Total Population sampling is a type of purposive sampling technique that involves examining an entire population (total population) that has a certain set of characteristics (for example, certain attributes/traits, experience, knowledge, skills, exposure to an event, etc.) [7]. The population in this study were FIFA referees and assistant referees are owned by Indonesia in 2020. The sampling used in this study is Total Population Sampling with a total sample of 12 people, consisting of 5 FIFA licensed referees and 7 FIFA licensed assistants. This is done because the referees and assistant referees of FIFA are referees who represent countries at the international level as a result of the selection of each appearance in the match in the domestic league.

The physical activities of 5 referees and 7 assistant referees were studied from 10 matches of Liga Shopee 2019/2020 in February-March 2020. All participants received written approval to participate in this research from the Head of the Department of Arbitration Human Resources Development of PSSI. In each match, the writer measures the results achieved by the referee and the assistant referee. The author chooses a match of the top flight of the Liga 1 Shopee 2019/2020. The match duration is 90 minutes plus the additional time.

To measure motor activity, the referee is tested with training intensity, heart rate monitor, distance covered, average speed and maximum speed during the match. Heart rate monitoring as a tool to show physiological tension during a game is the most effective one [5]. The referee's average heart rate during the match is between 85-95% of the maximum pulse rate, while the assistant referee is between 75-85% of the maximum pulse rate [6]. After conducting this research, it is hoped that with proper training, the performance of the referees and assistant referees can be improved and the risk of injury can be reduced [7].

The referee has different heart rate zones depending on the maximum heart rate concerned. In order for data collection to be accurate, the authors choose a suitable device using a smartwatch that has sensors, in most cases in direct contact with the user's skin, which supports the collection of information to monitor, manage and improve exercise, such as position indicators, accelerometers, gyroscopes, magnetometers, using heart rate sensors, or even sensors to capture body temperature, maximal oxygen consumption (VO2 max) [8].

The smartwatch used in this study is the Polar M600 with an internal GPS sensor. The Polar M600 is produced by a Finnish manufacturer that is compatible with satellites and is connected to a smartphone based on Android, so it can record the distance covered and the running speed during the match. After the match is over, they synchronize data with smartphones based on Android using the Polar Flow application and Google Wear OS, while the heart rate sensors are synchronized directly using the sensors on the smartwatch in the wrist area, either on the left hand or right hand according to user habits. To verify the compatibility of the results obtained with the normal distribution, the Shapiro Wilk test was used, and to determine the variance homogeneity of the comparable results, the Lavene test was used. Statistical significance and mean difference were tested by Student's T-test for independent samples and if they did not match the normal test, then Mann Whitney test is applied.

The procedures which were performed and calculated using MS Excel, namely :

- Calculating the rank number in group 2 (R2)
- Calculating U1
- U1= n1.n2= n2(n2+1)/2 -ΣR2
- Calculating U2=n.1n2-U1

- Calculating U count
- U count is the smaller U
- Finding the probability in Mann Whitney Table
- U count =2 with n2 =7, n1=5, p=0.016

The conclusion was drawn by comparing the probability U above with p=0.05. Probability Mann Whitney =0.016 < p=0.05 Therefore H_0 is rejected and H_a is accepted. There is a difference in the average covered distance between the referee and the assistant referee in a match..

III. Result and Discussion

The data presented in table 1 shows that there is a difference between the referee and the assistant referee in terms of average age, height, weight and experience in leading matches.

Table 1. General characteristics of the subjects

Factor	FR	FAR
Age (Years)	33.6 ±0.89	33 ± 3.8
Height (cm)	176 ± 3.2	172 ± 3.3
Weight (kg)	73.96 ± 1.2	64.78 ± 8.9
Refereeing experience (years)	3.8 ± 2.2	4.14 ± 2.1

FR = FIFA Referee, FAR = FIFA Assistant Referee Age (years)

The data presented in table 2 shows that the difference between the referee and the assistant referee, both in terms of motor activity (total distance covered during the match, average speed and maximum speed) and training intensity (maximum heart rate) and average heart rate, is significant. The test results were calculated using Microsoft Excel 2010.

It can be seen from the data presented in Table 2 and Figure 1 that during the match, the referee ran the average distance of 8.62 km and the assistant referee was 4.41 km (the shorter average distance was 4.21 km, giving a difference of 48.9%). Depending on the match, the distance difference ranges from 4.12 km to 4.59 km. Analysis using the Mann-Whitney U test proved that the main referee ran farther during the match than the assistant referee (p = 0.016). Mann Whitney probability = 0.016 <p = 0.05. Therefore, H_0 is rejected and H_a is accepted. There is a difference in the average distance between the referee and the assistant referee in a match.

Table 2. Description of the statistical data (as mean) and the mean difference (as p-value) of the distance traveled, speed, and heart rate obtained from the referee and the assistant referee tested during the match

	FR	FAR	P value (p)
Distance covered (km)	8.62 (8.43-9.11)	4.41(4.31-4.52)	0.016
Mean Heart rate (bt/min	163.6 (158-167)	143 (128-159)	0.004
Max. heart rate (bt/m)	186 (181-193)	161 (153-166)	0.345
Mean Speed (km/h)	5.06 (4.67-5.51)	2.80 (2.65-2.91)	0.004
Max. Speed (km/h)	20.4 (19.3-21.9)	21.71 (19.87-22.7)	0.028

In turn, the maximum heart rate was in the range 181-193 bt/minute for the referee and 153-166 bt/minute for the assistant (Fig. 3). Mann Whitney probability = 0.345> p = 0.05. Therefore, H_0 is accepted and H_a is rejected. There is no difference in maximum heart rate between the referee and the assistant referee in a match.

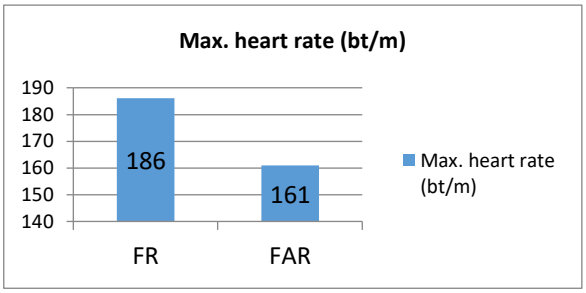

Fig. 1. The referee and assistant referee's mean maximal heart rate quartile during the match

If we follow from the data presented in Figure 4, the main referee achieves a higher average speed than the assistant referee in a match, with a higher average speed of 2,206 km/h. This difference was highly statistically significant (p = 0.05). Mann Whitney probability = 0.004 <p = 0.05, then H_0 is rejected and H_a is accepted. There is a difference in the average running speed between the referee and the assistant referee in a match.

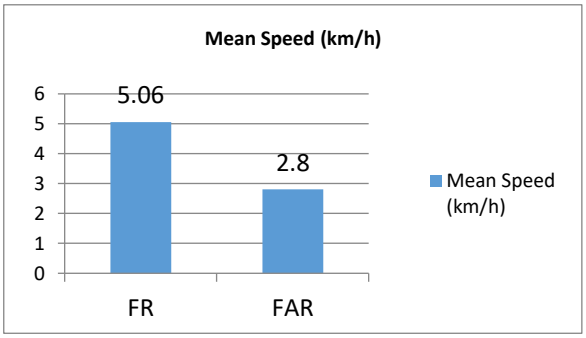

Fig. 2. Quartile average velocity of referees and assistant referees during a match.

In turn, in most of the matches analyzed (seven), the assistant referee's speed reached a higher maximum than the main referee, an average of 1.31 km/h (Fig. 5). The analysis of the significance of the difference in arithmetic mean results, Mann Whitney probability = 0.028 <p = 0.05 then H_0 is rejected and H_a is accepted. There is a difference in maximum speed between the referee and the assistant referee in a match

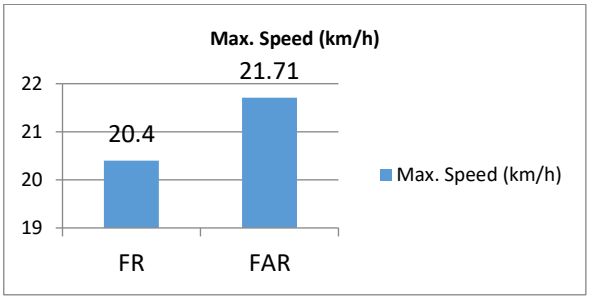

Fig. 3. Referees and assistant referees maximum speed quartile during a match.

Discussions

The results of this study are consistent with the study of [9]. Where the distance traveled by many variables may have influenced the results. There are differences between referees and assistant referees in terms of average age, height, weight and experience in leading the Liga 1 Shopee 2019/2020 matches. It can be seen from the data presented in Table 2 and Fig. 1 that during the match, the referee ran the average distance of 8.62 km and the assistant referee was 4.41 km (the shorter average distance was 4.21 km, giving a difference of 48.9%). Depending on the match, the distance difference ranges from 4.12 km to 4.59 km. Analysis using the Mann-Whitney U test proved that the main referee ran much further during the match than the assistant referee. The maximum heart rate is

in the range of 181-193 bt/minute for the referee and 153-166 bt/minute for the assistant referee. The main referee achieves a higher average speed than the assistant referee in a match, with a higher average speed of 2,206 km/h. In addition, there is a difference in maximum speed between the referee and the assistant referee in a match. These variables include changes in activity intensity (low to high), as well as motivation and other factors [9]. In addition, the referees and assistant referees who served at league level 1 compared to league 2 and even league 3 have different physical abilities and characteristics of the movements made by the referee and the assistant referee according to the classification and experience of the referee in leading the match. The activity profile of high-end referees can be influenced by (1) the distance covered by the movement of the ball; (2) the number of runs at high speed (45 m sec 71) best describes the physical performance of the referee; (3) heart rate recording can be a useful tool to determine the period of the match and determine the referee's physical condition [10].

The results of this study describe in depth the physical activity between the referee and the assistant referee. The most essential thing is their physical ability, according to the results of research by M. Ceyhun Birinci regarding the VO2 max value according to the classification and length of service of the referee ($p < 0.05$) that the respiration capacity of the national level referees is better than the provincial/regional level referees because there are different levels of their classification and experience [13]. This situation is caused by the level of classification and experience as a referee [11]. Based on the results of this study, it cannot be denied that experience greatly affect the efficiency of the referee's movement to arrange a match in the Liga 1 Shopee 2019/2020 match. In addition, in terms of decision making, the experience and age of the referee will determine the perceptual ability of the referee in the field [12]. In conducting systematic referee training, especially in providing course material or refresher, it is better to not only focuses on understanding the rules of the game, but on how the appropriate training programs differ from each other between the referee and the assistant referee. This is believed to have contributed to the improvement of the referee's ability to make objective and important decisions even though it was influenced by a large crowd from the home side [13]. The performance of high intensity training loads will affect cognitive abilities in making decisions [14]. The author has shown in this study that the average speed of the leading referees during the match the referee runs an average distance of 8.62 km and the assistant referee 4.41 km (the shorter average distance is 4.21 km, giving a difference of 48, 9%). Depending on the match, the distance difference ranges from 4.12 km to 4.59 km. Analysis using the Mann-Whitney U test proved that the main referee ran much further during the match than the assistant referee ($p = 0.016$) with the causes identified above. It should be added here that the assistant referee's activity differs significantly from the main activity of the referee in terms of the portion of high and medium intensity running is the total distance covered during the match These facts show that the movement characteristics of the referee and the assistant referee are different from one another The assistant referees run along the side lines and they position themselves at the level of the offside player, ensuring the ball hits or over the goal line (goal or no goal / out or no out). This move requires the referee to run at high and very high intensity, run at maximum speed and run sideways to ensure the offside position and ensure the ball has been played by the kicker in the case of offside. Finally, it should be added that the interpretation of the results of this study has the limitations of the small sample size. The profile presented regarding the motor activity of the referees must still be verified, also with the distinction between groups of referees leading the match with different rankings and at various levels of sporting competitions (international matches between countries/clubs, continental matches such as the AFC Cup, league and national level). Furthermore, it needs to be emphasized that the motor activity profile of the referee must be the basis for modification or development of fitness tests that are adjusted to the match level and the license level based on the criteria to become a referee at a competition.

IV. Conclusion

The motor activity between the referee and the assistant referee has differences that are reflected in the test, the training program created, and the characteristics of the movements used when leading the field and the overall preparation of the referee and the assistant referee to lead the match. The given motor training program must be more rational and refer to the characteristics of motion in the actual match, both from the referee and the assistant referee. In addition, the test instruments used at each level must reflect the characteristics of the motion and the needs of the referee and the assistant referee, which is adapted to the specific training intensity to meet the movement needs in the field.

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