

The effect of playing area on the intensity of effort expended during soccer training

تأثير مساحة اللعب على شدة الجهد المبذول أثناء تدريبات كرة القدم

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Abstract : The aim of this research was to determine the effect of changing the playing area on the intensity of effort exerted by soccer players, thus answering the following question: Are there statistically significant differences in cardiac response between the three playing areas (small, medium, and large)?.

To achieve the goal, the researcher used the descriptive approach by tracking the mean cardiac response of a sample of 14 volunteer players when they performed three forms of games (1 vs. 1), (3 vs. 3) + 3, and (7 vs. 7) + GK in three different areas (small, medium and large).

The researcher found statistically significant differences in the mean cardiac response between the three playing areas (small, medium and large), and from this he concluded that changing the playing area affects the intensity of the effort expended in football training

Keywords: playing areas, intensity of effort, cardiac response

الملخص :

هدف البحث إلى معرفة تأثير تغيير مساحة اللعب على شدة الجهد المبذول لدى لاعبي كرة القدم وبالتالي الإجابة على التساؤل التالي: هل توجد فروق ذات دلالة احصائية في الاستجابة القلبية بين مساحات اللعب الثلاث (الصغيرة والمتوسطة والكبيرة)؟

لتحقيق الهدف استخدم الباحث المنهج الوصفي بتتبع متوسط الاستجابة القلبية لعينة من 14 لاعبا متطوعا عند أدائهم لثلاث أشكال من الألعاب (1 ضد 1) و (3 ضد 3) + 3 و (7 ضد 7) + 2 حارس مرمى في ثلاث مساحات مختلفة (صغيرة ومتوسطة والكبيرة).

وقد توصل الباحث الى وجود فروق ذات دلالة احصائية في متوسط الاستثارة القلبية بين مساحات اللعب الثلاث (صغيرة ومتوسطة والكبيرة)، ومنه استنتج أن تغير مساحة اللعب يؤثر على شدة الجهد المبذول في تدريبات كرة القدم.

- الكلمات المفتاحية : مساحة اللعب، شدة الجهد المبذول، الاستجابة القلبية

1. Introduction and problematic of the study:

1.1. Introduction to the Study:

Football has witnessed remarkable development in recent years as a result of research that has sought to accurately understand football activity and utilize it in the field of physical and functional preparation for football players, which will be reflected in their skill, tactical, and psychological performance. This research has led to the experimentation of new methods or the development of old methods to simulate the conditions of a football match. These studies have shown that the effort in a football match alternates between periods of effort and periods of rest. According to **(Jean-Christophe, 2019, 12)**, players at a high level make 1,400 movements in a football match every 4 seconds in the 90 minutes of play, during which the efforts vary in intensity and there is time for recovery. **Kirkendall (2001)** describes football as a series of phases of play (4 vs. 4) or less on specific areas

1.2. The problem of the study:

It is clear that the issue of the impact of training on the player's body in football is an important matter that attracts the attention of those concerned with the game, and that choosing appropriate and organized exercises has a role in the process of development of physiological changes such as the heart rate, which is used during rest as an indicator of the fitness of the circulatory and respiratory systems. A physically fit person returns to their resting heart rate faster **(Billat, 2012, 30)**. A physically fit heart can pump a large amount of blood with a small number of beats per minute **(Wilmore et Costill, 2006, 334)**. The researcher believes that heart rate is one of the important physiological indicators that gives an indication of the effort exerted during training.

This is confirmed by **(Carré, 2013, 08)** who says, "It is recommended to use it as a monitor of the training process and not as a training goal." The results of some

studies have proven that heart rate tracking “The results of the mean maximum heart rate in the games were very close to those in competition ($173 \pm 10\%$ versus 160-170 bpm in competition) (**Jean-Christophe, 2018, 44**). Based on these data and the widespread use of games in recent times in physical preparation programs for soccer players, we decided to conduct this study, through which we seek to answer the following question

- What is the effect of different playing areas (field dimensions) on the effort expended in football training?

To answer this question, the following partial questions must be answered:

1. Are there statistically significant differences in the mean cardiac response between the playing areas (small, medium and large) in the game (1 vs. 1)?
2. Are there statistically significant differences in mean cardiac response between the playing areas (small, medium, and large) in the 3 vs. 3+ 3 game?
3. Are there statistically significant differences in mean cardiac response between the playing areas (small, medium, and large) in the 7 vs. 7 + GK game?

1.3. Defining Terms and Concepts:

1.3.1. playing areas

These are the dimensions of the playing field that are determined by the coach according to the goal of the training session. According to this study, they are (small, medium, large).

1.3.2. Physical exertion intensity:

It is the difficulty with which an exercise is performed, or the degree of muscular and nervous effort exerted by the athlete when performing a specific exercise for a specific period of time, accompanied by an increased heart rate.

1.3.3. Cardiac response:

The heart's response to physical exercise, or a physiological response, which involves an increase in the heart rate above the normal rate for physical exercise. It is an indicator of the physical effort exerted.

1.4. Study objectives:

The research aims to:

- Identify the effect of different playing areas on mean cardiac response in soccer training.

2. The practical chapter:

2.1. Research Methodology:

Using the correct method to arrive at scientific truth gives the research a serious character. Because the research aims to determine the effect of different playing areas on mean cardiac response, the researcher relied on the descriptive approach.

2.2. Research sample:

The research sample included 14 amateur soccer players who volunteered for the study. The following table represents the characteristics of the research sample according to the variables of height, weight, and age.

Table(01). A table representing the characteristics of the research sample

Variables	Unity	Mean	Standard Deviation
Age	year	26	3.66
Height	metre	1.69	0.45
Weight	kg	68.14	1.72

2. 3. Study protocol:

The researcher compared heart rate across different playing areas as follows:

- Heart rate in the game (1 vs1) between different playing areas (small , medium, large)

- Heart rate in the game (3 vs. 3) +3 between different playing areas (small , medium, large).
- Heart rate in the game (7 vs. 7) + GK between different playing areas (small , medium, large).

2.4. Games specifications:

Table(02). A table representing the characteristics of games

(1 vs. 1)	Objective	The game of putting the ball in the opponent's area
	Training volume	(30 s / 30s) x 4 times x (2 sets / 2 minutes rest) = 10 minutes
	Eara dimensions	Small: 25 m ²
		Medium: 50 m ²
		Large: 100 m ²
(3 vs. 3) + 3	Objective	Keep the ball with 4 supporting players
	Training volume	(2 minute / 2 minutes) x 6 times = 24 minutes
	Eara dimension	Small: 150 m ²
		Medium: 200 m ²
		Large: 250 m ²
(7 vs. 7) + GK	Objective	Free play with two goals scored and goalkeepers present.
	Training volume	(8 min / 2 min) x 3 times = 30 minutes
	Eara dimensions	Small: 1800 m ²
		Medium: 2400 m ²
		Large: 3000 m ²

Source: Prepared by the researcher

2.5. Physiological Measurements:

The researcher measured heart rates during the games as follows:

- Cardiac response during exercise was tracked using a heart rate monitor, which provides readings on a display screen. Heart rate was recorded after each repetition and at the end of the rest period between repetitions, and the mean cardiac response for each player in a single exercise was calculated.

2.6. Materials used in the study:

1. Heart rate monitor
2. Vests (3 different colors)
3. Balls in good condition
4. Support staff

2.7. Statistical methods used in the research:

The researcher relied on the Statistical Package for the Social Sciences (SPSS) program to process the data, using the following statistical methods:

- Arithmetic means, standard deviations
- One-way analysis of variance (ANOVA) test.
- Post hoc comparisons (LSD) test to identify areas of difference

2. 7. Presentation and Analysis of Results:

2.7.1. Presentation and analysis of the results of the first hypothesis, which states: There are statistically significant differences in the mean cardiac response between the playing areas (small, medium, and large) in the (1 vs. 1) game.

Table (03): Represents the results of the one-way analysis of variance test for the results of the mean cardiac response in the game (1 vs. 1) according to the variable of playing areas.

Sources of variance	Sum of Squares	Df	Mean Squares	F-Value	p-value
Between Groups	63.429	2	31.714	11.575	0.000
Within Groups	106.857	39	2.740		
sum	170.286	41			
Significance Level 0.05			Statistical Decision: There are statistically significant differences.		

Table (03) shows that the value of (F) equals 11.575, which is a statistically significant value, as the value of the significant probability (Sig) equals 0.000, which is less than the significance level ($\alpha = 0.05$). From this, we conclude that there are statistically significant differences between the different playing areas in the mean cardiac response in the (1 vs. 1) game. To determine these differences according to the playing area and in favor of each group, the researcher used what are called post hoc tests, including the (LSD) test, meaning the least significant difference.

Table (04): Represents the results of the (LSD) test for the results of mean cardiac response in the game (1 vs. 1) according to the variable of playing areas:

Variables	Play areas according to specific areas (I)	Play areas according to specific areas (J)	Differences between means	p-value
Mean cardiac response	large	medium	*1.29	0.016
	large	small	*3.00	0.000
	medium	small	*1.71	0.028

It is clear from the results of Table (04) above that there are statistically significant differences in the mean cardiac response in the game (1 vs. 1) attributed to the variable of eara, as the results showed that the difference is significant between all the specified earas (small, medium and large) and is always in favor of the larger eara, meaning that the larger the playing eara, the greater the mean cardiac response.

2.7.2. Presentation and analysis of the results of the second hypothesis, which states: There are statistically significant differences in the mean cardiac response between the playing areas (small, medium, and large) in the (3 vs. 3)+3 game.

Table (05): Represents the results of the one-way analysis of variance test for the results of the mean cardiac response in the game (3 vs. 3)+3 according to the variable of playing areas.

Sources of variance	Sum of Squares	Df	Mean Squares	F-Value	p-value
Between Groups	33.333	2	16.667	6.099	0.005
Within Groups	106.571	39	2.733		
sum	139.905	41			
Significance Level 0.05			Statistical Decision: There are statistically significant differences.		

Table (05) shows that the value of (F) equals 6.099, which is a statistically significant value, as the value of the significant probability (Sig) was 0.005, which is less than the significance level ($\alpha = 0.05$). From this, we conclude that there are statistically significant differences between the different playing areas in the mean cardiac response in the (3 vs. 3) + 3 game. To determine these differences in the results of the mean cardiac response in the games according to the playing area and in favor of any group, the researcher used what are called post hoc tests and the (LSD) test, meaning the least significant difference.

Table (06): Represents the results of the (LSD) test for the results of mean cardiac response in the game (3 vs. 3)+3 according to the variable of playing areas

Variables	Play areas according to specific areas (I)	Play areas according to specific areas (J)	Differences between means	p-value
	large	medium	1.43*	0.000
	large	small	*2.14	0.000
	medium	small	0.71	0.062

It is clear from the results of Table (06) above that there are statistically significant differences in the mean cardiac response in the game (3 vs. 3) + 3 attributed to the variable of eara, as the results showed that the significant difference between the small playing eara and the large playing eara, as well as between the large eara and the small eara, is always in favor of the larger eara, meaning that the mean cardiac response is always high in the larger eara.

2.7.3. Presentation and analysis of the results of the second hypothesis, which states: There are statistically significant differences in the mean cardiac response between the playing areas (small, medium, and large) in the (7 vs. 7) + GK game.

Table (07): Represents the results of the one-way analysis of variance test for the results of the mean cardiac response in the game (7 vs. 7) + GK according to the variable of playing areas.

Sources of variance	Sum of Squares	Df	Mean Squares	F-Value	p-value
Between Groups	86.714	2	43.357	4.500	0.017
Within Groups	375.786	39	9.636		
sum	486.500	41			
Significance Level 0.05			Statistical Decision: There are statistically significant differences.		

Table (07) shows that the value of (F) equals 4.500, which is a statistically significant value, as the value of the significant probability (Sig) equals 0.017, which is less than the significance level ($\alpha = 0.05$). From this, we conclude that there are statistically significant differences between the different playing areas in the game (7 vs. 7) + GK. To determine these differences in the results of mean cardiac response in the game format according to the playing area and in favor of each group, the researcher used what are called post hoc tests and the LSD test, meaning the least significant difference.

Table (08): Represents the results of the (LSD) test for the results of mean cardiac response in the game (7 vs. 7) + GK according to the variable of playing areas:

Variables	Play areas according to specific areas (I)	Play areas according to specific areas (J)	Differences between means	p-value
Mean cardiac response	large	medium	*1.43	0.021
	large	small	*3.50	0.001
	medium	small	*2.07	0.003

It is clear from the results of Table (08) above that there are statistically significant differences in the mean cardiac response in the game (7 vs. 7) + GK attributed to the variable of eara, as the results showed that the difference is significant between all the specified earas (small, medium and large) and is always in favor of the larger eara, meaning that the larger the playing eara, the greater the mean cardiac response.

2.8. Discussion of the results:

2.8.1. Discussion of the results of the first hypothesis, which states: There are statistically significant differences in the mean cardiac response between the playing areas (small, medium, and large) in the (1 vs. 1) game.

The study recorded an arithmetic mean and standard deviation for cardiac response in (large, medium, small) equal to (190.86 ± 1.66 , 189.57 ± 1.79 , 187.86 ± 1.51) respectively, where we notice that there is a direct proportion between the playing area and the mean cardiac response, meaning that the larger the playing area, the higher the mean cardiac response in the game (1 vs. 1).

The results also showed that there are statistically significant differences in the mean cardiac response (FC) in the game (1 vs. 1) due to the difference (effect) of the playing area in the game (1 vs. 1) where the calculated (F) was equal to (11.575) and the value of the significant probability (sig) was equal to (0.000) which is less than the significance level ($\alpha = 0.05$).

Tables (03), (04) also showed that the difference was statistically significant between all playing areas and was always in favor of the larger area, meaning that there were statistically significant differences in the mean cardiac response between playing areas (small, medium and large) in the game (1 vs. 1). From this we conclude that the first hypothesis was achieved.

2.8.2. Discussion of the results of the second hypothesis, which states:

There are statistically significant differences in the mean cardiac response between the playing areas (small, medium and large) in the game (3 vs. 3)+3.

The study recorded an arithmetic mean and standard deviation of cardiac response in (large, medium, small) equal to (189.57 ± 1.70 , $188.14 \pm 1.1.83$, 187.43 ± 1.40) respectively, where we notice that there is a direct proportion between the playing area and the mean cardiac response, meaning that the larger the playing area, the greater the mean cardiac response in the game (3 vs. 3) + 3.

The results also showed that there are statistically significant differences in the mean cardiac response (FC) for the training game format (3 vs. 3) + 3 due to the difference (effect) of the playing area, where the calculated (F) was equal to (6.099) and the value of the significant probability (sig) was equal to (0.005), which is less than the significance level ($\alpha = 0.05$).

Tables (05), (06) also showed that the difference was statistically significant between the small area and the large area, between the medium area and the large area. from this we conclude that the second hypothesis was achieved.

2.8.3. Discussion of the results of the third hypothesis, which states: There are statistically significant differences in the mean cardiac response between the playing areas (small, medium and large) in the game (7 vs. 7) + GK.

The study recorded an arithmetic mean and standard deviation of cardiac response in (large, medium, small) equal to $(178.14 \pm 2.38, 176.71 \pm 3.95, 174.64 \pm 2.76)$, and it became clear from the results of Table No. (05) that there are statistically significant differences in the mean cardiac response (FC) for training in the form of games due to the difference (effect) of the playing area in the game (7 vs. 7) + GK where the calculated (F) was equal to (4.500) and the value of the significant probability (sig) was equal to (0.017) which is less than the significance level ($\alpha=0.05$).

Tables(07),(08) also showed that the difference was statistically significant between all playing areas and was always in favor of the larger area, meaning that there were statistically significant differences in the mean cardiac response between playing areas (small, medium and large) in the game (7 vs. 7) + GK. From this we conclude that the third hypothesis was achieved.

3. General discussion:

The researcher attributes the recording of these significant differences in heart rate in games between the various playing areas studied (small, medium, and large) to the effect of the difference in playing area on heart rate, which is

confirmed by (Hourcade, 2019, 35-36): "The playing area can affect this physiological variable."

Carré (2013, 08) says, "The heart rate is an indicator of the effort exerted, and it is recommended to use it as a monitor of the training process and not as a training goal." Muhammad Samir Saad al-Din (2000, 186) adds, "During high-intensity training, there is a significant increase in the heart rate and it reaches 195-200 beats/minute at the age of 20..." Hence, the researcher believes that there is a direct relationship between the mean cardiac response and the intensity of training, whereby the higher the heart rate, the more we conclude that the exercise or training is of high intensity, and vice versa.

According to the results of this study, we say that training in the form of games leads to a higher cardiac response as the playing area increases, which indicates that the intensity of training increases in games with the increase in the playing area, meaning that the larger the playing area, the more intense the training.

The researcher attributes this to the fact that the wider the area, the more the player moves and moves quickly, and runs relatively longer distances at a relatively greater speed, and that the smaller the playing area, the less the player moves and the more his performance situations are from a standstill, which is consistent with (Aguar et al, 2012, 106), who indicated that effective time in play could provide a possible explanation for differences in physiological and physical effort and various variables studied in games.

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