

HOW SAFE IS RECREATIONAL SOCCER PLAYING AS A HEALTH ENHANCING PHYSICAL ACTIVITY FOR APPARENTLY HEALTHY ADULTS IN MAIDUGURI, NIGERIA?

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ABSTRACT

Background: Soccer is a competitive sport, but its suitability as a recreational health enhancing physical activity has not been explored among adults in Nigeria. **Objectives:** This study was conducted to determine the cardiovascular responses and changes in rating of perceived exertion (RPE) following recreational soccer game among amateur soccer players. **Method:** Sixty-seven apparently healthy young men conveniently selected from three non-professional football clubs in Maiduguri participated in the study. The participants were pre-screened for any cardiovascular ailment before engaging in recreational soccer playing for a total of 30 minutes. Participants' base line cardiovascular measurement and RPE were taken before and after the soccer session. Descriptive statistic of mean was used to summarize physical characteristic of the participants and one-way repeated measures Analysis of Variance were used to compare the cardiovascular parameters of the subjects at rest, after soccer and into recoveries. **Results:** The mean age and body mass index of the participants were 23±4.3 years and 19.5±2.6 kg/m² respectively. The result shows significant heightened heart rate (HR), systolic blood pressure (SBP), diastolic BP (DBP) and RPE immediately following soccer playing by 67.4 ± 19.9 bpm, 19.6 ± 10.6 mmHg, 19.1 ± 14.9 mmHg and 9.2 ± 2.3, respectively. It also shows significantly (p<0.05) higher derived values including mean arterial pressure (MAP) and rate pressure product (RPP) after soccer playing compared to the baseline resting values. HR and RPP were still higher than the baseline values eight minutes into recovery, while SBP, DBP, MAP six minutes into recovery were comparable to the baseline value and were even lower than the baseline values eight minutes into recovery. **Conclusion:** This study found heightened cardiovascular response and RPE after 30 minutes of soccer playing among non-professional soccer players in Maiduguri. The finding suggests that soccer playing may be too strenuous physical activity to be recommended for meeting the physical activity requirements for health enhancing benefits among apparently

Keywords: Soccer, physical activity, recovery responses, recreational sport, health enhancing benefits

INTRODUCTION

Physical activity is any bodily movement produced by skeletal muscles that requires energy expenditure.¹ This definition includes recreational or leisure-time play, games, sports or planned exercise in the context of daily, family, and community activities.² According to the general guidelines, individual adults are expected to engage in physical activity of moderate to vigorous intensity for up to 30 minutes per session or day, 5 times a week. Specifically, 150 minutes of moderately intense or 75 minutes of vigorous intensity physical activity per week is required to derive a health enhancing benefits,² although each session of exercise must be performed for up to 10 minutes at any one time to count towards the total weekly recommendation. Among the physical

activities that can be deemed to be moderately intense are carrying light load such as moving furniture and household items, carrying sacks, performing multiple household tasks at once, clearing land and dancing or walking.^{3,4} Vigorous intensity activity are carrying heavy loads such as blocks, farming as in making ridges and poultry works, jogging, and bicycle riding.^{3,4} A combination of moderate and vigorous intensity physical activity for up to 150 minutes per week can also be used to meet the requirement for health benefits.

Soccer is a game played by two teams of eleven players on rectangular, one-hundred-yard-long field with the goal post at either ends. Soccer is a global sport and its rules must be interpreted and applied with absolute consistency wherever the game is played.^{5,6} It is a sport, in which an individual may go from standing still to explosive run, extolling high physical demand on the body. Giving the growing consensus on the benefits of physical activity and increasing awareness on the menace of non-communicable diseases and the health enhancing benefits of physical activity,⁷ there is temptation to engage in any enjoyable sporting activity such as soccer playing at leisure time (recreational soccer) as a means to meeting the requirement of physical activity as recommended by the health guidelines. In Nigeria, it is a common practice among civil service workers and government agencies for otherwise unfit middle aged and even older adults to engage in sporadic soccer sports as in novelty matches.

Soccer is a popular sport and is most probably the recreational and leisure activity of choice among Nigerian youths. It is also plausible that even middle-aged adults who are desirous of improving their activity level may be tempted to use soccer playing to accrue weekly minutes of physical activity to derive health enhancing benefits. While in a planned non-competitive recreational physical activity such as jogging, an individual can slow down or self-limit as fatigues sets in, a competitive sport such as soccer playing that involves playing an opposing team and competing to win the game, the pace may not be self-selected. Unlike many recreational sports, soccer players are prone to injuries due to fall, or due to wrong move or hard

tackle by the opponents as they compete for ball control. Anecdotal reports show that several deaths have occurred among apparently healthy adults and elites' athletes collapsing and dying during or after a soccer tournament or training session.

At rest, the body consumes 3.5ml of oxygen per kilogram of body weight per minute or one metabolic equivalent (MET). Moderately intense physical activities have been estimated as falling into 3-5 METs range category, while vigorously intense physical activity falls in the 6-8 METs category.⁵ Moderate intensity physical activity include activities such as walking which causes an increase in breathing rate, increase sweating but not enough to prevent the exercising individual from being able to hold a conversation. Examples of vigorous or hard activity are jogging and bicycling.⁵ Cardiovascular parameters such as heart rate (HR) have been used to indirectly qualify the intensity of a physical activity, and rating perceived exertion (RPE) scale also been established as a valuable and reliable indicator in the monitoring of an individual's subjective perception of effort.^{8,9}

Based on the rating of perceived exertion minimum and maximum rating of 6 and 20, an estimate of average resting and maximum heart rate of 60 and 200 beats per minute respectively (RPE multiplied by 10) has been proposed. RPE and its equivalent estimated HR have therefore been used interchangeably in estimating exercise intensity.¹⁰ Literature review shows that MET estimation based on HR increment above resting values is adequate in estimating energy expenditure during exercises and physical activity, because it is based on an individual parameter of HR at rest, which can be related to an individual's aerobic capacity.^{11,12} A regression equation to estimate the MET following a walk/run test using net heart rate increment above the resting values, has been developed.⁹ A net HR threshold values for light (< 3 METs), moderate (3-6 METs) and vigorous physical activity (>6 METs) have been set as 16, 35 and 70 respectively.⁹

Using Borgs perceived exertion scale, RPE has also been used to gauge the limit for both sub maximal and maximal exercises. A physical activity may be

classified as very light (6 to 7 RPE), very light (8 to 9 RPE), fairly light (10 to 11 RPE) somewhat hard (12 to 13 RPE), hard 14 to 15 RPE) very hard (16 to 17 RPE) or very hard (18 to 20 RPE).^{10,8} It has also been determined that moderate intensity physical activity burns 3.5 to 7 calories per minute¹² and physical activities that burn less than 3 calories per minute or more than 7 calories per minute are light and vigorous activities respectively. Other activities of daily living that involves burning calories at moderate intensity level are heavy cleaning, and general carpentry.³ Soccer is naturally a competitive sport and there may be frequent and sporadic ionotropic influence,¹¹ making it potentially a strenuous physical activity especially in response to jeers by the spectators and fans.

Whether soccer playing can be classified as moderate or vigorous or very hard- intensity or strenuous physical activity is unclear. Several factors such as the pace of the activity may come into play in the intensity level of a soccer played during a practice session or match. Factors such as the age of the team mates, or age match between opposing teams, aerobic fitness of the individual and team mates and fitness match between opposing teams, comes into play in determining the pace and therefore the intensity of the activity. Unlike most other physical activities, soccer may not be played at a pace selected by an individual. Due to the competitive nature of the sport, it is plausible that this activity is more than a vigorous level physical activity. A reasonable presumption is that activities that exceed somewhat hard level (RPE 12 -13) are the limit for health enhancing purpose, and physical activity that exceed the RPE between 14-16 may be too strenuous to sustain and may be injurious to health if forced.

Presently, there is paucity of empirical data on the extent of cardiovascular change during soccer playing and how soon after cessation of soccer do the cardiovascular parameters return to resting state is unknown. In the absence of robust instruments with capability for analyzing oxygen consumption such as metabolic cart, HR and RPE as measures of exercise intensity and energy cost of activity are commonly utilized in gauging intensity in a low resource country such as Nigeria. More so

the concurrent validity of RPE and HR in estimating exercise intensity is well established.^{10,8} The aims of the study are to determine the cardiovascular parameters in response to soccer playing among the apparently healthy amateur soccer players in Maiduguri, and to estimate the METs level of soccer game using HR and RPE.

MATERIALS AND METHOD

Design

A pre and post- tests non-experimental research design was utilized for this study.

Participants

Sixty-seven apparently healthy male soccer players, playing with Qatar football club of Jere local government (n= 22), Konduga United football club of Konduga Local Government area (n=20) and University of Maiduguri Teaching Hospital Football Club (n= 23) were conveniently recruited to participate in this study. These three football clubs based in Maiduguri, Borno State, Nigeria, were identified from the records of the Borno State Ministry of Youth and Sport. The study was conducted in the football fields where each of these clubs gather every evening to practice soccer (i.e. in Qatar football field, Konduga United Football Field and University of Maiduguri Teaching Hospital Football Field).

Procedure

Ethical approval of the Institutional Review Committee (IRC) of University of Maiduguri Teaching Hospital (UMTH) was sought and obtained before the commencement of this study. The purpose of the research was presented through an introductory letter and explanation to the coaches of all players in the above clubs. Participants were approached in the evening between 5-6pm everyday between February 1 and 28, 2014. On arrival, the protocol of the study was explained to the participants. One of the researchers who is a final year physiotherapy student interviewed the participants for medical history of any cardiovascular ailment by asking if they had either been previously diagnosed or treated for any cardiovascular condition by a physician and those who met the inclusion criteria of not having previous history of cardiovascular conditions,

being an amateur soccer player and a member of the selected football clubs was given a consent form to sign. In order not to alter their regular cardiovascular responses to soccer playing, the participants were advised not to take known confounding substances such as kola nut, cigarette or heavy meal at least 2 hours prior to football training.

On the second day of data collection, participants' aerobic capacity was assessed through a 1.5 mile run test on a track marked around the football fields. The time spent to complete the test was recorded. Participants' weights were also measured to the nearest 0.5 Kg using bathroom weighing scale (Harson, Model H89 DK Blue). Their height was also measured to the nearest 0.5 cm using a tape measure with subjects standing against the wall. Participants were then seated on a chair with back rest for 10 minutes to facilitate measurement of the resting cardiovascular parameters. Five minutes into assumption of sitting position, the participants' HR and blood pressure were measured using an automated blood pressure and pulse rate monitor (model 8100/8101), following standardized procedures. After taking the resting values, including the RPE on a scale of 6-20, the participants were allowed to commence their usual mode of soccer training session. The training session involved uninterrupted soccer playing between two opposing sides of eleven players each on a standard football field. The coach of the team served as the referee during the training and occasionally gave instructions to all players on the non-competitive nature of the session. The training session lasted for 30 minutes. After the training the cardiovascular and RPE measurements were taken immediately and after 2, 4 and 8 minutes into recovery. The values were recorded on the data sheet.

Indices such as the Mean arterial pressure (MAP) which is an average pressure within the cardiac cycle [$1/3 (SBP - DBP)$], rate pressure product (RPP) which is an index of myocardial oxygen uptake ($HR \times SBP$), pulse pressure (PP) which is a correlate of stroke volume ($SBP - DBP$) were derived.¹¹ Body mass index which is the ratio of body weight to the square of the body height as kg/m^2 , was also

calculated. From the 1.5 mile run time, the aerobic capacities of the participants were derived using a nomogram.¹³ HR change from resting values and post soccer values (Exercise HR minus resting HR) were also computed for each participant. Participants also rated their perceived exertion following soccer. From the HR change and RPE values reported at the end of the training session, the intensity of the soccer as physical activity was also determined and recorded.¹⁰

Data analysis

Descriptive statistics of mean and standard deviation was used to describe the participant physical characteristics. One-way repeated measures ANOVA was used to explore the difference in the cardiovascular response and RPE of the participant before training and after training, and into recovery. The Bonferroni *post-hoc* test was used to examine where the significant differences between the different time frames occurred. The level of significance was set at $p < 0.05$.

RESULTS

Physical Characteristic of the Participant

The mean age and body mass index of the 67 apparently healthy adult amateur soccer players participant were 23.2 ± 4.3 years (95% Confidential interval = $22.2 - 24.3$ years) and 19.5 ± 2.6 (95% confidential interval = $18.8 - 20.1$) Kg/m^2 , respectively. The mean 1.5 mile run test time covered by the participant was 634.96 ± 59.66 seconds and the mean aerobic capacity of the participants was 50.2 ± 6.0 ml/kg/minute. Details of the physical characteristic of the participant are as shown in table 1. The baseline, post soccer and recovery responses of the subjects are shown in Table 2. The mean resting heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) of the participants before soccer practice were 71.6 ± 15.4 beats per minute (bpm), 130.1 ± 19.1 mmHg and 79.7 ± 15.9 mmHg, respectively. The mean resting mean arterial pressure (MAP), pulse pressure (PP), rate pressure product (RPP) and rating of perceived exertion (RPE) were 96.8 ± 14.3 , 49.9 ± 16.4 , 9452 ± 2968 and 6.0 ± 0 , respectively.

Immediately post soccer practice, the mean HR, SBP and DBP of the participants were 138.7 ± 16.6 beats per minute, 149.8 ± 17.0 mmHg, and 98.7 ± 12.2

mmHg respectively. The mean MAP, PP, RPP and RPE of the participants at the same time frame were 116.1±11.8 mmHg, 50.9 18.4 mmHg, 206133±705 units and 15.2±2.3. The mean HR, SBP and DBP of the participants two minutes after cessation of soccer practice were 130.3±16.13 bpm, ±146.2±18.1 mmHg and 91.3±11.0 mmHg respectively, while the mean MAP, PP and RPP were 109±11.9, 51.6±18.0 and 18523±3391 units respectively. Four minutes after cessation of soccer practice, the mean recovery HR, DBP and DBP of the participants were 124.0±16.4 bpm, 137.3±17.8 mmHg, and 85.9±10.3 mmHg respectively, while the mean recovery MAP, PP, and RPP were 103.2± 10.9 mmHg, 51.1± 16.4 mmHg and 17031± 3476 mmHg respectively.

Table 1: Physical Characteristics of the Participants

Variable	Mean (SD)
Age	23.2±4.3
Weight	656±10.0
Height	1.68 ± 0.10
BMI	19.5 ± 2.6
1.5 miles Run Time	634.96±59.66
Aerobic Capacity	50.2±6.0

BMI = Body Mass Index

Table 2: Cardiovascular responses at rest, following soccer practice and in recoveries

Variable	Baseline	Soccer	1st Rec.	2nd Rec.	3 rd Rec.	4 th Rec.
Heart Rate	71.6 ±15.4	138.7±16.8 ^H	130.3±16.13 ^H	124.0±16.4 ^H	118.3±15.7 ^H	101.1±17.3 ^H
Systolic BP	130.1±19.1	149.8±170 ^H	146.2±18.1 ^H	137.3±17.8 ^H	130.7±18.4	123.8±19.8 ^L
Diastolic blood pressure	79.7±15.9	98.7±12.2 ^H	91.3±11.0 ^H	85.9±10.3 ^H	80.7±11.6	75.6±11.7 ^L
Mean arterial pressure	96.8±14.3	116.1±11.8 ^H	109±11.9 ^H	103.2±10.9 ^H	97.3±11.8	91.6±12.3 ^L
Pulse pressure	49.9±16.4	50.9±18.4	51.6±18.0	51.1±16.4	50.0±16.5	48.3±17.6
Rate pulse product	9452±2968	20613±3705 ^H	18523±3391 ^H	17031±3476 ^H	15541±3516 ^H	13918±4088 ^H
Rated perceived exertion	6.0±0	15.2±2.3 ^H				

1st Rec = First recovery values are values 2 minute after the cessation of physical activity (soccer)

2nd Rec = Second recovery values are values 4 minute after the cessation of physical activity (soccer)

3rd Rec = Third recovery values are values 6 minute after the cessation of physical activity (soccer)

4th Rec = Fourth recovery values are values 8 minute after the cessation of physical activity (soccer)

All exercise and recovery pulse pressure and 3rd recovery SBP, DBO and MAP values are comparable (not significantly different, p<0.05) from the corresponding baseline values. The 4th recovery SBP, DBP and MAP are significantly lower than their corresponding values. All other values are significantly higher (p<0.01) than their corresponding baseline values.

Mean values for the SBP, DBP and HR and the derived parameters six and eight minutes into recovery are as shown in Table 2.

Comparison of Resting and Post Soccer Responses

Table 2 shows that significantly higher HR (P<0.001), SBP (P<0.001), DBP (P<0.001) and MAP (P<0.001) were observed post soccer when compared to the baseline values. Significant higher (p<0.001) RPP and RPE were also observed post soccer when compared to the baseline values. All exercise and recovery pulse pressure and 3rd recovery SBP, DBO and MAP values are comparable (not significantly different) from the corresponding baseline values. The 4th recovery SBP, DBP and MAP are significantly lower than their corresponding values. All other values were significantly higher (p<0.01) than their corresponding baseline values. A mean HR change of a 67.1± 20.2 and ranged between 62-72 bpm from base line was found for all the subjects in the present study (not Shown in Tables).

DISCUSSION

The mean BMI scores of the participant in this study was $19.5\text{kg}/\text{m}^2$, indicating that overall the amateur soccer players were all of normal weight or even less. This is not surprising given the average aerobic capacity ($50.2\pm 6.0\text{ ml}/\text{kg}/\text{minute}$) of the subjects which show the subjects overall have good aerobic fitness.¹³ Higher SBP observed immediately after soccer practice, when compared to the baseline values, affirms the consensus,^{11,14,15,12,12} that SBP should rise upon initiation of exercise and as exercise intensity increases from baseline values. Our findings that show significant difference in the DBP before and after soccer practice is inconsistent with that of¹⁴ that reported exercise produce no change in DBP, but in line with that of¹² which found that exercise significantly raises DBP response in healthy adult. Our findings that show increased diastolic pressure may be indications that the anaerobic component of exercise during soccer practice is substantial. This is because resisted exercises or its equivalents such as power runs, and sprinting for a short spell attendant in soccer, often cause rise in DBP.

Our findings that shows heart rate remain elevated and only slowly trend during recovery towards the resting level, is consistent with the findings of.¹⁶ Higher MAP after soccer practice which lasted for up to 8 minutes post cessation of soccer practice is consistent with the findings of,¹⁷ which showed MAP increases with physical activity and falls only slowly over time. Overall the subjects' cardiovascular parameters were characterized by heightened HR, SBP, DBP, MAP and RPP observable during soccer and immediately after, all values which then trended lower during recovery. Recovery was never full at eight minutes post practice for HR and RPP, as these parameters are still higher than the baseline values eight minutes into recovery. However, SBP, DBP, MAP were comparable to the baseline values six minutes into recovery and the values were even lower eight minutes into recovery. Heart Rate is an important indicator of myocardial oxygen uptake and this parameter is a more sensitive indicator or correlates of metabolic rate than other indicators such as blood pressure. Since metabolism is expected to remain high even hours after a long duration exercise, HR

may not be expected to return to resting level as quick as the other direct indices of cardiovascular system, following a soccer practice session.

A change in HR of 67.1 ± 20.2 and range between 62-72 bpm from base line as observed in the present study is an indication that the soccer activity can be more than a moderately intense physical activity. Our result show HR change during soccer can exceed the net increase of 35 and 70 from baseline (threshold for moderate and vigorous activity) and this recreational sport can be more intense than activities such as jogging and bicycling respectively according to.³ Furthermore a change in the rating of perceived exertion from the baseline value of 6.0, which significantly increase up to 15.2 immediately after the soccer practice, further affirm that soccer is more than a somewhat hard' physical activity and can be argued to be a strenuous physical activity which may not be considered safe for health enhancing purposes among unfit adults. It is therefore conceivable that playing soccer can be too physically demanding physical activity for apparently healthy adults initiating changes in their lifestyles.

From our findings, we can speculate that highly intense physical activity like soccer may be considered unsafe for the general population and more especially for the middle age adults who may harbour some cardiovascular risks. It may also be considered unsafe for beginner exercise or physical activity participants, because of the risk for musculoskeletal injury attendant in soccer. Physical activity may be unsustainable for the minimum duration of 10 minutes for which health enhancing benefits of physical activity may be derived, if the intensity level is more than moderate. Physical activity such as soccer can be considered to be somewhat hard or hard, and may therefore not be sustainable and therefore considered unsafe for beginner exercisers seeking to habituate physical activity and exercise as part of their lifestyle.

Furthermore, given the anaerobic components of energy metabolism during soccer especially in a match can be substantial. Soccer is not a physical activity that can be performed at self-selected pace

as the pace is not within the firm control of any individual player. By the principle of specificity of training,¹¹ only those trained and are conditioned to soccer may include soccer into the array of choices on physical activity for health enhancing benefits. Therefore, while soccer practice sessions may be includible in the array on physical activity choices for young adults or amateur soccer players, it may not be advisable for the untrained or the new 'inductees' into healthful living through physically active lifestyle.

Study Limitations

Findings from this study should be interpreted against the background that soccer is normally played for 45 minutes followed by 15 minutes of rest and another 45 minutes. In real life, not all players may be allowed to play for the entire duration of a full session and practice sessions for amateur soccer may not last for more than 20 minutes, twice in a soccer practice day. Furthermore, cardiovascular parameters and changes may also be influenced by other intrinsic and extrinsic factors not controlled for in this study. Also, the convenience sampling technique utilized could limit the generalization of the findings. In this study the subjects' cardiovascular parameters in response to soccer practice session were monitored within 30 seconds following cessation of play. It can be safely presumed that values obtained within 30 seconds after cessation of activities can be expected to closely approximate the steady state values. Also, post exercise RPE were assessed 9-10 minutes after the termination of soccer practice, and the rating

may be different if it were assessed right before termination of exercise. Furthermore, HR and RPE as employed in this study are only indirect measures of oxygen consumption. Future studies using the appropriate instrumentations that is capable of gas analysis that can provide better information on the energy cost of soccer is warranted.

CONCLUSION

This study found heightened cardiovascular response and RPE after 30 minutes of soccer playing among non-professional soccer players in Maiduguri. The finding suggests that soccer playing may be too strenuous physical activity to be recommended for meeting the physical activity requirements for health enhancing benefits among apparently healthy adults in Maiduguri. There is the need for consultation with relevant experts including physiotherapists and physicians before engaging in physical activity. If soccer playing for 30 minutes is to be included in the arrays of physical activity that could be counted towards the total recommended weekly minutes, some training and conditioning may be necessary. Risk for injury in soccer is also a consideration in making any recommendation on soccer as a type of health enhancing physical activity prescription. Overall, from safety and adherence perspectives, soccer playing may not be advisable as a health enhancing physical activity for every apparently looking adults in Maiduguri and certainly not for the stressed busy executives.

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