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# Effect of Recreational Soccer on the Physiological Parameters and Risk of Injuries in Adult Males

## ARTICLE INFO

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## ABSTRACT

**Aims** The purpose of this study was to evaluate GPS daily dependability to establish the consistency of VO2max, HRmax, total distance, decelerations and accelerations done, metabolic power, relative velocity, high-speed running, and high-intensity metabolic power distance in recreational soccer.

**Instruments & Methods** In 2022, this descriptive study recruited 30 adult males with no specific diseases. The soccer matches (four vs. four) were played on an artificial grass outdoor field (pitch size 40×43m). Participants finished the match in 60 minutes and repeated the identical match a week later. Several criteria were included in the analysis (VO2max, HRmax, total distance, decelerations, and accelerations, metabolic power, relative velocity, high-speed running, and high-intensity metabolic power). Typical measurement error and interclass correlation were used to evaluate the absolute HR data between the two matches, and SPSS 23 software was used for statistical analysis.

**Findings** The high levels of dependability were observed in total distance (ICC=0.56), accelerations (ICC=0.53), mean HR (ICC=0.71), high-speed running (ICC=0.65), and metabolic power (ICC=0.54).

**Conclusion** Recreational soccer improves the physiological parameters and decreases the risk of injuries in adult males.

**Keywords** VO2max; HRmax; Total Distance; Relative Velocity; High-Speed Running; High-Intensity Metabolic Power

## CITATION LINKS

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## Introduction

Multiple studies have shown that participating in recreational team sports, like soccer, can significantly enhance public health [1-4]. Soccer, the most popular sport globally [2], can be leveraged to promote adherence to exercise programs and improve overall fitness. Soccer is a vigorous physical activity that can elevate blood pressure, such as diastolic and systolic blood pressure, resting heart rate, and maximal aerobic power ($VO_2max$) [5-7].

Soccer is a team sport involving aerobic and anaerobic components [8]. Simultaneous assessment of internal and external load characteristics can provide a more precise understanding of a health activity that can provide many benefits in terms of soccer's activity and physical demands [9].

Regardless of its popularity, recreational soccer played by adult men will be systematically evaluated for external and internal load factors [10]. According to the only available data on the dependability of internal load measurements in soccer, the mean heart rate has a typical measurement error of 2.4% (with a 90% confidence interval of 1.6 to 3.1) [11].

In team sports, the global positioning system (GPS) is a popular instrument for evaluating external load characteristics [12]. It aids in the collection of time motion data. Then, it analyzes the number of changes in direction, total distance traveled (TD), deceleration and acceleration activities and time taken at high speed when running (HSR) [13, 14]. Extensive studies have been undertaken on GPS technology's accuracy, validity, and dependability, with mainly good results [15-17]. Certain limits in accuracy have been observed. Nonetheless, a substantial body of research supports using this technology, namely 10Hz GPS, to assess environmental stress variables during recreational soccer activities [11, 15, 17].

It has been demonstrated that coaches can lower injury rates in team sport athletes by using RPE and GPS monitoring techniques [18]. A recent study by Malone *et al.* [19] found a statistically significant correlation between team sport participants' injury risk and weekly training intensity variations that are greater ≥75%. It is well known that a soccer match's physiological and physical demands can differ significantly based on the players' ages [20, 21]. However, it has been demonstrated that more seasoned players exhibit superior physical control throughout the game due to their superior technical and tactical abilities [24]. Before graduating, training objectives must coincide with the team's maturity goals since players need to be physically prepared to move on to the next level. To exemplify this, Buchheit *et al.* [20] demonstrated a correlation between the corresponding age groups and increased running frequency at high and very high intensities.

So far, little study has been conducted on the analysis of $V0_2max$, HRmax, total distance, decelerations and acceleration performed, metabolic power, relative velocity, high-speed running, and high-intensity metabolic power distance in recreational soccer health programs. This study is impeded by a lack of information on the data's dependability. The primary goal of this study was to use GPS daily reliability to establish the consistency of $VO_2max$, HRmax, total distance, decelerations and acceleration performed, metabolic power, relative velocity, high-speed running, and high-intensity metabolic power distance in recreational soccer.

## Instrument and Methods

In 2022, this descriptive study recruited 30 adult males with no specific diseases. The study included sedentary, untrained recreational volunteers of any age or health state, including those with obesity, diabetes and hypertension.

$VO_2max$ and HRmax were calculated using the maximum running incremental test and data analysis. The respiratory parameters were measured by breath using a Quark b2 automated metabolic cart from Cosmed in Italy. The same research group just published the technique utilized in this research [11].

Four-on-four games were played for seven minutes on a 40×34-meter surface. The competitors played 60-minute recreational soccer matches, and the same tournament was repeated the following week, with each player participating twice. During the game, each side member took turns playing goaltender, changing every seven minutes. The training load parameters were captured using a STATSports Viper 10Hz GPS device and evaluated with the STATSport Viper Software [11].

The research considered %HRmax, total distance (TD) measured in meters, high-speed running over (HSR) more than 14.4km/h, and relative velocity defined as the ratio of the total distance to total time were all taken into account in the study [18, 19]. Furthermore, GPS data was used to get metabolic power (MP) in w.kg1 and high-intensity metabolic power distance (HMD) greater than 20w.kg1 [20]. The indirect evaluation of metabolic power was based on the notion that running swiftly on level ground is energetically equivalent to running steadily uphill. Manzi *et al.* [21] previously investigated the ecological validity of metabolic power in soccer.

The Shapiro-Wilk test showed that the data was not normal. The explained variance ($R^2$) was used [22] with the statistical significance at $p<0.05$. Typical measurement error (TEM) and interclass correlation (ICC) were used to evaluate the absolute HR data between the two matches with the categories (poor if 0.4, fair if >0.4, good if >0.6, and excellent if >0.75) [23]. The mean differences with 95% confidence intervals were used to assess the differences between both matches. A paired t-test was used to determine whether there were systematic differences between the two matches. To determine Cohen's d (ES), the

coefficients were normalized depending on the intersubject standard deviation corresponding to the criteria; 0.2 (trivial), >0.2 (small), >0.5 (medium), and >0.8 (large) [23]. The SPSS 23 software was used for statistical analysis.

## Findings

The participants' mean age was 37.4±2.3 years, weight was 75.8±4.3kg, height was 168.0±5.2cm, BMI was 28.2±2.0, and $VO_2$max was 37.5±2.5ml.kg.min−1. The average heart rate in the first and second weeks were 157.2±5.6 and 155.7±6.3bpm (p=0.55; ICC=0.17), HRmax percentages were 91.3%±5.3 and 90.4%±5.2% (p=0.57; ICC=0.19), the total distance covered was 2574±135 and 2473±138m (p=0.15; ICC=0.28), and the accelerations were 27.6 and 26.5 (p=0.48; ICC=0.5), the decelerations were 44.25 and 45.34 (p=0.35; ICC=0.4), the MP values were 4.62±0.30 and 4.58±0.31w.kg1 (p=0.54; ICC=0.25) and the relative velocity was 54.6±5.6 and 55.7±5.8m.min1, respectively (Table 1).

**Table 1.** The reliability of $VO_2$max, HRmax, total distance, decelerations and acceleration performed, metabolic power, relative velocity, high-speed running, and high-intensity metabolic power distance confidence intervals (CI=90%) in recreational soccer

| Parameter | Mean of change | Typical error of measurement | Interclass correlation | Variance ($R^2$) |
|---|---|---|---|---|
| **Mean HR (bpm)** | -1.40 (-2.1; +0.2) | 3.14 (2.24; 4.05) | 0.71 (0.61; 0.56) | 0.74 |
| **HR Percentage (HRmax)** | -0.70 (-1.7; +0.1) | 1.25 (1.63; 1.52) | 0.64 (0.54; 0.67) | 0.58 |
| **Total Distance (TD, m)** | -110.5 (-176; -16.6) | 164 (125; 134) | 0.56 (0.33; 0.62) | 0.51 |
| **Accelerations (n°)** | -0.26 (-1.57; +1.24) | 2.35 (1.63; 3.53) | 0.53 (0.35; 0.67) | 0.46 |
| **Decelerations (n°)** | -0.18 (-1.56; +1.23) | 2.12 (1.53; 1.02) | 0.54 (0.33; 0.59) | 0.52 |
| **Metabolic Power (MP, w/kg)** | -0.03 (-0.13; +0.04) | 0.13 (0.15; 0.41) | 0.54 (0.34; 0.67) | 0.53 |
| **Relative Velocity (RV, m/min)** | -1.73 (-2.35; -0.32) | 2.3 (1.58; 3.25) | 0.74 (0.56; 0.75) | 0.54 |
| **High-Speed Running Over (HSR, m)** | -2.06 (-3; -1.19) -3.67 | 3.21 (2.35; 3.35) | 0.65 (0.54; 0.73) | 0.61 |
| **High-Intensity Metabolic Power Distance Over (HMD, m)** | -3.86 (-10.6; +1.64) | 13.4 (10.3; 16.6) | 0.72 (0.64; 0.67) | 0.55 |

## Discussion

According to this study, the average heart rate during matches was 82% of the maximal heart rate, greater than the ACSM standard [25]. This implies that soccer may be an efficient aerobic training strategy to enhance physiological features [26]. Furthermore, the average heart rate recorded in this study corresponds to earlier studies on the workloads of recreational soccer players [2]. When the match was duplicated, the heart rate readings had high reliability. Our findings support recent research on heart rate reliability in recreational soccer throughout four x four games [9].

In professional soccer, GPS technology is routinely utilized to evaluate environmental stress variables [15]. In our study, all variables were found to have high to exceptional reliability ratings. Our findings show that all external load factors are very reliable.

The data on soccer for health cannot be compared to previous data on the same issue. However, it may be compared to the dependability statistics of five-a-side soccer small-sided games in soccer, especially four vs. four games played for 7 minutes on a pitch size of 40×34 meters [9]. Additionally, the findings of this study closely reflect those of Stevens *et al.* [9], with practically similar scores. This study backs up prior studies on professional soccer players, which showed that repeated five-a-side soccer small-sided games give reliable external workload parameters. This validates using four-by-four recreational soccer games as a medical therapy stimulus.

Prior studies have demonstrated that GPS affects recreational soccer; shorter periods lead to higher total and higher distance traveled at high speeds [27, 28]. Nonetheless, the overall distance remains constant throughout the many formats examined. Several factors could explain variations in players' responses to temporal movement. Players may experience higher levels of neuromuscular fatigue in a two-minute contest than in a one-minute, thirty-second encounter. It has been demonstrated that intramuscular acidosis or potassium buildup in the muscle interstitium might be linked to tiredness during high-intensity competition [29]. Soccer players normally need 65 to 75 seconds on average to recover between fast runs during the competition [30]. Repeated sprint investigations indicate that this amount of time is adequate for PCr synthesis and muscle reoxygenation [31, 32]. However, longer wait periods can cause players to adopt pacing methods, which would lower the external load because they would be aware of how long the wait would be and would therefore be self-pacing [33]. However, switching from offense to defense during the shorter defensive phase may result in aggressive play after winning the ball, increasing external pressure.

The study considers typical external load statistics such as relative speed and total distance, metabolic parameters and power, and the acceleration of high metabolic demands. Changes in direction, brief shuttle runs, and accelerations all substantially influence the exercise's energy expenditure [34]. Additionally, estimated metabolic power, such as acceleration counts, may be more effective than heart rate alone in identifying differences in locomotor performance. As a result, research findings are currently lacking, so this research can contribute to a better understanding of energy expenditure in recreational soccer [35].

This study has to be acknowledged for several limitations: The effects of gaming could not be investigated concurrently with the weekly external GPS data collection. Matches are the weekly event with the largest load; hence they should also be

considered [36]. The study only lasted two weeks because of time restrictions in recording the obtained data. Most comparable research used observation periods ranging from two seasons to six weeks [37-41]. Shorter studies do, however, also exist. Thorpe *et al.* [36] examined the impact of GPS on soccer over 17 days as one example. Furthermore, the high variability of VO2max, HRmax, total distance, decelerations and accelerations executed, metabolic power, relative velocity, high-speed running, and high-intensity metabolic power distance during recreational soccer may also be to blame, even though the differences were statistically significant [28]. Thus, these aspects should be taken into account in future research. This data cannot be extended to other forms because only formats with an offensive and defensive advantage leisure soccer seven vs. seven players' seal. Subsequent studies could examine how GPS affects recreational soccer with numerical restrictions or lowers numerical performance, as well as if it is appropriate for the demands of a soccer match.

## Conclusion

Recreational soccer improves the physiological parameters and decreases the risk of injuries in adult males.

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**Ethical Permissions**: This study was approved by the Committee of Ethics in Negeri Padang University (EC.2022.202). All methods were performed by the declaration of Helsinki. After explaining the objectives of the research, written informed consent was obtained from all participants. They were also ensured of the confidentiality of data and made aware of the right to withdraw from the study.

**Conflicts of Interests**: The authors declare no conflict of interest in this study.

**Authors' Contribution**: Aldha Yudi A (First Author), Introduction Writer (25%); Rohmansyah NA (Second Author), Methodologist/Main Researcher/Discussion Writer/Statistical Analyst (25%); Oktavianus I (Third Author), Discussion Writer (25%); Madarsa NI (Fourth Author), Introduction Writer/Discussion Writer (25%)

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