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Effect of Different Frequency of Recreational Soccer on Health Indices of Collegiate Youth

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Abstract

Background: Sedentary lifestyles among youth are associated with increased risks of obesity and cardio metabolic diseases. Recreational soccer, as a non-competitive and enjoyable physical activity, may offer a practical intervention to improve multiple health indices in untrained youth. However, the optimal frequency of participation for maximizing these benefits remains unclear.

Objective: This study examined the effects of different frequencies of recreational soccer participation on body composition, cardiovascular health, flexibility, and physical performance in untrained collegiate youth.

Methods: Fifty-six collegiate students (aged 17–21) with at least one year of recreational soccer experience were randomized into four groups: Control, 1 day/week (1DPW), 2 days/week (2DPW), and 3 days/week (3DPW) of small-sided recreational soccer games for eight weeks. Health indices assessed pre- and post-intervention included fat mass, fat-free mass (FFM), forced vital capacity (FVC), blood pressure, flexibility (sit-and-reach test), explosive strength (vertical jump), sprinting speed, and heart rate. Data were analysed using mixed ANOVA with post hoc tests.

Results: Higher soccer frequency (3DPW) significantly increased FFM and improved vertical jump and sprint performance compared to lower frequencies and control ($p < 0.05$). Flexibility improved significantly in the 2DPW and 3DPW groups, while minimal changes were observed in the 1DPW and control groups. Fat mass reduction was most pronounced in the 1DPW and 2DPW groups, suggesting a benefit of moderate frequency for fat loss, likely due to optimal recovery and session intensity. Systolic and diastolic blood pressure decreased significantly across all intervention groups, with no additional benefit observed beyond 2DPW. No significant changes were found in FVC or heart rate across groups.

Conclusion: Recreational soccer is an effective strategy for improving body composition, flexibility, cardiovascular health, and physical performance in untrained youth. Moderate participation frequencies (1–2 days/week) yield optimal fat reduction and flexibility gains, while higher frequencies (3 days/week) further enhance muscle mass and athletic performance. These findings support the implementation of personalized, enjoyable physical activity regimens to promote youth health and prevent lifestyle-related diseases.

Keywords: Recreational soccer, youth health, physical activity, training frequency, body composition, flexibility, cardiovascular fitness, sedentary behaviour.

Introduction

Youth health is significantly influenced by physical activity and sports, offering multifaceted benefits that extend beyond physical well-being. Regular physical activity is associated with improvements in mental health, including reduced symptoms of depression and anxiety(Cook, Li, & Heinrich, 2014) and enhanced social and emotional well-being, particularly among at-risk youth(Lubans, Plotnikoff, & Lubans, 2012). Participation in sports provides positive developmental opportunities, fostering resilience and promoting cultural engagement, as seen in programs designed for aboriginal youth (Mark et al., 2015; Leapetswe et al., 2022). Longitudinal studies further demonstrate that physical activity during adolescence is linked to lower cardiometabolic risk in adulthood (John et al., 2018), underscoring the critical role of active lifestyles in preventing non-communicable diseases (Avery et al., 2019).

However, a growing concern is the prevalence of sedentary lifestyles among youth, characterized by prolonged sitting and increased screen time. These behaviors are associated with negative health outcomes, including obesity and cardiometabolic diseases (Saunders & Vallance, 2017). A study by (Sisson et al., 2010) highlighted the contribution of low physical activity and sedentary leisure activities to rising rates of overweight and obesity in youth. Zhu et al., (2017) found variations in sedentary behaviour prevalence across different populations, with boys and urban residents exhibiting higher rates in China. Sedentary time in children can range

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from 3.2 to 9.2 hours per day (Souhail et al., 2022), posing a significant health risk, as it is linked to negative behavioural outcomes and may predispose individuals to sedentary lifestyles later in life (Kelly & Fitzsimons, 2019; Sander et al., 2010).

Recreational soccer can be defined as the practice of soccer without the existence of a competitive objective within the framework of a federated competition or a license for its practice, encompassing only the practice of soccer in a free form and with recreational or health purposes (Castillo-Bellot, Mora-Gonzalez, Fradua, Ortega, & Gracia-Marco, 2019) . Bangsbo et al. (2008) shown that playing football recreationally helps untrained men's body composition, cardiovascular health, and aerobic fitness. Furthermore, it has been demonstrated that playing recreational football improves middle-aged and older persons' health outcomes (Hao et al., 2018), and may improve blood pressure and heart-rate markers (Filipe Manuel et al., 2022). In addition to its health benefits, recreational football improves long-term commitment to physical activity by promoting social connection and a sense of belonging. (Israel et al., 2019).

The impact of recreational soccer on body composition has been documented in several studies. Milanović et al. (2015) found that amateur football players can improve their fat-free mass and reduce body fat. Further, Clemente et al. (2022) shown beneficial impacts on paediatric populations strength, power, speed, change of direction, and aerobic capacity. Bangsbo et al (2008) discovered that regular participation in recreational soccer can improve cardiovascular fitness and contribute to the reduction of fat mass. Recreational soccer not only shows positive effect on body composition but also shows significant reduction in blood pressure and reduction in heart rate (Bangsbo et al., 2008). However, the optimal frequency of recreational soccer participation to maximize these benefits remains unclear, highlighting the importance of determining appropriate exercise regimes for untrained youth. Given these potential benefits, this study aims to investigate the effects of different frequencies of recreational soccer programs on the health indices of untrained youth.

Materials and Methods

Participants

Fifty-Six collegiate level students were recruited and completed the study (aged: 21±1.5, height: 153±2.75, body mass:42±2.1). All participants were actively engaged in recreational soccer. The inclusion criteria required participants to (1) have a minimum of one year of recreational soccer experience, (3) be youth (17-21 years), and (3) be injury-free with no major injuries in the past 6 months. The participants were explained the details of the study and the risks associated with the study. Thereafter, the participants signed informed consent forms.

Experimental Design

The study utilized a Randomized Control design. Participants completed two familiarization sessions and two actual experimental testing sessions (Pre and Post interventions) to examine the effects of the recreational soccer on health Indices of sedentary youth. During the familiarization sessions, the anthropometric characteristics were recorded. In the experimental sessions, the baseline data were recorded which was followed by the warm-up and Small-Sided Games (SSG)

The control group were prohibited from the participating, whereas the experimental group performed SSG with varied frequencies (I.e 3 Days per week, 2 Days per week and 1 Days per week).

Conditioning Protocols

The training schedule used in the study are presented in Table 1. The experimental groups performing 1 day, 2 days and 3 days per week of a recreational soccer were periodized keeping all the objectives of sports training in mind. The load was gradually increased over weeks by increasing the duration of the sessions ranging between 40-60 minutes per session (Milanović et al., 2015).

Table: - 1

Week	Duration of the Session (Work-Rest-Work in Minutes)
First	20-10-20
Second	22-10-22
Third	24-10-24
Fourth	26-10-26
Fifth	28-10-28
Sixth	30-10-30
Seventh	32-10-32
Eight	34-10-34

Data Collection

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Body Composition (Fat Mass and Fat Free Mass)

The ACCUNIQ BC300 Body Composition Analyzer (SELVAS Healthcare, Korea) uses bioelectrical impedance analysis with an eight-point electrode system to measure fat mass (FM) and fat-free mass (FFM) segmentally and whole-body in kilograms. Participants fasted and avoided exercise for two hours before testing. Studies confirm the BC300's accuracy and reliability compared to Dual Xray Absorptiometry, especially in obese adults (Zhou, Höglund, & Clyne, 2019).

Forced Vital Capacity

Forced vital capacity (FVC) was measured via spirometry following standardized guidelines, including pre-test abstinence from smoking, food, and bronchodilators. Trainees used a nose clip, sat upright, and performed at least three forceful exhalations into a calibrated spirometer. Results, recorded in liters or milliliters, adhered to ATS/ERS standards (Miller et al., 2005).

Blood Pressure (Systolic and Diastolic)

Blood pressure was measured using a digital sphygmomanometer after participants rested for five minutes. The cuff was placed at heart level, and three readings were taken, each separated by a one-minute rest. Measurements were recorded in mmHg to the nearest 2 mmHg. Digital sphygmomanometers are validated for accuracy (Stergiou, Yiannes, & Rarra, 2006)

Flexibility Test

The sit-and-reach test, a widely used measure of flexibility, involves sitting with legs straight, feet against a box, and reaching forward without bending the knees. The distance reached is recorded to the nearest 0.5 cm, with at least three attempts for reliability. This test primarily assesses lower back and hamstring flexibility (Holt, Pelham, & Burke, 1999).

Explosive Strength Test

The My Jump app, available for iPhone, is a reliable tool for measuring squat jump performance using the device's accelerometer. Trainees perform a vertical jump from a squat position, and the app records flight time and calculates jump height in centimetres, providing instant feedback on performance metrics such as jump height, flight time, and power output. Research has shown that the My Jump app is both valid and reliable compared to force plates (Balsalobre-Fernández, Glaister, & Lockey, 2015).

Heart Rate

Heart rate was continuously monitored during exercise using a Polar heart rate monitor, a non- invasive and reliable device (Gillen & Gibala, 2014; Gillinov et al., 2017). Participants completed a health screening and avoided caffeine and strenuous activity for 24 hours prior. Data were analysed statistically to assess cardiovascular response (Gillen & Gibala, 2014).

Sprinting Speed

Sprinting speed was assessed using the My Sprint app on an iPhone, following a standardized protocol including informed consent, health screening, a 10-minute warm-up, and three 40-meter maximal sprints. Times were recorded and analysed to calculate average speed. This method is widely used for evaluating athletic performance ((Lockie, Schultz, Callaghan, Jeffriess, & Berry, 2013; Romero-Franco et al., 2017).

Statistical Analysis

Data are presented as mean± standard deviations (SD). Differences in Pre and Post Tests between the Four interventions (I.e. 3DPW,2DPW,1DPW and Control) were assessed by Mixed ANOVA with Least Significance Difference (LSD) post hoc test. Practical significance was assessed by calculating Co-hen d and interpreted as trivial (< 0.2), small (0.2–0.5), medium (0.5–0.8) and large (> 0.8). Random errors were interpreted as good, moderate and modest to poor

Results

Body Composition (Fat Mass and Fat Free Mass)

The Shapiro-Wilk test showed Fat-Free Mass data were normally distributed (all $p > 0.05$), and Levene's test confirmed homogeneity of variances across groups ($p = 0.38$). ANOVA revealed a significant group effect on Fat-Free Mass, $F(3,48) = 3.78$, $p = 0.02$, partial eta squared = 0.19, indicating differences between groups (Control, 1DPW, 2DPW, 3DPW). The main effect of time was marginally significant, $F(1,48) = 3.94$, $p = 0.05$, partial eta squared = 0.08. The group × time interaction was not significant, $F(3,48) = 0.94$, $p = 0.43$. Only the 3DPW group showed significantly higher Fat-Free Mass compared to the Control group (p-adj = 0.0147). No other groups differed significantly, suggesting intervention frequency is key to increasing Fat-Free Mass (Ref. Figure:- I Fat-Free Mass).\

The Shapiro-Wilk test confirmed normality of fat reduction data (all $p > 0.05$), and Levene's test supported homogeneity of variances ($p = 0.08$). A Mixed ANOVA showed significant main effects of Group ($p = 0.002$) and Time ($p = 0.005$), and a significant Group × Time interaction ($p = 0.012$), indicating fat reduction varied by group over time. Tukey's HSD revealed the 3DPW group had significantly less fat reduction than 1DPW and 2DPW groups, while the Control group did not differ significantly from others. Thus, 1DPW and 2DPW regimens were more effective for fat reduction than 3DPW (Ref. Figure I Fat Mass).

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Figure I:- Pre and Post Test of Fat Free Mass and Fat Mass ***Forced Vital Capacity***

Levene's test ($p = 0.98$) confirmed equal variances in Forced Vital Capacity (FVC) across all groups, meeting the homogeneity assumption. The Shapiro-Wilk test ($p = 0.78$) indicated the FVC data were normally distributed. Mixed ANOVA revealed no significant effects of Group ($F(3,24) = 1.39$, $p = 0.27$, $np^2 = 0.15$), Time ($F(1,24) = 0.28$, $p = 0.99$, $np^2 = 0.28$), or their interaction ($F(3,24) = 0.84$, $p = 0.48$, $np^2 = 0.10$), despite a medium effect size for Group. Thus, no significant differences in FVC were observed (Ref. Figure II).

Figure II:- Pre and Post Test of Vital Capacity *Blood Pressure (Systolic and Diastolic)*

The Shapiro-Wilk test (pre: $p = 0.5092$; post: $p = 0.1300$) and Q-Q plots confirmed normality of systolic blood pressure data for both pre and post conditions. Levene's test ($p = 0.5818$) indicated equal variances across groups, satisfying homogeneity assumptions. Mixed ANOVA showed a significant reduction in systolic blood pressure over time ($F(1,48) = 7.3873$, $p = 0.0091$), but no significant interaction between group and time ($F(3,48) = 0.9397$, $p = 0.4289$), indicating similar changes across all groups (Ref. Figure III Systolic Blood Pressure).

The Shapiro-Wilk test (pre: $p = 0.274$; post: $p = 0.987$) and Q-Q plots confirmed normality of systolic blood pressure data, while Levene's test ($p = 0.785$) indicated equal variances across groups. Mixed ANOVA revealed a significant interaction between time and group ($F = 245.50$, $p \approx 3.87\times10^{-18}$, $\eta^2 = 0.968$), and a significant time effect ($p \approx 1.38\times10^{-23}$), but no significant group effect ($p = 0.814$). Post-hoc analysis showed no significant difference between 2DPW and 3DPW groups ($p = 1.0$), suggesting intervention frequency increase did not affect diastolic pressure change (Ref. Figure III Diastolic Blood Pressure).

Figure III- Pre and Post Test of Systolic and Diastolic Blood Pressure

Explosive Strength

The Shapiro-Wilk test ($p = 0.0846$) confirmed normality, and Levene's test ($p = 0.9150$) supported homogeneity of variances for Vertical Jump across groups. Mixed ANOVA showed a significant Group × Time interaction ($F(3,24) = 12.788$, $p < 0.05$, $\eta^2 = 0.615$), indicating differing changes in Vertical Jump performance over time among groups. The 3DPW group improved most (pre: 35.84 cm, post: 37.14 cm), while Control slightly declined. Main effects were not significant. Post-hoc tests suggest three days per week training may enhance vertical Jump, though larger samples are needed (Ref. Figure IV Vertical Jump).

Figure IV- Pre and Post Test of Vertical Jump

Sprinting Speed

The Shapiro-Wilk test ($p = 0.3036$) and Q-Q plots confirmed normality of sprint times, while Levene's test ($p = 0.8271$) showed homogeneous variances across groups. Mixed ANOVA revealed no significant main effect of Group ($p = 0.96$), but a significant main effect of Time ($p < 0.001$, $\eta p^2 = 0.98$) and a significant Group × Time interaction ($p < 0.001$, $\eta p^2 = 0.97$). Sprint times improved most in the 3DPW group (-0.364s), followed by 2DPW (-0.231s), 1DPW (-0.156s), while the Control group slightly declined (+0.027s), indicating higher training frequency led to greater sprint improvements (Ref. Figure IV Sprinting Speed).

Figure IV- Pre and Post Test of Sprinting Speed

Flexibility Test

Sprint times and flexibility scores were normally distributed with homogeneous variances (Shapiro-Wilk $p > 0.05$; Levene's $p = 0.81$). Mixed ANOVA showed a significant main effect of Time ($F(1,52) = 21.95$, $p < 0.001$, $\eta p^2 = 0.297$), but no main effect of Group ($F(3,52) = 1.98$, $p = 0.128$). A significant Group × Time interaction ($F(3,52) = 6.61$, $p < 0.001$, $\eta p^2 = 0.276$) indicated that 2DPW and 3DPW groups improved flexibility by 7.34 and 7.21 units, respectively, both significantly more than 1DPW (0.22 units) or Control (-0.41 units) (Ref. Figure V Flexibility) .

Figure V- Pre and Post Test of Flexibility

Heart Rate

The Shapiro-Wilk test confirmed normality for Heart Rate data ($p = 0.98$), and Levene's test indicated homogeneous variances across groups ($p = 1.80$). No significant interaction between Group and Time was found ($p = 0.327$), suggesting that changes in heart rate from pre- to post- intervention did not differ among Control, 1DPW, 2DPW, or 3DPW groups. These results indicate that the intervention had no statistically significant effect on heart rate, with consistent values observed regardless of group assignment or time point (Ref. Figure VI Heart Rate)

Figure VI - Pre-Post Test of Heart rate

Sprinting Speed	Heart Rate	Flexibility	Fat Mass	Fat Free Mass	Diastolic Blood Pressure	Vital Capacity
8.89	67.71	12.6	55.13	55.8	68	4.319
8.87	67.57	14.17	55.92	55.2	70.43	4.063
8.83	71.86	13.49	53.63	53.06	68.86	4.135
8.77	66.57	19.18	59.16	59.3	68.86	4.857
8.73	73.29	14.38	53.38	53.17	65.71	4.055
8.58	63.43	13.36	54.52	54.1	66.57	4.313
8.52	61.29	18.19	54.52	54.5	64.57	4.584
8.76	65.57	15.68	55.14	55.71	68.9	4.557
-1.79	8.24	14.12	-3.17	-4.71	-3.36	-6.11
-3.26	-6.13	-5.716	-2.5	-1.99	-5.48	6.15
-3.51	-14.71	34.84	1.65	2.71	-6.23	10.85
-0.11	-1.5	-18.24	-6.79	-6.05	0.4	-6.17

Systolic Blood Pressure	112	112.57	111.14	111.43	107.57	106.57	111.14	107.57	-3.95	-5.33	0	-3.46
Vertical Jump	4.35	4.18	4.2	4.95	4.27	4.19	4.48	4.51	-1.98	0.29	6.66	-8.96
Vital Capacity	4.319	4.063	4.135	4.857	4.055	4.313	4.584	4.557	-6.11	6.15	10.85	-6.17
Variables	**Pre 1DPW**	**Pre 2DPW**	**Pre 3DPW**	**Pre Control**	**Post 1DPW**	**Post 2DPW**	**Post 3DPW**	**Post Control**	**Percentage Change_1DPW**	**Percentage Change_2DPW**	**Percentage Change_3DPW**	**Percentage Change Control**

Table 2 :- Measurement of Pre-Post Test and Percentage Changes of the Health Indices. Discussion

The study found a significant main effect of training frequency on fat-free mass (FFM), indicating that groups with different resistance training frequencies (Control, 1DPW, 2DPW, 3DPW) showed significant differences in FFM, with a moderate effect size. This supports the idea that higher training frequencies can enhance muscle protein synthesis and FFM gains due to more frequent stimulation of muscle fibre (Schoenfeld, Grgic, & Krieger, 2019). However, the main effect of time on FFM approached but did not reach statistical significance, suggesting that the duration of the intervention may have been too short for measurable changes in FFM to occur, a trend noted in previous research (Kennedy et al., 2024). The lack of a significant group-by-time interaction indicates that while baseline FFM differed by group, the rate of change over the intervention did not vary significantly by training frequency, aligning with findings that adaptations may plateau after reaching a certain training threshold. Secondly, the findings also indicate that recreational soccer played one or two days per week (1DPW, 2DPW) leads to significantly greater fat reduction compared to three days per week (3DPW), possibly due to higher session intensity and better recovery (Karp et al., 2019). The reduced effectiveness in the 3DPW group may result from accumulated fatigue and diminished motivation, which can lower exercise quality. Interestingly, the control group showed similar fat reduction to all intervention groups, suggesting that only the optimal frequency of soccer yields substantial benefits. These results highlight the importance of personalized exercise regimens, as individual responses to frequency and intensity can vary (McGuire & Wing, 2021). Furthermore, the social engagement inherent in recreational soccer may enhance adherence and motivation, contributing to the effectiveness of the 1DPW and 2DPW regimens (Smith et al., 2020).

The current findings suggest no significant differences in Forced Vital Capacity (FVC) among groups with varying frequencies of recreational soccer participation. Several factors may explain this outcome. Firstly, while soccer is known to improve cardiovascular fitness and muscular strength, the typical intensity and duration of recreational play may not be enough to induce substantial changes in FVC across different training frequencies (Krustrup et al., 2018). Additionally, individual differences such as baseline fitness, age, sex, and health status can influence exercise responses, potentially masking group-level effects (Milanović, Pantelić, Čović, Sporiš, & Krustrup, 2015). There may also be a ceiling effect, where participants already possess optimal lung function due to regular activity, making further improvements difficult to detect (Krustrup et al., 2009). Methodological factors, such as the timing of FVC assessments and the absence of specific respiratory muscle training, could also impact results (Ozmen et al., 2017). These findings suggest that while recreational soccer offers broad fitness benefits, it may not significantly enhance lung function unless combined with targeted respiratory training. Recreational soccer significantly reduces systolic blood pressure (SBP) in individuals with hypertension, as shown by a strong main effect of time regardless of group differences. The significant time × group interaction indicates individual variability, possibly due to baseline fitness or training intensity, consistent with meta-analyses showing soccer's superior impact on cardiorespiratory fitness (Mohr et al., 2014). Soccer's inclusive, enjoyable nature promotes sustained participation, enhancing long-term cardiovascular health and quality of life (Krustrup et al., 2012). A significant reduction in diastolic blood pressure (DBP) was observed across all groups, indicated by a strong time effect, aligning with literature on the benefits of regular physical activity (Cornelissen & Smart, 2013; Whelton et al., 2018). This highlights the importance of both timing and frequency in intervention outcomes (Boulé et al., 2019). However, increasing soccer frequency from two to three days per week did not yield additional DBP reduction suggesting a possible threshold effect (Haskell et al., 2020)1. Factors such as physiological adaptation, adherence, and individual variability may explain this plateau (Gordon et al., 2021; Sullivan et al., 2019; Bouchard et al., 2012). The study demonstrates that structured recreational soccer training significantly improves vertical jump performance in untrained youth, with training frequency playing a key role. Participants training more frequently showed the greatest gains, while those in the control group declined, suggesting that increased training sessions enhance athletic outcomes by promoting skill development and physiological adaptation. Recreational soccer's blend of aerobic and anaerobic activities, including high-intensity sprints and jumps, boosts muscular power and overall fitness. Consistent training frequency is vital for neuromuscular adaptation, as highlighted by Reis et al. (2013) and (Krustrup, Dvorak, Junge, & Bangsbo, 2010), who reported cardiovascular and muscular benefits. The sport's varied movements also enhance strength, coordination, and motor control, all crucial for vertical jump performance. The study found no significant differences in heart rate across recreational soccer groups (1DPW, 2DPW, 3DPW, Control), suggesting a complex relationship between exercise frequency and heart rate. This may be due to the variable intensity and duration of recreational soccer, which might not have been sufficient to induce measurable cardiovascular changes. Research indicates that higher intensity training is needed to significantly impact heart rate and cardiovascular fitness (Høigaard et al., 2022). Individual differences in baseline fitness could also dilute group differences, as more active participants may show less pronounced changes (Kriemler et al., 2024). Additionally, the timing of measurements and the relatively short study duration may have limited the ability to detect changes, as long-term participation is often required to see improvements in cardiovascular markers.

Conclusion

The study highlights the effects of recreational soccer and its frequency on various health and fitness outcomes. Higher training frequencies were associated with greater gains in fat-free mass and vertical jump performance, supporting the value of frequent, structured activity for muscle development and athletic improvement. However, fat reduction was most pronounced at moderate soccer frequencies (1–2 days per week), likely due to optimal recovery and session intensity, while increased frequency did not yield additional benefits for blood pressure or heart rate. The lack of significant changes in forced vital capacity and heart rate suggests that recreational soccer alone may not suffice for improvements in these areas without targeted interventions or longer durations. Overall, the findings underscore the importance of personalized exercise regimens, considering individual variability and the potential for adaptation plateaus. Recreational soccer, particularly at moderate frequencies, offers substantial benefits for body composition, cardiovascular health, and physical performance, especially when enjoyment and adherence are prioritized.

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