

EFFECTS OF DIFFERENT SMALL-SIDED FOOTBALL TRAINING FREQUENCIES ON HEALTH-RELATED FITNESS IN INCARCERATED ADULTS IN SERBIA

Kristina Mladenović¹, Danijela Živković¹, Anđela Došić¹, Tijana Purenović-Ivanović¹,
Nenad Đokić¹, Saša Pantelić¹

¹Faculty of Sport and Physical Education, University of Niš, Serbia

ABSTRACT

This study examined the effects of a 12-week small-sided football program performed at two different weekly frequencies on health-related fitness in 60 Serbian male incarcerated individuals aged 18–50 years. Participants were randomly allocated to three groups: EG1 (n=20), completing three training sessions per week; EG2 (n=20), completing two sessions per week; and a control group (CG, n=20). Pre- and post-intervention assessments included body composition, cardiorespiratory fitness (VO2max), muscular endurance, and flexibility. Body mass decreased in EG1 (–3.7 kg, $p<0.001$) and EG2 (–1.87 kg, $p=0.020$), while body fat percentage decreased in both groups (EG1: –3.0%, $p=0.032$; EG2: –1.3%, $p<0.001$). Muscle mass increased significantly in EG2 (+3.5 kg, $p<0.01$). VO2max increased from 45.59 ± 7.12 to 46.69 ± 6.98 ml/kg/min in EG1 ($p=0.002$) and from 40.75 ± 6.85 to 43.50 ± 6.40 ml/kg/min in EG2 ($p<0.001$). Muscular endurance improved moderately, whereas flexibility gains were minimal. ANCOVA confirmed significant adjusted between-group effects for several outcomes. Both training frequencies produced positive effects on health-related fitness, with improvements in cardiorespiratory fitness and body composition, accompanied by improvements in muscular fitness and limited impact on flexibility. These findings suggest that structured small-sided football programs may represent a practical strategy for promoting health-related fitness in correctional settings. However, the present findings do not establish that three weekly sessions are superior to two.

Key words: small-sided football, inmates, body composition, cardiorespiratory fitness, muscular endurance.

Corresponding author

Kristina Mladenović
mladenovickika@gmail.com

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INTRODUCTION

Incarcerated populations exhibit elevated rates of chronic disease, cardiovascular risk factors, and mental disorders compared with the general population (Gates & Bradford, 2015; Lancia, Tomassini, Scendoni, Fanella, Gili, Gambelunghe et al., 2025). This elevated health burden is compounded by insufficient physical activity and sedentary behaviour, which contribute substantially to chronic non-communicable disease load and adverse cardiometabolic outcomes (Ekelund, Tarp, Ding, Sanchez-Lastra, Dalene, Anderssen et al., 2026; Suutari-Jääskö, Parkkila, Vähänikkilä, Tulppo, Perkiömäki, Huikuri, & Ukkola, 2026). Accordingly, health-related physical fitness, including cardiorespiratory endurance, muscular function, flexibility, and body composition, is closely associated with health status and quality of life (Bahls, Kavousi, Bakker, Kränkel, Baurecht, Timmermans et al., 2025). At the beginning of 2023, 10,787 incarcerated individuals were held in correctional facilities in Serbia, corresponding to a rate of 162 prisoners per 100,000 inhabitants, which is substantially higher than the European average of 124 (Aebi, & Cocco, 2024). At the same time, the operation of the prison system entails substantial public expenditure, with annual costs estimated at approximately €128 million, or roughly €33 per day per incarcerated individual (Aebi, & Cocco, 2024). Considering that convicted individuals re-enter the general population upon release, the health status of prison populations constitutes a broader public health challenge, as chronic diseases prevalent in this population can generate additional healthcare and economic costs for society (Enggist, Møller, Galea, & Udesen, 2014). Institutional conditions, limited mobility, and predominantly sedentary behavior patterns within correctional facilities (Kraft, Gröben, & Wicker, 2025) further exacerbate adverse health outcomes (Stephenson, Leaman, O'Moore, Tran, & Plugge, 2021). Although international standards governing prison management require correctional institutions to provide inmates with regular opportunities for physical exercise and recreational activities as an integral component of humane detention conditions (United Nations, 2015), its systematic and programmatically structured implementation is often insufficient, and empirical data on its effects remain limited, particularly in national contexts such as the Republic of Serbia.

Over the past decade, sport has increasingly been recognized as a public health intervention within the penal system, with the potential to simultaneously improve physical health, support psychosocial adaptation, and facilitate reintegration processes (Herbert, Plugge, Foster, & Doll, 2012; Colinso, Hariasz, Konieczko, Trzaskoma, & Kosendiak, 2025). Among various physical activity models, small-sided football has emerged as a functionally effective and organizationally feasible form of intervention (Federici, Valentini, Ceccarini, & Lucertini, 2015). Recent systematic evidence also indicates that small-sided soccer interventions can improve cardiorespiratory fitness and selected components of health-related fitness, although the magnitude of effects may vary according to population characteristics and intervention design (Gómez-Álvarez, Boppre, Hermosilla-Palma, Reyes-Amigo, Oliveira, & Fonseca, 2024). Its implementation has been shown to produce significant improvements in $\text{VO}_{2\text{max}}$, muscular strength, metabolic profile, and body composition across diverse

population groups (Bennike, Andersen, & Krusturup, 2024). Nevertheless, despite the proven potential of small-sided football in the general population, systematic studies examining its effects within correctional settings are lacking, particularly in Southeastern European countries. Existing research is limited in scope, often lacks clearly defined health outcomes, and does not focus on components of health-related physical fitness. Furthermore, evidence regarding the optimal weekly training frequency required to achieve meaningful health benefits in correctional settings remains scarce. This gap in the literature hinders evidence-based decision-making in the development of public health programs within the penal system.

Given the inclusion of two different weekly training frequencies, the study also allows exploratory analysis of potential frequency-related (dose-related) effects of small-sided football. Therefore, the aim of this study was to evaluate the effects of a structured small-sided football program on the components of health-related physical fitness in incarcerated individuals in Serbia, with the intent of providing a scientifically grounded basis for integrating sport-based interventions into strategies for health promotion in correctional facilities.

METHOD

Study participants

The sample consisted of 60 male incarcerated individuals with a mean age of 35 ± 7 years (EG1: 34 ± 5 ; EG2: 34 ± 8 ; CG: 37 ± 9), sentenced to prison terms ranging from 10 to 30 years. Inclusion criteria were: absence of medical contraindications to moderate-to-high intensity physical activity, stable health status at the time of enrollment, and voluntary written consent to participate. Exclusion criteria included participants with acute cardiovascular, respiratory, or orthopedic conditions that could compromise the safety of testing or intervention procedures. Following a safety screening conducted by the facility security service, candidates underwent a systematic medical examination at the prison healthcare unit to assess overall health status. The final study groups were formed using stratification based on age, health status, and physical fitness to ensure balance and minimize variability between groups. Following stratification, participants were randomly allocated to three groups ($n=20$ per group): Experimental Group 1 (EG1; small-sided football program three times per week), Experimental Group 2 (EG2; small-sided football program twice per week), and a Control Group (CG; continuation of regular daily activities without an organized sports program). Only participants who attended at least 80% of the scheduled training sessions were included in the analysis, ensuring sufficient exposure to the intervention.

Study design and ethical considerations

This study was designed as a prospective, controlled intervention trial with parallel groups and repeated measurements (baseline–post intervention). It was conducted in a single correctional facility in the Republic of Serbia over a 12-week period.

The study was conceptualized in accordance with the principles of epidemiological intervention research (Smith, Morrow, & Ross, 2015). Prior to its implementation, approval was obtained from the Ministry of Justice of the Republic of Serbia (Approval No. 704-00-2/2023-03-170, from September 25th, 2023).

Measures and procedures

All measurements were performed at baseline and after 12 weeks. Chronological age was determined from the date of birth – the data collected from the facility records. Body height (BH, in 0.1 cm) was measured using a Martin anthropometer. Body composition was assessed via bioelectrical impedance analysis (Tanita TBF-300, Tanita Corporation, Tokyo, Japan), yielding body mass (BM, in 0.1 kg), body fat (BF%), fat-free mass (FFM, in kg), muscle mass (MM, in kg), and basal metabolic rate (RMR, in kcal). Cardiorespiratory fitness was assessed via the 20 m Shuttle Run test, converted to estimated $\text{VO}_{2\text{max}}$ (in ml/kg/min) using standardized equations (Tomkinson, Lang, Blanchard, Léger, & Tremblay, 2019). Flexibility was measured with the Sit-and-Reach test (SAR, in cm) (hamstring and lower back) (Ashok, 2008) and the Split test (ST, in cm) (maximal heel-to-wall distance in a lunge) (Luque-Siles, Gallego-Izquierdo, Jiménez-Rejano, de-la-Orden, Plaza-Manzano, López-Illescas-Ruiz et al., 2016). Abdominal muscular endurance was measured with the 30-second sit-up test (TL, number of repetitions) (Castro-Piñero, González-Montesinos, Mora, Keating, Girela-Rejón, Sjöström, & Ruiz, 2009). Muscular fitness was evaluated using the Countermovement Jump (CMJ, in cm) and Countermovement Jump with Arm Swing (CMJa, in cm) measured by the Optojump system according to the Bosco protocol (Bosco, Luhtanen, & Komi, 1983), with established validity and reliability (Markovic, Dizdar, Jukic, & Cardinale, 2004). All assessments were conducted by the same research team under standardized conditions following current physical fitness guidelines (Petrigna, Pajaujene, Delextrat, Gómez-López, Paoli, Palma, & Bianco, 2022).

Exercise protocol

Experimental groups participated in a 5v5 small-sided football program (4 field players + 1 goalkeeper) on a 20 × 40 m hard court. Each 60-minute session included warm-up (10 min), main session (game and specific exercises; 2 × 20 min), and cool-down with stretching, at moderate-to-high intensity (10 min). The sessions were planned as moderate-to-vigorous-intensity activities (60–80% HRmax), with exercise intensity monitored with rating-of-perceived-exertion measures (ACSM, 2007).

The control group did not engage in any organized physical activity during the study period.

Statistical analysis

The descriptive statistics [average value (Mean), standard deviation (SD), minimum (Min), maximum (Max)] were summarized for all variables. Prior to the statistical

analysis, the distribution of raw data sets was assessed using the Kolmogorov-Smirnov test (K-S) and demonstrated that all data had a normal distribution ($p>0.05$). Baseline between-group differences were assessed via one-way ANOVA. Intervention effects were evaluated using ANCOVA with baseline values as covariates, and repeated-measures ANOVA tested group $\times$ time interactions. Effect sizes were also calculated to quantify the magnitude of the observed differences. Cohen's d_z was reported for within-group comparisons, with values of 0.20, 0.50, and 0.80 conventionally interpreted as small, medium, and large effects, respectively. For ANCOVA effects, partial eta squared (η_p^2) was reported, with values of 0.01, 0.06, and 0.14 conventionally interpreted as small, medium, and large effects, respectively (Cohen, 1988). Within-group changes were analyzed with paired-samples t-tests. The level of significance was set at $p<0.05$, and the data were analysed using the Statistical Package for the Social Sciences, version 21.0 (IBM Corp., Armonk, NY, USA).

RESULTS

Table 1 presents descriptive statistics for all health-related fitness variables pre- and post-intervention. All values, both pre- and post-intervention, are reported as minimum, maximum, mean, and standard deviation for each variable. Further inferential analyses are presented in subsequent tables.

Table 1. Descriptive parameters of health-related fitness variables at baseline and final measurements

Variables	Baseline measurement			Final measurement		
	Min	Max	Mean $\pm$ SD	Min	Max	Mean $\pm$ SD
BH	166	195	180.82 $\pm$ 6.50	166	195	180.82 $\pm$ 6.50
BM	50.7	136.4	86.66 $\pm$ 14.44	53.4	126.6	85.84 $\pm$ 13.93
BF%	9.6	39.9	21.17 $\pm$ 5.73	9.8	33.2	20.45 $\pm$ 5.40
FFM	33.5	86.7	61.62 $\pm$ 10.27	32.6	86.3	58.97 $\pm$ 11.59
MM	9.1	46.5	20.47 $\pm$ 7.68	11.5	49.6	21.95 $\pm$ 7.36
RMR	1765	2834	1982.63 $\pm$ 375.14	1182	2762	2017.48 $\pm$ 291.26
VO ₂ max	24.6	58.6	42.28 $\pm$ 8.23	26.1	60.4	43.38 $\pm$ 8.47
SAR	21	62	46.88 $\pm$ 8.71	5	61	46.28 $\pm$ 10.43
ST	22	60	45.50 $\pm$ 8.95	28	62	46.33 $\pm$ 8.39
TL	9	39	28.23 $\pm$ 5.22	18	41	30.22 $\pm$ 5.41
CMJ	15.7	46.8	29.77 $\pm$ 6.76	18.8	46.2	31.62 $\pm$ 7.07
CMJa	20.8	55	37.09 $\pm$ 7.57	24.9	61.6	39.22 $\pm$ 8.81

Legend: Min– minimum; Max– maximum; Mean– average value; SD– standard deviation; BH– body height (cm); BM– body mass (kg); BF%– body fat percentage (%); FFM– fat-free mass (kg); MM– muscle mass (kg); RMR– resting metabolic rate (kcal); VO₂max– maximal oxygen consumption (ml/kg/min); SAR– sit-and-reach test (cm); ST– split test (cm); TL– trunk lift from supine position (number of repetitions); CMJ– countermovement jump (cm); CMJa– countermovement jump with arm swing (cm)

Table 2 presents pre- and post-intervention results for the three study groups, along with paired-samples t-test values and corresponding significance levels (p). Statistically significant effects were observed for body mass, body fat percentage, and muscle mass, as well as for cardiorespiratory fitness and flexibility assessed by the split test.

Table 2. Pre- and post-intervention differences in health-related fitness parameters

Variables Mean±SD	CG (n=20)				EG1 (n=20)				EG2 (n=20)			
	t	p	Cohen's d _z	Mean±SD	t	p	Cohen's d _z	Mean±SD	t	p	Cohen's d _z	
BM	pre	86.23±12.0	-1.718	0.102	0.384	91.21±12.68	5.309	<.001†	1.187 ¹	82.55±17.41	2.548	.020*
	post	89.33±14.1				87.52±11.92				80.68±14.75		0.570
BF%	pre	20.77±4.98	-2.395	.027*	0.536	23.66±6.48	2.31	.032*	0.517	19.07±4.88	4.619	<.001†
	post	22.92±5.5				20.65±4.89				17.77±4.74		1.033¹
FFM	pre	63.03±6.78	0.21	0.836	0.047	65.91±6.32	4.402	<.001†	0.984 ¹	55.94±13.65	1.499	0.150
	post	62.55±10.5				59.62±10.93				54.75±12.43		0.335
MM	pre	21.64±7.57	-0.775	0.448	0.173	19.48±6.85	0	1	0.000	20.29±8.74	-3.475	.003†
	post	22.6±7.32				19.48±5.97				23.78±8.28		0.777
RMR	pre	1991.5±220.93	0.124	0.903	0.028	2082.35±263.79	0.936	0.361	0.209	1874.03±543.74	-1.586	0.129
	post	1984.4±339.92				2048.4±217.19				2019.65±313.92		0.355
VO₂max	pre	40.5±6.92	1.089	0.290	0.244	45.59±8.56	-3.488	.002†	0.780	40.75±8.47	-6.095	<.001†
	post	39.97±6.85				46.69±8.81				43.5±8.64		1.363¹
SAR	pre	47.6±8.13	0.25	0.806	0.056	46.1±8.97	-1.241	0.23	0.277	46.95±9.38	1.1	0.285
	post	47.05±10.24				47.6±7.51				44.2±13.02		0.246
ST	pre	44.3±9.59	-2.52	.021*	0.563	44.45±9.81	1.071	0.297	0.239	47.75±7.25	-1.466	0.159
	post	46.4±9.68				43.75±8.85				48.85±5.73		0.328
TL	pre	28.15±3.59	-2.595	.018*	0.580	29.45±4.98	-3.717	.001†	0.831¹	27.1±6.63	-1.774	0.092
	post	30.35±4.61				31.45±5.07				28.85±6.34		0.397

Variables Mean±SD	CG (n=20)				EG1 (n=20)				EG2 (n=20)			
	t	p	Cohen's d _z	Mean±SD	t	p	Cohen's d _z	Mean±SD	t	p	Cohen's d _z	Mean±SD
CMJ	pre 29.02±5.98	-3.66	.002†	30.66±8.76	30.66±8.76	-1.081	0.293	0.242	29.63±5.29	-0.455	0.654	0.102
	post 32.97±7.38			31.86±8.13	31.86±8.13				30.05±5.49			
CMJa	pre 36.33±6.47	-1.42	0.172	0.318	36.5±9.01	-0.813	0.426	0.182	38.44±7.23	-3.642	.002†	0.814^L
	post 38.84±9.72				37.58±9.39				41.24±7.14			

Legend: CG– control group; EG– experimental group; n– number of participants; Mean– average value; SD– standard deviation; t– t-test value; p– level of significance; Cohen's d_z – effect size for pre–post changes; pre– pre-intervention/baseline measurement; post– post-intervention/final measurement; BM– body mass (kg); BF%– body fat percentage (%); FFM– fat-free mass (kg); MM– muscle mass (kg); RMR– resting metabolic rate (kcal); VO₂ max– maximal oxygen consumption (ml/kg/min); SAR– sit-and-reach test (cm); ST– split test (cm); TL– trunk lift from supine position (number of repetitions); CMJ– countermovement jump (cm); CMJa– countermovement jump with arm swing (cm)

* significant at p<0.05; † significant at p<0.01; L– large effect

Table 3 summarizes the ANCOVA results for health-related fitness variables following the small-sided football intervention. After adjustment for baseline values, significant group effects were identified for body mass, body fat percentage, muscle mass, VO₂max, and split test performance, whereas no significant group differences were found for the remaining variables (p>0.05).

Table 3. Effects of the small-sided football program on participants’ health-related fitness

Variable	F	Sig.	η_p^2
BM post	8.598	0.001†	0.235^L
BF% post	8.228	0.001†	0.227^L
FFM post	3.022	0.057	0.097
MM post	3.360	0.042*	0.107
RMR post	0.899	0.413	0.031
VO ₂ max post	14.719	<.001†	0.345^L
SAR post	1.044	0.359	0.036
ST post	4.497	0.015*	0.138
TL post	3.241	0.265	0.104
CMJ post	3.066	0.054	0.099
CMJa post	0.589	0.559	0.021

Legend: CG– control group; EG– experimental group; F– F value; Sig.– significance level; η_p^2 – partial eta squared as a measure of effect size for the group effect in ANCOVA; pre– pre-intervention/baseline measurement; post– post-intervention/final measurement; BM– body mass; BF%– body fat percentage; FFM– fat-free mass; MM– muscle mass; RMR– resting metabolic rate; VO₂max– maximal oxygen consumption; SAR– sit-and-reach test; ST– split test; TL– trunk lift from supine position; CMJ– countermovement jump; CMJa– countermovement jump with arm swing

* significant at p<0.05; † significant at p<0.01; L– large effect

DISCUSSION

The results of this study indicate that a small-sided football program has a measurable and statistically significant effect on cardiorespiratory fitness, with ANCOVA analysis confirming that this effect remains significant even after adjustment for baseline values, as well as a selective and variable effect on body composition components, with a partial impact on muscular fitness and flexibility among inmates. These findings are particularly relevant in the context of the prison population, which is characterized by an increased risk of cardiometabolic diseases due to pronounced

physical inactivity and limited opportunities for movement (Herbert et al., 2012). They underscore the effectiveness of a structured small-sided football program in incarcerated individuals and corroborate previous studies conducted in general population samples (Zouhal, Hammami, Tijani, Jayavel, de Sousa, Krstrup et al., 2020).

The experimental groups demonstrated a statistically significant reduction in body mass and body fat percentage, whereas the CG showed a tendency toward increased body mass (not statistically significant) and a significant increase in body fat percentage. ANCOVA confirmed a significant group effect for body mass ($p=0.001$) and body fat percentage ($p=0.001$), indicating a clear intervention effect. These changes likely reflect a negative energy balance resulting from increased energy expenditure during regular physical activity (Xu, Qi, Liu, Li, & Clemente, 2024). These findings are consistent with previous research (Enggist et al., 2014; Gates, & Bradford, 2015) indicating that a sedentary lifestyle in prison conditions is a significant risk factor for obesity and metabolic disorders. Differences were also observed between the experimental groups. Although EG1 exhibited a statistically significant decrease in fat-free mass according to the paired-samples *t*-test, ANCOVA did not confirm a statistically significant adjusted group effect ($p=0.057$), indicating that this isolated within-group change should be interpreted cautiously and does not provide evidence of a differential intervention effect. Because FFM was estimated using bioelectrical impedance analysis, the observed change may also partly reflect normal measurement and biological variability rather than a true loss of fat-free tissue. A significant increase in muscle mass in EG2 indicates that small-sided football may provide a sufficient training stimulus to promote favorable changes in muscular status, with a statistically significant adjusted between-group effect observed in the ANCOVA ($p=0.042$), while the concurrent decrease in body fat percentage reflects favorable changes in body composition.

Improvements in $VO_{2\max}$ in the experimental groups indicate a substantial cardiovascular adaptation to the football program (Zouhal et al., 2020). The EG1 group, training three times per week, maintained its initial higher level of cardiorespiratory fitness and demonstrated a significant improvement, while the EG2 group, training twice per week, showed a larger absolute increase from a lower baseline level. Intergroup differences may be interpreted according to the dose-response principle, whereby higher training frequency is generally associated with greater cumulative training load and potentially more pronounced physiological adaptations (Garber, Blissmer, Deschenes, Franklin, Lamonte, Lee et al., 2011). These findings are further supported by ANCOVA analysis ($p<0.001$), indicating that the overall between-group difference remained statistically significant after adjustment for baseline values. This pattern aligns with previous evidence showing that moderate- to high-intensity physical activity over 8–12 weeks can significantly increase $VO_{2\max}$ even in sedentary individuals (Helgerud, Engen, Wisløff, & Hoff, 2001; Krstrup & Bangsbo, 2015). The greater progress in the EG2 group may be explained by higher adaptive potential in participants with lower baseline fitness levels (Mann, Lamberts, & Lambert, 2014). The CG showed no statistically significant improvement, with a slight decline in

VO₂max reflecting the negative effects of a sedentary lifestyle, consistent with prior findings (Suutari-Jääskö et al., 2026). Unexpected improvements in certain tests in the CG suggest possible influences of uncontrolled variables, such as more engaged participation in daily activities or specific aspects of the prison environment (Waters, Reeves, Fjeldsoe, & Eakin, 2012).

The small-sided football program did not produce a statistically significant effect on static hamstring flexibility (sit-and-reach test), consistent with findings that dynamic physical activity without targeted stretching protocols has limited impact on passive range of motion (Bryant, Cooper, Peters, & Cook, 2023; Ingram, Tomkinson, d'Unienville, Gower, Gleadhill, Boyle, & Bennett, 2025). ANCOVA confirmed this result ($p=0.359$), showing no significant group effect. These results suggest that targeted stretching programs are necessary to achieve meaningful flexibility improvements. Conversely, although the paired-samples t-test indicated improvement among CG in the split test, which is not the case for the sit-and-reach test, ANCOVA revealed a significant group effect ($p=0.015$), indicating a subtle but statistically confirmed program effect on hip and groin flexibility (Konrad, Alizadeh, Daneshjoo, Anvar, Graham, Zahiri et al., 2024).

Effects on muscular endurance and explosive strength were inconsistent. Although the t-test indicated improvements in trunk flexion performance in CG and EG1, ANCOVA revealed no significant group effect ($p=0.768$), suggesting the absence of a clear intervention effect. This finding may indicate that the movement characteristics of small-sided football do not provide a sufficiently specific stimulus to elicit meaningful improvements in abdominal muscular endurance (Faude, Schnitker, Schulte-Zurhausen, Müller, & Meyer, 2013). This can be further explained by the specificity of the training program, as the intermittent nature of small-sided football does not provide continuous loading necessary for the development of local muscular endurance, nor does it include progressive overload characteristic of strength training (Kraemer & Ratamess, 2004). CMJ increased significantly only in the CG (t-test), whereas ANCOVA did not confirm a group effect ($p=0.054$), indicating the absence of a clear intervention effect; the observed within-group change may instead reflect test familiarization, day-to-day variability, or nonspecific neuromuscular adaptations rather than an effect of the small-sided football intervention (Markovic & Mikulic, 2010; Aslam, Habyarimana, & Bin, 2025).

Taken together, the present findings indicate that a structured small-sided football program can improve several components of health-related physical fitness in incarcerated adults within a relatively short intervention period. While the observed benefits were most pronounced for cardiorespiratory fitness and body composition, these outcomes are particularly relevant given the elevated burden of cardiometabolic risk factors in correctional populations. Because health-related fitness is closely associated with the prevention of chronic non-communicable diseases and overall functional health (Posadzki, Pieper, Bajpai, Makaruk, Könsgen, Neuhaus, & Semwal, 2020), the improvements observed in the present study may extend beyond individual fitness outcomes. From this broader correctional public health perspective, structured small-sided football may represent a feasible addition to prison health promotion

strategies, as it requires relatively simple organization while simultaneously engaging multiple components of physical fitness.

Nevertheless, the present findings should be interpreted in light of the study limitations. Study limitations include a small, homogeneous sample from a single institution, short intervention duration, and uncontrolled factors such as diet, spontaneous activity, and living conditions, which may introduce bias. Motivational influences and test-retest learning effects cannot be excluded. Future research should involve larger, diverse inmate populations across multiple correctional settings with long-term follow-up to determine whether improvements in physical fitness can be maintained over time and whether they translate into broader health, behavioral, or rehabilitation-related outcomes.

CONCLUSION

A 12-week structured small-sided football program led to significant improvements in cardiorespiratory fitness and body composition among incarcerated adults, with moderate benefits observed for muscle mass and selected measures of flexibility. Findings suggest that regular moderate-to-high intensity physical activity can effectively enhance health-related fitness in populations with limited access to exercise. Both training frequencies produced positive effects on several health-related fitness outcomes; however, the present findings are not sufficient to establish that three weekly sessions are superior to two.

The present findings support the implementation of structured small-sided football as a feasible, low-cost, and health-promoting intervention within correctional facilities, where opportunities for organized physical activity are often limited. Integrating structured sport-based interventions in prison settings may thus contribute to improvements in overall health and functional capacity. Although the present study was not designed to evaluate long-term clinical or rehabilitation outcomes, improving health-related fitness represents an important step toward strengthening preventive public health initiatives in correctional environments. Future studies with adequately powered direct comparisons between different training frequencies are warranted to determine whether a frequency-response relationship exists.

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Received on 27.06.2026.

Accepted on 28.09.2026.