

THE IMPACT OF WELL-PLANNED TRAINING ON CHANGING SEDENTARY LIFESTYLE HABITS

IMPACTO DO TREINAMENTO BEM PLANEJADO SOBRE A MUDANÇA DE HÁBITOS SEDENTÁRIOS

EL IMPACTO DE UN ENTRENAMIENTO BIEN PLANIFICADO EN EL CAMBIO DE HÁBITOS SEDENTARIOS

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ABSTRACT

Introduction: A sedentary lifestyle is one of the biggest health problems of the 21st century. The role of the trainer in motivating the sedentary individual is crucial. Also, there is a growing accessibility to gyms today, especially outdoor gyms, as a novel way to motivate people to train. **Objective:** The aim of the study was to evaluate the impact of regular combined indoor and outdoor physical activity on anthropometric and functional parameters and the adoption of a more active lifestyle. **Methods:** The study included 45 participants between 18 and 56 years of age. They underwent 12 weeks of resistance training, focusing on chest presses and leg presses. Height, weight, bioelectrical impedance, chest and leg press one-repetition maximums, push-up and curl-up counts, and sit and reach were measured both before and after the 12-week training program. **Results:** After 12 weeks of training, male participants showed a significant increase in the percentage of skeletal muscle mass ($p < 0.05$) and a significant decrease in the fat mass percentage ($p < 0.05$). Female participants experienced a significant reduction in the fat mass percentage ($p < 0.05$). Both groups were able to significantly increase their one-repetition maximums for the chest press ($p < 0.05$) and leg press ($p < 0.05$). Push-up and curl-up counts increased significantly after 12 weeks of training in both sexes, as did flexibility in both sexes. A year after the study, 80% of all participants were still training with a combination of indoor and outdoor physical activities. **Conclusions:** After 12 weeks of training, the body composition of both female and male participants had changed significantly. Twelve weeks of resistance training significantly increased strength and flexibility in both male and female participants. A well-thought-out training plan seems to be the key factor in motivating a beginner trainee to adopt a more active lifestyle. **Level of Evidence IV; Case series.**

Keywords: Sedentary lifestyle; Outdoor gym; Body composition; Muscle strength; Flexibility.

RESUMO

Introdução: Um estilo de vida sedentário é um dos maiores problemas de saúde do século XXI. O papel do treinador na motivação do indivíduo sedentário é fundamental. Além disso, atualmente o acesso às academias é crescente, em especial nas academias ao ar livre, como uma nova maneira de motivar as pessoas a treinar. **Objetivos:** O objetivo do estudo foi avaliar o impacto da atividade física regular em ginásio e ao ar livre sobre os parâmetros antropométricos e funcionais e a adoção de um estilo de vida mais ativo. **Métodos:** O estudo incluiu 45 participantes entre 18 e 56 anos de idade. Eles foram submetidos a 12 semanas de treinamento de resistência, com foco em supino e extensão das pernas. Estatura, peso, impedância bioelétrica, supino e extensão das pernas máximos com uma repetição, contagem de flexão de solo e abdominais e sentar e alcançar foram registrados antes e depois do programa de treinamento de 12 semanas. **Resultados:** Depois de 12 semanas de treinamento, os participantes do sexo masculino tiveram aumento significativo do percentual de massa muscular esquelética ($p < 0,05$) e diminuição significativa do percentual de massa gorda ($p < 0,05$). As participantes do sexo feminino tiveram redução significativa do percentual de massa gorda ($p < 0,05$). Ambos os grupos foram capazes de aumentar significativamente seu máximo de uma repetição de supino ($p < 0,05$) e extensão das pernas ($p < 0,05$). As contagens de flexão de solo e abdominais aumentaram significativamente depois de 12 semanas de treinamento em ambos os sexos, assim como a flexibilidade. Um ano depois do estudo, 80% de todos os participantes ainda estavam treinando com uma combinação de atividades físicas internas e ao ar livre. **Conclusão:** Depois de 12 semanas de treinamento, a composição corporal de participantes do sexo feminino e masculino mudou significativamente. As 12 semanas de treinamento de resistência aumentaram significativamente a força e a flexibilidade em participantes do sexo masculino e feminino. Um plano de treino bem pensado parece ser o fator chave para motivar um iniciante a adotar um estilo de vida mais ativo. **Nível de Evidência IV, Série de casos.**

Descritores: Comportamento sedentário; Composição corporal; Força muscular; Flexibilidade.

RESUMEN

Introducción: El sedentarismo es uno de los mayores problemas de salud del siglo XXI. El papel del entrenador para motivar al individuo sedentario es fundamental. Además, hoy en día el acceso a los gimnasios es cada vez mayor, especialmente en los gimnasios al aire libre, como una nueva forma de motivar a las personas



a entrenar. Objetivos: El objetivo del estudio fue evaluar el impacto de la actividad física regular en gimnasios y al aire libre sobre los parámetros antropométricos y funcionales y la adopción de un estilo de vida más activo. Métodos: El estudio incluyó a 45 participantes de entre 18 y 56 años de edad. Los participantes fueron sometidos a 12 semanas de entrenamiento de resistencia, centrándose en press de banca y extensión de piernas. Se registraron datos de altura, peso, impedancia bioeléctrica, press de banca y extensión de piernas máximos con una repetición, recuento de flexión del suelo, abdominales y prueba de sentarse y alcanzar antes y después del programa de entrenamiento de 12 semanas. Resultados: Tras 12 semanas de entrenamiento, los participantes del sexo masculino presentaron un aumento significativo del porcentaje de masa muscular esquelética ($p < 0,05$) y una disminución significativa del porcentaje de masa grasa ($p < 0,05$). Las participantes del sexo femenino presentaron una disminución significativa del porcentaje de masa grasa ($p < 0,05$). Ambos grupos fueron capaces de aumentar significativamente su máximo de una repetición de press de banca ($p < 0,05$) y de extensión de piernas ($p < 0,05$). Los recuentos de flexión del suelo y de abdominales aumentaron significativamente después de 12 semanas de entrenamiento en ambos sexos, al igual que la flexibilidad. Un año después del estudio, el 80% de los participantes continuaba entrenando con una combinación de actividades físicas internas y al aire libre. Conclusión: Tras 12 semanas de entrenamiento, la composición corporal de los participantes de ambos sexos cambió significativamente. Las 12 semanas de entrenamiento de resistencia aumentaron significativamente la fuerza y la flexibilidad en ambos sexos. Un plan de entrenamiento bien pensado parece ser el factor clave para motivar a un principiante a adoptar un estilo de vida más activo.

Nivel de Evidencia IV, Serie de casos.

Descriptor: *Conducta sedentaria; Composición corporal; Fuerza muscular; Flexibilidad.*

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INTRODUCTION

Sedentary lifestyle is one of the biggest health problems of the 21st century.¹ The availability of various modes of transportation along with the developments in information technology and internet pushed people towards moving less in general, as they could now get everything using a few clicks. During COVID-19 pandemic this kind of lifestyle pattern became more common, due to lockdown.^{2,3,4} Common health risks associated with this lifestyle include the metabolic syndrome,¹ thrombophilia,⁵ decrease in cognitive performance⁶ and mental health problems.⁷

Physical activity represents the key element in maintaining health and preventing various diseases, which is evident in the fact that the lack of adequate physical activity is recognized as the fourth leading cause of global mortality.⁸ WHO's Global action plan on physical activity (2018-2030) has set a goal of achieving 15% reduction in the prevalence of physical inactivity among adolescents and adults over the world.⁹ It is of crucial importance that exercise professionals take part in the planning and adapting the training regimen to the individual and that progress is measured by tracking various anthropometric and functional parameters, which may at the same time additionally motivate the individual to stay on course. Disparity between physical fitness and the type of training offered may be the cause of non-compliance to the regimen.¹⁰ In a study that examined how many participants continued to work out after the study was completed, it was concluded that a more detailed evaluation of the individual is needed, especially of their willingness to change, in order to eliminate misunderstanding and decrease the risk of quitting.¹¹

There is a growing accessibility to gyms today, however, one of the newest concepts in the field are outdoor gyms, as a novel way to motivate people to train, completely free of charge, with the added benefit of socializing with fellow users.¹² Certain studies have shown that participants used green surfaces and outdoor gyms as additional physical activity with an accentuated social component.^{13,14} Also, it was shown that sedentary people who started training in outdoor gyms created new habits and managed to change their lifestyle with great pleasure.¹⁴ A systematic review comparing the effect of Indoor vs. outdoor gym training showed that outdoor training had better effects on the psychological state of the individual.¹⁵ Using all of this knowledge,

it is important to think towards training in outdoor gyms, but with a trainer that could advise and help the individual diversify their training regimen and be more creative in order to get better results.

Therefore, the aim of the study was to evaluate the impact of combined indoor and outdoor regular physical activity on anthropometric and functional parameters. Furthermore, we wanted to evaluate the impact of combined indoor and outdoor training on the adoption of a more active lifestyle.

MATERIALS AND METHODS

Sample

The study included 45 healthy participants of both sexes (29 males and 16 females) between 18 and 56 years of age. Each of the participants lived a sedentary lifestyle (engaging in less than 60 minutes of moderate intensity physical activity on a weekly basis) for at least six months prior to the study. Exclusion criteria were the following: cardiovascular diseases (ischemic heart disease, arrhythmias, hypertension, congenital or acquired valve disease or cardiomyopathy, claudications), endocrine disorders (hyper/hypothyroidism, diabetes mellitus), vertigo and musculoskeletal disorders. All participants signed the informed consent form after the study plan as well as potential benefits and risks were explained to them. The study was approved by the Ethics Committee of the Medical Faculty in Novi Sad and carried out in the period between April and June 2019.

Study design

This was a prospective, pretest/posttest study with no control group. Before starting the 12-week training period, all participants had two familiarization sessions during which they performed the exercises from the program (chest press and leg press) with varying levels of difficulty, in order to establish what is the proper form of the given exercises. After the start of the training period, the two exercises were performed three times per week, with at least one day of rest in between sessions. These core exercises were incorporated in a varying training protocol that included exercises for other body parts, as well as recreational endurance exercises, to make the program more interesting and acceptable for the participants. The training regime was refreshed every two weeks with attention to strength gains in the core exercise.

Measurements

All measurements were carried out in morning hours in order to avoid daily physiological variations. All measurements were performed twice: 1) prior to the training program and 2) after 12 weeks of training.

Anthropometric measurements

Height and weight were measured using a medical weighing scale with height rod (SD301, Winmedic, Serbia). These values were then used to calculate the BMI (kg/m^2) of the participants using the formula $\text{BMI} = \text{Bodyweight} / (\text{Height})^2$.

Bioelectric impedance analysis (BIA)

BIA was performed using a commercial scale with bio impedance (Omron BF 511, Japan). Participants removed any metal objects that make contact with the skin to ensure precision in measurements. After supplying the age, sex and weight of the participant, the apparatus calculates the percentages of skeletal muscle mass (SM%) and fat mass (FM%), and residual mass (Residual) is calculated from these.

Chest press 1RM testing

Before the testing, participants would warm-up by cycling for five minutes and doing dynamic stretching for the upper body. Lifting was done on a chest press machine (Hammer strength, USA). Testing began with 10 kg and progressively increased until the participant couldn't overcome the given resistance more than once, thus establishing their 1-repetition maximum (1RM).

Leg press 1RM testing

Participants prepared for the testing by warming up on the stationary bike for five minutes followed by dynamic stretching of the lower body. Leg presses were performed on a 45-degree, plate-loaded leg press machine (Magnum MG-PL70, Matrix Fitness, USA). The starting load was 60 kg, progressively increasing it until the participant wasn't able to complete two repetitions, which established their 1RM. A repetition started with the eccentric phase (lowering the weight by bending the knees) until the knees were flexed at a 90-degree angle, after which the weight was pressed back up to the starting point.

Push-up and curl-up count

Participants were instructed to perform as many push-ups and curl-ups as possible during one minute.

Sit and reach test (SRT)

This test was used to assess low-back and hamstring flexibility. We used the Sit n' Reach® Trunk Flexibility Box (Baseline, USA). Participants were instructed not to perform any intense exercise before the test, to ensure valid measurements. The participants sat on the floor, placing soles of their bare feet flat against the box and then leaning forward as far as they could. The zero point was taken to be 23 centimeters behind the participants' feet. When they reached their limit, they held it for two seconds and we recorded the number from the scale. This procedure was repeated three times and the average was calculated and used as the final number.

One-year follow-up

One year after the end of the study, we contacted all of the participants in an effort to check if they had continued training. In order to avoid bias, the participants were not aware of this aim of the study. We asked them if they had engaged in at least 150 minutes of moderate to high-intensity physical activity weekly, during the previous 12 months.

Statistical analysis

Shapiro-Wilk test was used to test the normality of distribution and concluded that all of the measured parameters were normally distributed.

Paired t-test was used to measure if the values of the variables have changed significantly after 12 weeks of training. The level of significance (α) used was 0.05. Statistical analyses were performed using SPSS for Windows (version 20, IBM, USA).

RESULTS

After 12 weeks of training, bodyweight and BMI were lower in both males and females, but not significantly (Table 1).

Body composition changes due to the 12-week training regime are shown on Figure 1. Male participants showed a significant increase in skeletal muscle mass percentage ($p < 0.05$). Female participants also increased their skeletal muscle mass percentage (albeit insignificantly). Both groups showed a significant decrease in fat mass percentage ($p < 0.05$) (Figure 2).

With 12 weeks of training, male participants were able to significantly increase their chest press 1RM, by an average of 30 kg ($p < 0.05$), as well as their leg press 1RM by an average of 31 kg ($p < 0.05$) (Figure 3). Female participants also significantly increased their chest press 1RM, by 15 kg on average ($p < 0.05$), and leg press 1RM by 29 kg on average ($p < 0.05$) (Figure 4).

Push-up and curl-up count significantly increased after 12 weeks of training in both sexes (Table 2).

Male participants experienced a significant increase ($p < 0.05$) in hamstring and low back flexibility, with SRT values increasing by 3 cm on average. Female participants also showed a significant increase in flexibility ($p < 0.05$). Their SRT values grew by 1 cm on average (Figure 5).

During the 12 months following the completion of the study, 80% of all participants (86% of males and 75% of females) were still engaging in moderate to high-intensity physical activity for at least 150 minutes a week, combining indoor and outdoor training.

Table 1. Body weight and BMI, before training and after 12 weeks of training.

	♂ Before	♂ After	♀ Before	♀ After
BODYWEIGHT (kg)	85.34±20.28	84.13±14.71	66.09±10.35	62.61±8.20
BMI (kg/m^2)	25.55±5.38	25.12±3.50	23.16±3.71	21.64±2.74

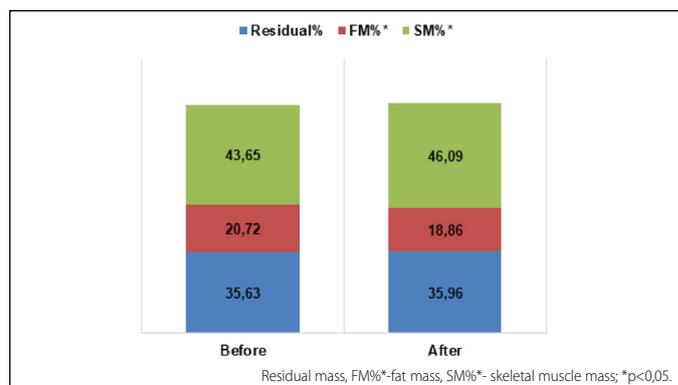


Figure 1. Body composition changes for male participants.

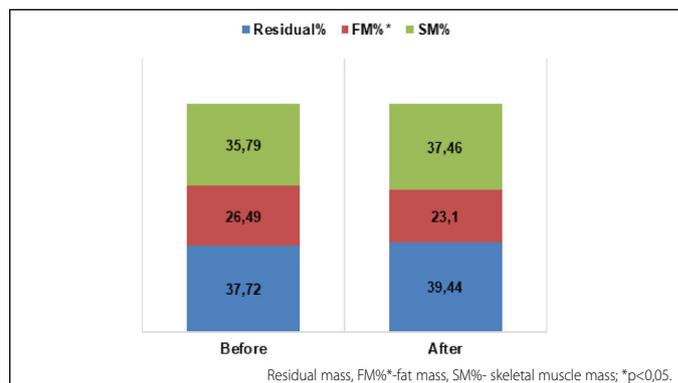


Figure 2. Body composition changes for female participants.

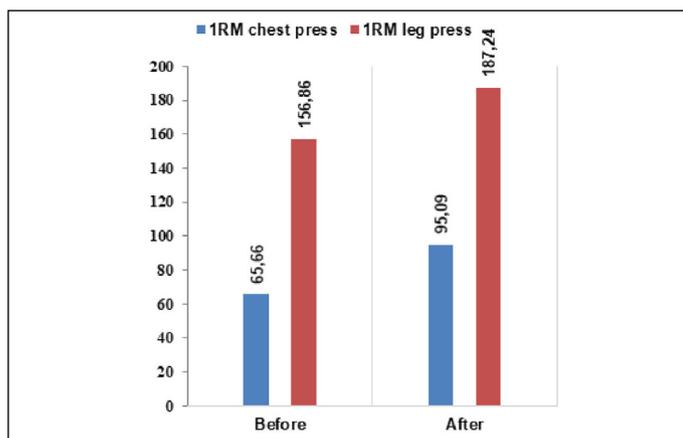


Figure 3. Changes in muscle strength (chest press 1RM and leg press 1RM) for male participants.



Figure 4. Changes in muscle strength (chest press 1RM and leg press 1RM) for female participants.

Table 2. Pushup and curl-up count (before and after 12 weeks of training); * p<0.05.

	♂ Before	♂ After	♀ Before	♀ After
PUSH-UPS	21±9.39	27.66±9*	10.81±11.73	15.31±9.11*
CURL-UPS	27.24±17.59	32.38±16.17*	15.13±13.4	20.75±11.25*

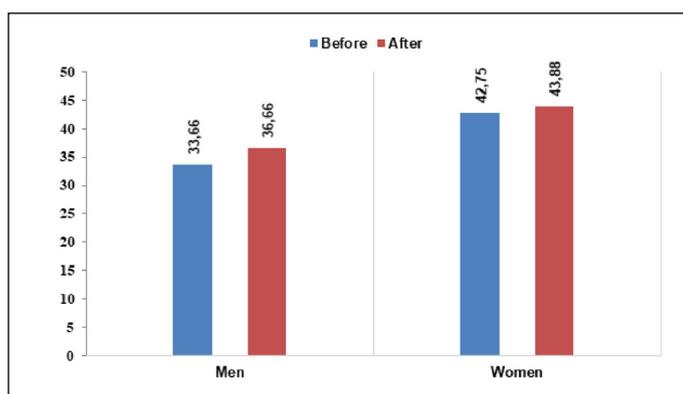


Figure 5. Changes in SRT after 12 weeks of training in both sexes.

DISCUSSION

After 12 weeks of training, our participants had changed their body composition, as evidenced by the significant reduction of FM%. As the decrease in FM% was significant and the reduction of bodyweight and BMI wasn't, we could assume that BMI is not a very good predictor of body composition, especially of FM%. A study by Hannan showed that BMI could stay the same even with FM% increase or decrease of 5%.¹⁶ Also, a systematic review with meta-analysis concluded that BMI fails to identify up to 50% of people with an abnormally high FM%.¹⁷ Moreover, another disadvantage of BMI is that it cannot estimate the level

of sarcopenia, as it was shown that the fat mass values calculated from BMI could be up to 4.3 kilograms lower than those obtained using BIA.¹⁸

Although both male and female participants increased their SM%, this change was significant only in males. Walts also found that the increase in SM% was significant only in male participants.¹⁹ A study, which dealt with evaluating muscle strength and mass in elderly people, found that sarcopenia is more prevalent among women.²⁰ They also found that women are more likely to have a lower SM% and that the training regimen should be different for men and women. As our participants all had the same training regimen, this could be the culprit of smaller increase in SM% for the women in our study.

In a study by Bastyan, after 12 weeks of training, only those in the endurance training group had a significant decrease in fat mass.²¹ In our study, even though strength training was the core of the training program, both male and female participants had a significant decrease in fat mass. Lehari and Mokha compared the reduction in fat mass in women using endurance training vs. resistance training. After six weeks, those who did endurance training had a far more significant reduction in fat mass compared with those who did resistance training. Resistance training produced a significant decrease in fat mass among female participants in our study, but it lasted two times longer.²²

In our study, both groups had a significant increase in upper and lower body strength after 12 weeks of training. In a study by Dias et al. examining the effects of eight weeks of resistance training on upper body strength (measured by 1RM) in non-athletes of both sexes, researchers found that both male and female participants experienced a significant increase in upper body strength, as did our participants.²³ Wirth et al. found a significant increase in lower body strength of their participants after eight weeks of resistance training using a leg press.²⁴ We have obtained similar results for both males and females in our study, as reflected in the significant increase of their leg press 1RM.

Weiss et al. examined the effects of functional strength training vs. traditional strength training on muscle strength in non-athletes of both sexes. After seven weeks, both groups showed significant increase in push-up count, but the curl-up count significantly increased only in the traditional strength training group.²⁵ Our results showed significantly increased push-ups and curl-up counting both sexes.

Decreased flexibility increases the risk of musculoskeletal injury, back pain and difficulties in performing everyday tasks.²⁶ Leite et al. had shown that resistance training increases or at least maintains flexibility in both male and female non-athletes, as they had significantly increased flexibility (trunk flexion) after eight weeks of training.²⁷ In our study, both males and females experienced a significant increase in flexibility estimated using SRT.

As all of our participants lived a sedentary lifestyle before the study, we were also interested in knowing what percentage of our participants would continue training after the study ended. We contacted the participants one year later, to see if they continued training. After a year, 80% of participants confirmed that they were still engaging in physical activity for at least three days a week or 150 minutes weekly. The majority continued training in the same gym, either with a personal trainer or in a group setting, and they also incorporated outdoor training into their regimen. We consider this to be a particularly important point as it has been shown that placing training equipment in certain areas of the park leads to an increase of physical activity level for those who spend time in the park.²⁸⁻³⁰

It is important to emphasize the role of the trainer in adapting the workouts and creating variety in order to help lead people into a healthier lifestyle. Furthermore, it is known that outdoor gyms usually do not imply the presence of a trainer. We think changing that would help the process of creating new healthy habits as trainers would motivate and guide the trainees using the outdoor gyms.

Healthcare education all over the world stressed the importance of physical activity in improving the health of the population. Our study shows that a well-designed program with the assistance of a trainer can help individuals increase their physical activity level and adopt a healthier lifestyle. By joining forces, physicians and trainers could greatly increase the success of exercise interventions in achieving long-lasting and meaningful lifestyle changes.

CONCLUSIONS

After 12 weeks of training, body composition of both female and male participants had significantly changed, but the change in BMI values

wasn't significant. BIA should be used together with anthropometric measurements to evaluate training progress, as it is more sensitive to changes in body composition. Twelve weeks of resistance training led to higher strength and flexibility in both male and female participants. Furthermore, over 75% of our participants continued on with a more active lifestyle through a combination of indoor and outdoor training. A well thought-out training plan seems to be the key factor in motivating a beginner trainee to adopt a more active lifestyle.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each of the authors made significant contributions to the designing and conduction of the study. BT: writing and revision; TS: writing and analysis of the data; SG: creating and carrying out the training and testing protocols; DC: writing and analysis of data; NJ: data collection and statistical analysis; JK: creating and carrying out the training and testing protocols; AZ: writing, intellectual concept and preparation of the whole project.

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