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The Influence of High Intensity Interval Training on Improving Physiological Performance and Social Status in a Sedentary Lifestyle: Review of the Literature

La Influencia Del Entrenamiento En Intervalos De Alta Intensidad En La Mejora Del Rendimiento Fisiológico Y El Estatus Social En Un Estilo De Vida Sedentario: Revisión De La Literatura

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Abstract. High-Intensity Interval Training (HIIT) has skyrocketed and become the most interesting training trend this year, providing short and effective training sessions to shape the ideal body. The World Health Organization (WHO) has recommended engaging in at least 150-300 minutes of moderate-intensity physical activity at 40-60% of the Maximal Heart Rate (MHR) or opt for 75-150 minutes of high-intensity/vigorous exercise. Physical activity at 60-85% MHR per week can maintain and improve fitness in adults. However, frequently cited challenges to engaging in physical activity are time limitation, low motivation, and non-compliance with established guidelines. This study aims to determine the effect of HIIT on physical fitness, VO2Max, and social status. The study employed a literature review, searching for articles from electronic databases, such as PubMed, ScienceDirect, ProQuest, and Google Scholar. The results showed that HIIT can improve physical fitness and have a significant and efficient positive effect on social status. In conclusion, HIIT training can potentially improve physical fitness, VO2max, and social status in adults with a sedentary lifestyle.
Keywords: HIIT, Physical Fitness, VO2Max, Social Status, Sedentary Lifestyle

Resumen. El entrenamiento en intervalos de alta intensidad (HIIT) se ha disparado y se ha convertido en la tendencia de entrenamiento más interesante de este año, proporcionando sesiones de entrenamiento cortas y efectivas para moldear el cuerpo ideal. La Organización Mundial de la Salud (OMS) ha recomendado al menos 150-300 minutos de actividad física de intensidad moderada a un 40-60% HRM (frecuencia cardíaca máxima) o 75-150 minutos de actividad física vigorosa/de alta intensidad a un 60-85% HRM por semana para mantener y mejorar la forma física. adultos. Sin embargo, los obstáculos citados con frecuencia para realizar actividad física son la "falta de tiempo", la baja motivación y el incumplimiento de las directrices establecidas. Este estudio tiene como objetivo descubrir qué tan grande es el efecto del HIIT sobre la aptitud física, el VO2Max y el estatus social. El método utilizado es la revisión de la literatura, buscando artículos de Electronic Data Based en los formatos PubMed, ScienceDirect y ProQuest. Los resultados de la investigación muestran que el HIIT puede mejorar la condición física y tener un efecto positivo en el estatus social de manera significativa y eficiente. La conclusión de este estudio es que el entrenamiento HIIT tiene un potencial significativo para mejorar la condición física, el VO2máx y el estatus social en adultos con un estilo de vida sedentario.
Palabras clave: HIIT, aptitud física, VO2Max, estatus social, estilo de vida sedentario

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Introduction

Nowadays, sedentary lifestyles have become a significant concern in many nations. This lifestyle is characterized by minimal physical activity, which entails prolonged periods of immobility, often spent in front of screens or engaging with electronic devices (Ma et al., 2019; Mamikutty et al., 2014). In fact, this behavior can increase the risk of health issues, including obesity, cardiovascular ailments, type 2 diabetes, and diminished physical fitness (Syamsudin et al., 2023). To combat this trend, exploring effective strategies for enhancing physical fitness and overall well-being among adults with sedentary lifestyles is imperative.

One noteworthy intervention that has garnered considerable attention in academic circles is High-Intensity Interval Training (HIIT), which is recognized for improving physical fitness and health among various populations, including those with sedentary lifestyles (Vigriawan et al., 2022). As Thompson (2019) suggested, HIIT has gained substantial popularity globally, ranking as the third most prevalent exercise trend worldwide. What makes this exercise popular is the alternation between intense exercise sessions and brief recovery intervals (Stöggl & Björklund, 2017). This methodology involves short bursts of vigorous activity followed by brief rest periods, enabling individuals to achieve heightened fitness levels within shorter durations than traditional low or moderate-intensity continuous exercises (Ahmadizad et al., 2015; Sanabria Jose, 2023).

Recent research highlights the efficacy of High-Intensity Interval Training (HIIT) in improving cardiorespiratory fitness. For example, HIIT was evidenced to increase VO2max, a key metric of physical fitness (Palaparthi, 2017). Additionally, this exercise could enhance muscle strength, endurance, and mass (Ramos et al., 2015). Other studies conducted by Ahmadizad et al. (2015), Vigriawan et al. (2022), and Weston et al. (2014) revealed notable reductions in Percentage Body Fat (PBF) and Waist Circumference (WC) after their participants did the HIIT training. Interestingly, this reduction made the participants more self-assured and improved their social standing. Besides physical health benefits, participating in HIIT group sessions can cultivate social bonds and bolster social support among individuals (Syamsudin, 2021). HIIT training is believed to improve physical fitness and aesthetic sense, which in turn positively influence self-perception, self-esteem, and overall quality of life (Nuzzo, 2019).

Nevertheless, while the benefits of HIIT training are well-documented in highly active populations, there is a knowledge gap regarding its efficacy in individuals leading sedentary lifestyles. Hence, this study seeks to undertake a thorough literature review to assess the influence of HIIT training on physical fitness, VO2max levels, and social standing in sedentary adults

Methods

This study employed a literature review method. It collected the data from secondary sources, focusing on research outcomes that discussed High-Intensity Interval Training (HIIT), physical fitness, and social status. To limit the scope, the study screened articles released in the last ten years, from 2013 to 2023, published in global academic databases such as PubMed, ScienceDirect, ProQuest, and Google Scholar. To give examples, the database can be easily accessed online through their respective links, such as https://scholar.google.co.id/ for Google Scholar, https://www.ncbi.nlm.nih.gov/pmc/ for NCBI journal, and https://onlinelibrary.wiley.com/ for Wiley Online Library. It is necessary to remember that the secondary data used in this study were scientific articles that used correlational educational research and experiments on HIIT, physical fitness, and sedentary lifestyle as the research design. The detailed process of how the data were collected and analyzed is illustrated in Figure 1.

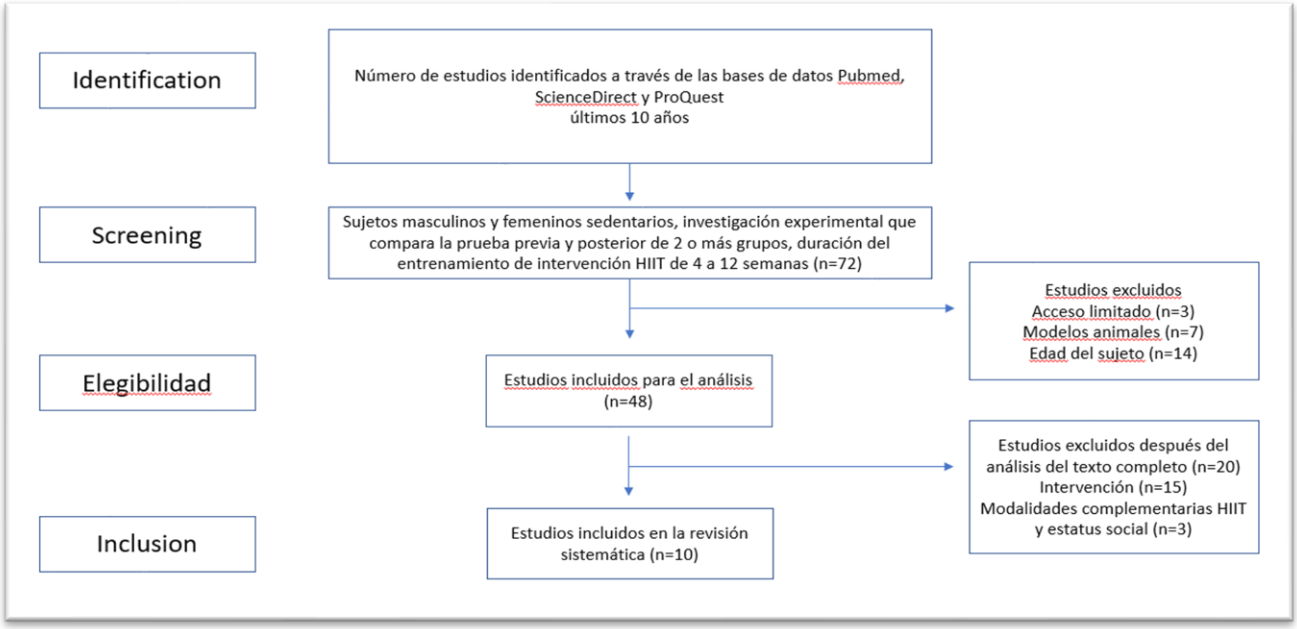

Figure 1. Illustration of the research design

Results

Table 1.
Analysis Table and Article Review

No	Author	Protocol & Duration	Vol & intervensi	Pre VO2Max (ml/kg min-1)	Post VO2Max (ml/kg min-1)	Gender & Age	BMI
1	(Polytechnic Institute of Beja (Portugal), 2023)	Jump Hight-bench press-Squat 6 weeks	HIIT 5 set (60 second) Hr Max 95%. 6 weeks	200.00 ± 30.00 W	220.00 ± 30.92 W	Men	22-±23 Normal
2	(Syamsudin et al., 2023)	Cycle ergometer Heart rate monitor 2 weeks, 4x per weeks	active on 10 sec, speed 100 rpm and 50 second pasif speed on 50 rpm (20 minute on 10:50)	27.7 ± 3.9	30.6 ± 3.5	Women (sedentary)	24.9 ± 1.6 Nomal & Overweight)
3	(Vigriawan et al., 2022)	Cycle ergometer Heart rate monitor 2 weeks, 4x per weeks	20 minute 10:50 seconds, active on 10 sec, speed 100 rpm and 50 second pasif speed on 50 rpm	26.4±2.47	35.2±2.12	Women	24.9 ± 3.0 (Nomal & Overweight)
4	(Reljic, Frenk, Herrmann, Neurath, & Zopf, 2020)	Cycle ergometer Heart rate monitor 12 weeks, 2x per	15 minute 2 minute of exercise 1 minute 80-95%	22.5 ± 6.5	26.0 ± 6.6	Women & Men 48.5 ± 10.	40.4 ± 7.2 (Obese 2 & Obese 3)

		weeks	HRM, 1 minute passive, 5x repetion 3 minute cooling down				
5	(Reljic, Wittmann, & Fischer, 2018)	Cycle ergometer Heart rate monitor 8 weeks, 2x per weeks	15 minute 2 minute passive, 4 minute 85-95% HRM, 2x repetion, finished 3 menute passive.	30.3 ± 9.1	35.3 ± 6.6	Women & Men/ 30.2 ± 7.7	Women & Men/ 30.2 ± 7.7
			15 minute 1 minute 85-95% HRM, 2 minute passive, 5x repetion	29.4 ± 7.3	36.5 ± 7.3	Women & Men/ 30.2 ± 7.7	24.9 ± 3.0 (Nomal & Overweight)
6	(Vella, Taylor, & Drummer, 2017)	Ergocycle and Treadmill Heart rate monitor 8 weeks, 4x per weeks	20 minute 1 menit aktive 75-80% HRM, 1 menute passive 35-40% HRM, 10x repetition	34.8 ± 2.9	37.4 ± 0.8	Women & Men/ 23.1 ± 6.6	29.9 ± 3.3 (Overweight & Obese 1)
7	(Allen et al., 2017)	Ergocycle Heart rate monitor 9 weeks, 3x per weeks	20-40 minute 20-30 second sprint, 3-4 minute passive, 5-8x repetition, progresif	26.34 ± 4.34	30.00 ± 4.97	Women & Men/ 49.2 ± 6.1	27.3 ± 4.0 (Pre Obese)
8	(Gillen et al., 2016)	Cycle ergonometer Heart rate monitor 6 weeks, 3x per weeks	10 minutes 10-20 second sprint, 50 minute passive, 10x repetition, progressive.	31.7 ± 4.6	34.7 ± 5.2	Women/ 36 ± 9	24.1 ± 3.5 (Normal & Overweight)
9	(Kong et al., 2016)	Cycle ergometer Heart rate monitor 5 weeks, 4x per weeks	20 minute 8 second active, 12 second passive	32.0 ± 6.6	34.3 ± 7.5	Women/ 21.5 ± 4.0	25.8 ± 2.6 (Pre Obese)
10	(Astorino et al., 2013)	Cycle ergometer Heart rate monitor 12 weeks, 3x per weeks	40 minute 4 minute exercise 60 detik 85-100% HRM, 75 second passive, 6-10x repetition, progesif 2-4 minute cooling down	29.4 ± 5.9	35.8 ± 5.7	Women 23.1 ± 5.6	25.3 ± 4.3 (Normal & Pre Obese)

Table 1 above provides key findings from ten studies. The first study was based on research by the Polytechnic Institute of Beja (2023) in Portugal. They found that HIIT training, a combination of jump height-bench press-squat in normal BMI men for 6 weeks, was proven to be effective in increasing vo2max. After that, local research from Indonesia conducted by Syamsudin et al. (2023) reported an ergo cycle with heart rate monitor control for 2 weeks (4 times a week) with a duration of 20 minutes and a passive interval (10:50). In their study, there was an increase in Vo2max from 27.7 to 30.6 ml /kg min-1 in women with overweight BMI. The next research employed an exercise protocol with a bicycle ergometer for 2 weeks, 4 times per week, with a duration of 20 minutes and active-passive intervals (Vigriawan et al., 2022). They revealed a higher increase than the previous research, in which VO2Max raises from 26.4 to 35.2 ml/kg min-1 in women with a BMI of 24.9 ± 3.0 (Normal & Overweight). Following that, Reljic et al. (2020) found that a 12-week training protocol, 2 times per week, focusing on intensity intervals, might lead to an increase in VO2Max from 22.5 to 26.0 ml/kg min-1 in women and men with BMI 48.5 ± 10.0, 40.4 ± 7.2 (Obese 2 & Obese 3). The table also presents findings from Reljic et al., (2018), who involved 8 weeks of training, 2 times per week with varying intensities and a 15-minute exercise protocol. Their study achieved similar results with the 5 times repetition protocol. Next, Vella et al. (2017) investigated an exercise protocol for 8 weeks, 4 times per week. Similarly, their study indicated an increase in VO2Max from 34.8 to 37.4 ml/kg min-1 in women and men with a BMI of 23.1 ± 6.6, 29.9 ± 3.3 (Overweight & Obese 1).Furthermore, there are still four studies that provide similar findings. For example, Allen et al. (2017) performed a 9-week training protocol, 3 times per week, which emphasized sprinting and rest. This study noted an increase in VO2Max in women and men with a BMI of 49.2 ± 6.1. Significant improvements were also seen in the pre-obese group. Meanwhile, Gillen et al. (2017) used a sprint protocol for 6 weeks, 3 times per week. The results showed an increase in VO2Max for women with a BMI of 36 ± 9. Even though the duration was short, this exercise produced significant results. Likewise, Kong et al's (2016) study showed an increase in VO2Max from 32.0 to 34.3 ml/kg min-1 in women with a BMI of 21.5 ± 4.0. it was found that a short 5-week protocol with active-passive intervals had a positive impact**.** The last study, written by Astorino et al. (2013), used 12 weeks of exercise, 3 times per week. This study also noted an increase in VO2Max from 29.4 to 35.8 ml/kg min-1 in women with a BMI of 23.1 ± 5.6. The results showed a positive response in the normal and pre-obese groups. In addition, the result of increasing VO2Max obtained was the same at 4ml/kg.

Discussion

This study utilized a Heart Rate Monitor (HRM), a sophisticated device designed to track the subject's heart rate. This tool plays a vital role in evaluating the subject's performance, especially in measuring the target heart rate goal (Clark et al., 2019). Furthermore, the study incorporated the ergocycle as an additional apparatus to facilitate exercise sessions. The ergocycle was selected for its specific advantages. Firstly, it alleviates the need for individuals to bear their body weight, making it suitable for overweight or obese participants by reducing joint stress. Secondly, the ergocycle allows for customizable resistance settings to match the subject's leg strength during high-intensity intervals. Lastly, monitoring subjects becomes more convenient as they can remain stationary without switching locations or equipment during training (Hoeger et al., 2019). In the data analysis phase, findings from seven studies (Allen et al.,

2017; Gillen et al., 2016; Kong et al., 2016; Polytechnic Institute of Beja (Portugal), 2023; Reljic et al., 2020; Syamsudin et al., 2023; Vella et al., 2017) revealed that research participants exhibited VO2max values as moderate both before and after the intervention period. Additionally, three studies (Astorino et al., 2013; Reljic et al., 2018; Vigriawan et al., 2022) documented an enhancement in VO2max levels from low to moderate subsequent to the prescribed training program. These collective outcomes signify a noteworthy improvement in VO2max values across the research spectrum.

As mentioned before, this study aimed to find out the influence of HIIT training on physical fitness, VO2Max, and social status by reviewing ten international articles. The relationship between these variables is presented as follows:

HIIT Effectively Improves Physical Fitness

The first relationship that this study strives to investigate is whether HITT affects individuals' physical fitness. Based on the research by Airlangga and Malang (2022), differences were found regarding the influence of the average HR value rest on CONT and HIIT. The HIIT group had decreased HR values, which were higher rather than those of CONT. This is in line with earlier meta-analysis (He et al., 2018; Huang et al., 2005), which claimed that regular aerobic physical exercise in >60-year-old samples could reduce HR rest by 8.4%. Apart from that, research from Heydari et al. (2012), cited in Syamsudin (2021), also presented similar findings. In that study, it was stated that High-Intensity Intermittent Exercise (HIIE) which is carried out on overweight men for 12 weeks showed a decrease in results heart rate significantly. In addition, it increased fitness levels by up to 17%. Decreased HR rest after regularly doing HIIT is possible due to the induction of improved stroke volume (Syamsudin et al., 2023). Enhancement of stroke volume will increase plasma volume, thereby increasing myocardial contractility, which will lead to a decrease in HR rest (Vigriawan et al., 2022). In addition, decreasing HR rest normally has many health benefits, such as reducing the risk of developing cardiovascular disease, high cholesterol and triglycerides, and hypertension (Sharashova et al., 2015).

HIIT Increasing VO2Max for Sedentary Lifestyle

Extensive research indicates that High-Intensity Interval Training (HIIT) effectively improves VO2max levels. Various training methodologies, such as sprint volume and passive approaches, have demonstrated the capacity to enhance VO2max. For example, a study by Kong et al. (2016) illustrated that a 5-week HIIT regimen could elevate VO2max levels. However, to achieve optimal outcomes, Astorino et al. (2013) recommended a 12-week HIIT program. Surprisingly, it was found that even brief HIIT sessions have shown effectiveness. This is supported by earlier research, in which engaging in 10-minute sessions, totaling 30 minutes weekly, has resulted in significant VO2max improvements (Gillen et al., 2016). When extended to 15 minutes, this duration has proven to yield more profound benefits, as indicated by Reljic et al. in 2018. In summary, HIIT stands as a highly efficient method for enhancing VO2max, with even brief training sessions offering notable advantages.

One of the reasons that this training is so effective might be because of the mechanical movements of High-Intensity Interval Training (HIIT). These movements are regulated by the peripheral (sympathetic) nervous system, stimulated by the Neuro-Muscular Junction and contraction of the musculoskeletal components (Hadiono & Wara Kushartanti, 2019). This contraction causes the heart's work to increase in this way. The chronic effect will be right ventricular hypertrophy, which increases stroke volume so that the heart can pump blood more efficiently. An increase in stroke volume will increase plasma volume, thereby increasing myocardial contractility, which leads to a decrease in HR (Syamsudin et al., 2023).

Musculoskeletal contractions that occur repeatedly cause muscle hypertrophy, which can increase the number of capillaries. One of the functions of these capillaries is to enable the musculoskeletal system to contract more quickly and for longer. Increasing musculoskeletal ability in breathing makes oxygen use efficient, so body fitness will increase VO2Max (Pranoto et al., 2024).

Increasing the work of the sympathetic nerves increases the work of breathing so that the work of the respiratory muscles increases. Repetitive contractions cause muscle hypertrophy, which can increase the number of capillaries and the number of red blood cells. Therefore, they can increase the number of mitochondria, which causes increased oxygen uptake (Hoshino et al., 2016).

HIIT Affects Social Status in Adults With a Sedentary Lifestyle

Social status is an important aspect of an individual's life. It includes their role and position in society. A sedentary lifestyle is often associated with social isolation, low involvement in social activities, and lack of social support. Therefore, it is important to understand how HIIT training can affect the social status of individuals with a sedentary lifestyle.

Based on the articles reviewed in this study, HIIT exercise in groups can increase social engagement and reduce social isolation by providing opportunities for individuals to engage in social activities with people who share similar interests. Additionally, the structured HIIT exercise environment can provide social support that improves self-confidence and overall quality of life (Medicine, 2013). Regular and effective HIIT training can also improve physical fitness, weight loss, and overall health, which in turn can improve the quality of life for individuals with a sedentary lifestyle (Cardozo et al., 2015). Moreover, participation in a HIIT exercise program can help individuals integrate into groups with similar interests, creating opportunities to forge new social connections.

HIIT Relationship Improves Physical Fitness and Social Status

HIIT training carried out in groups can provide an opportunity for individuals with a sedentary lifestyle to get involved in social activities. Through their participation in group exercise sessions, they can interact with people who share the same interest in improving fitness and health. This can help reduce social isolation and build positive social relationships. Some research (e.g., Airlangga & Malang, 2022) affects the reduction in waist circumference. This is in line with research (Ahmadizad et al., 2015) that HIIT with a treadmill 3 days per week for 6 weeks was effective in reducing Percentage Body Fat (PBF). Further, research conducted by Allen et al. (2017) showed that HIIT training with 30-second sprints with passive 4-5 minute intervals for 9 weeks effectively reduced waist circumference in sedentary adults. This is possible because the increase in work performed by skeletal muscles causes an increase in ATP consumption, thereby causing ATP levels in skeletal muscles to decrease. Decreased ATP activates the AMPK enzyme (Adenosine Monophosphate-Activated protein Kinase). This enzyme causes the mobilization of fat from fat tissue. Through the ACC enzyme, adipose tissue, which stores fat, especially in the waist area, can be reduced (Marcinko et al., 2015). Fat loss in women who were overweight positively correlated with increased physical fitness. In addition, decreasing waist circumference is positively correlated with increasing flexibility, which is one component of physical fitness. A person with good physical fitness can find it easier to carry out various daily activities and reduce the possibility of injury (Nuzzo, 2019). Increasing self-confidence in sedentary adults has a positive correlation with increasing social status in socializing in society (Nuzzo, 2019). These positive changes can influence individuals' perceptions of themselves and increase life satisfaction. By feeling healthier and more energetic, individuals with a sedentary lifestyle may feel more confident and have a better quality of life overall.

Conclusion

Based on the studies reviewed above, it can be concluded that HIIT training has significant potential to improve physical fitness, VO2max, and social status in adults with a sedentary lifestyle. HIIT exercise can improve an individual's social engagement, social support, quality of life, and social integration. This can help overcome social isolation, increase self-confidence, and improve the individual's social relations with the surrounding environment.

This research implies the importance of introducing and encouraging participation in HIIT exercise programs for adults with a sedentary lifestyle. In improving physical fitness and social status, a well-structured and group HIIT training program can provide an environment that supports, motivates, and facilitates positive social interactions. These implications emphasize the importance of addressing the social isolation and lack of social support that often occurs in this population.

Research limitations

This study, focusing on the relationship between High-Intensity Interval Training (HIIT) and social life, has limitations worth noting. Firstly, its great reliance on references from the past 10 years may overlook significant insights from earlier periods. Secondly, this study did not use human subjects, which introduces variability in responses that may not fully represent the broader population. Additionally, external factors like seasonal changes or personal events may affect post-test evaluations, and they are not discussed in this study. While the pre-test/post-test group design is valuable, establishing causality remains challenging due to uncontrolled variables like sleep patterns or psychological factors. Further research with broader designs and tighter controls is necessary to comprehensively understand the HIIT-social life relationship.

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