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Effects of High-Intensity Interval Training on Body Weight in Obese Adults

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ABSTRACT

Background: Obesity has become an epidemic and is a major threat to health. There are many ways to overcome obesity, one of which is exercise, but there are still reasons such as not having time to exercise. The purpose of this study is to discuss and describe the effects of High-Intensity Interval Training on weight loss in obese adults. **Method:** The method used in this study was a literature review using PRISMA to determine the number of articles used, the PEDro scale to assess each article, and check the quartiles of articles through schimago, then The articles were explained the population, intervention, comparison and outcome of each article. **Result:** The results obtained were that weight loss in the HIIT group varied from each article, namely 3.9kg, 5.3kg, 5.7kg, and 5kg, All comparison groups from articles that discussed HIIT and BMI also experienced weight loss, but HIIT had advantages in losing weight compared to some other comparisons, except for a study conducted by D'Amuri et al in 2021 which showed greater weight loss results in the MICT group, namely 0.3kg more than the HIIT group which was only 5.7kg, however, the two groups did not have a significant difference. **Conclusion:** This study concludes that High-Intensity Interval Training can reduce the weight of individuals who are obese in adulthood.

Introduction

Obesity has become an epidemic and is a major threat to health in various parts of the world because obese people usually avoid sports and physical activity to avoid stigma and shame [1]. Obesity is a multifactorial disease with an increasing incidence and burden in people all over the world [2]. Obesity is one of the most threatening health burdens worldwide and its prevalence has increased markedly over the last few decades [3]. Obesity from all corners of the earth has increased almost threefold since 1975, in 2016 data was obtained which stated that someone aged 18 years and over experienced overweight conditions with a total of more than 1.9 billion people, and from the total turned out to be more than 650 million people who fall into the category of obesity [4]. The number of people in Indonesia who experience cases of obesity (Body Mass Index or BMI ≥25-27 and BMI ≥27), aged ≥15 years is 35.4%, while people who are obese with BMI ≥27 are only 21.8 %. In this case, for residents aged ≥15 years and having obesity, the prevalence was higher in women by 29.3% compared to men, only around 14.5%. The results of the data obtained stated that obesity was higher in urban areas (25.1%) than in rural areas (17.8%). When compared by age group, the highest obesity was in the age group of 40-44 years (29.6%) [5].

In clinical practice, body fat is most commonly and simply estimated using a formula combining weight and height, the underlying assumption being that most of the variation in body weight for

people of the same height is due to fat mass [6]. Obesity can be determined through calculating BMI, the calculation is used to measure a person's weight in relation to their height, rather than basing a judgment of obesity solely on a person's weight, this assessment follows the logic that the average human might expect taller people to be heavier [7, 8, 9].

There are several ways to overcome this problem in the form of obesity, one of which is by doing exercise, although aerobic and anaerobic exercise have benefits for weight loss, some reasons why someone is lazy to do sports are because there are several things that must be done, some have the perception bad things related to sports, already working or busy taking care of children, and other reasons stated if they don't have time to exercise [10].

One of the exercises that has a short time is High Intensity Interval Training (HIIT). done in a short time, while the rest interval is interpreted as a pause that is useful for the recovery process [11]. HIIT is a short workout followed by a burst of intense energy and accompanied by a rest period, meaning that HIIT should always involve alternating short intervals of high-intensity, or all-out training with short intervals of rest (active recovery) [12, 13]. HIIT is a type of exercise that is quite interesting, this is because this exercise oscillates between the aerobic system and the anaerobic system through various levels of intensity during the exercise process [14]. HIIT is also usually defined as training consisting of repeated bouts of high-intensity exercise performed above the lactate threshold (a perceived "hard" or greater effort) or critical speed/power, punctuated by periods of low-intensity exercise or complete rest [15].

Studies related to HIIT training on body weight in adults, especially those who are obese, are still very minimal in Indonesia. Therefore, this study will discuss and describe the effects of HIIT on weight loss in obese adults.

Materials and Method

The research method used in this research is literature review research which is library research by conducting a summary or explaining through the results of the review, the results of the analysis and study of a main point, and is not an argument or conjecture but a study based on several studies [6].

Articles will be searched through several journals using the keywords HIIT, obesity, and adults. Based on the results of the search conducted, the studies found ranged from 872 articles. A total of 348 articles were obtained on ScienceDirect, 29 articles on MDPI, 178 articles on Scopus, and 317 articles on Springer. The research population can be seen in Figure 1 below.

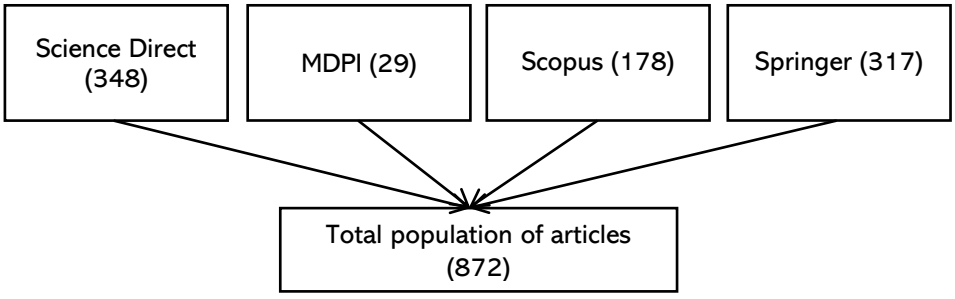

Figure 1. Research Population

The number of articles obtained was very large, therefore to determine the number of research samples used in this research a screening process was carried out, namely based on inclusion and exclusion criteria. The inclusion criteria in this study were that the research articles used were experimental, the studies used discussed the relationship between HIIT and body weight in adult obesity, all articles were published from 2018 to 2022, the research articles contained PICO (population, intervention, comparison, and outcome) and indexed journals in https://www.scimagojr.com/ at least quartile 3 (Q3).

The exclusion criteria in this study were that the title of the article was irrelevant to the title of the research, the article was not published using English, the article did not have the full text, and the research abstract in the article was irrelevant.

The quality procedure of the total population of 872 will use the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The flow of information from the prism can be seen in Figure 2 below.

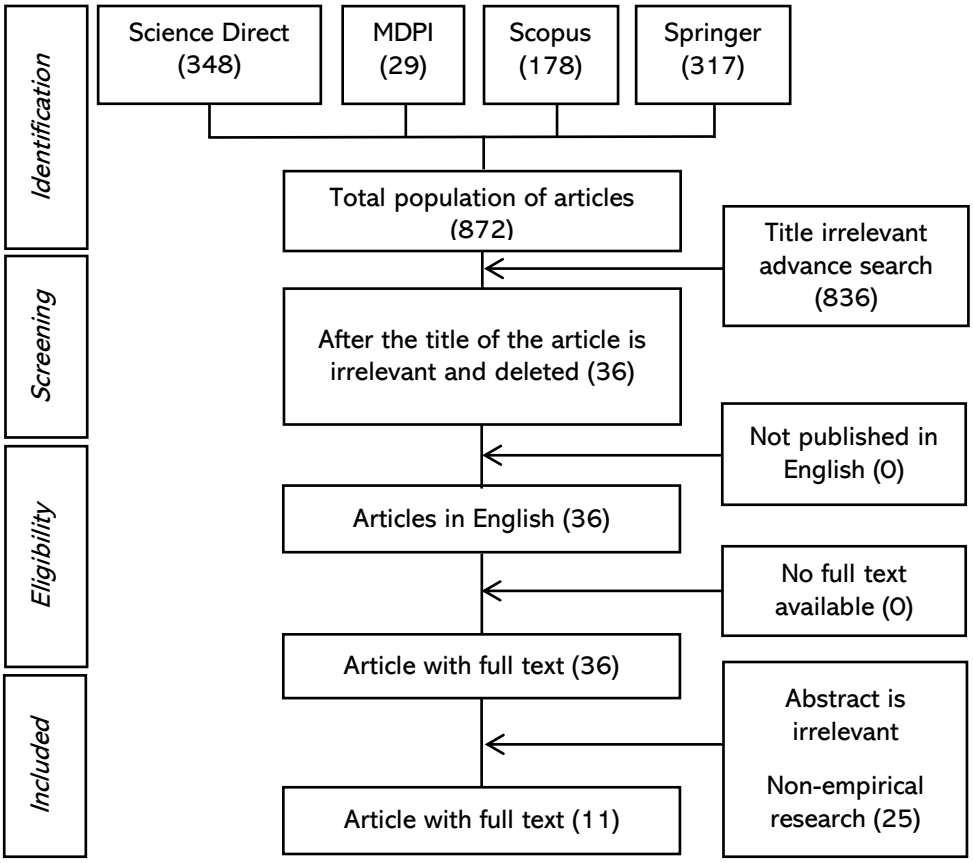

Figure 2. PRISMA

After all the articles have been found, an assessment process will then be carried out, namely the PEDro Scale. The PEDro scale is based on the Delphi checklist developed by Verhagen and colleagues at the Department of Epidemiology, University of Maastricht which is used for quality assessment of randomized clinical trials to conduct systematic reviews developed by the Delphi consensus [17]. The purpose of the PEDro scale is to help users of the PEDro database quickly identify known or suspected randomized clinical trials i.e. RCTs or controlled clinical trials (CCT) archived in the PEDro database that are likely to be internally valid (criteria 2-9) and can have sufficient statistical information to make the research results interpretable (criteria 10-11) [17]. An additional criterion (criterion 1) relating to external validity (or "generalizability" or "applicability" of the trial) has been maintained so that the Delphi list is complete, but this criterion will not be used to calculate the PEDro score reported on Pedro's website [17].

Results and Discussion

Results

The research articles that will be used as a basis for this research are 11 articles with of course having various journal values, from Q1 to Q3, and all of the articles used have eligibility criteria. For clearer details about journal quartiles and PEDro checklists, see Table 1 of PEDro scale checklists and journal quartiles.

Table 1. Checklist PEDro Scale and Quartile

Articles	Year	PEDro Scale	Quartile
Hemmatinafar, A., Fathi, M., & Ziaaldini, M. M. Effect of 8 weeks of HIIT on hepatic enzyme levels, lipid profile, and body composition in overweight young men	2020	8/11	3
Arboleda-Serna, V. H., Patiño-Villada, F. A., Pinzón-Castro, D. A., & Arango-Vélez, E. F. Effects of low-volume, high-intensity interval training on maximal oxygen consumption, body fat percentage and health-related quality of life in women with overweight: A randomized controlled trial.	2022	8/11	1
Reljic, D., Frenk, F., Herrmann, H. J., Neurath, M. F., & Zopf, Y. Effects of very low volume high intensity versus moderate-intensity interval training in obese metabolic syndrome patients: a randomized controlled study	2021	7/11	1
Reljic, D., Frenk, F., Herrmann, H. J., Neurath, M. F., & Zopf, Y. Low-volume high-intensity interval training improves cardiometabolic health, workability, and well-being in severely obese individuals: a randomized-controlled trial sub-study	2020	7/11	1
Vaccari, F., Passaro, A., D'Amuri, A., Sanz, J. M., Di Vece, F., Capatti, E., Magnesa, B., Comelli, M., Mavelli, I., Grassi, B., Fiori, F., Bravo, G., Avancini, A., Parpinel, M., & Lazzer, S. Effects of 3-month high-intensity interval training vs. moderate endurance training and 4-month follow-up on fat metabolism, cardiorespiratory function, and mitochondrial respiration in obese adults	2020	6/11	1
Saeidi, A., Shishvan, S. R., Soltani, M., Tarazi, F., Doyle-Baker, P. K., Shahrbanian, S., Mollabashi, S. S., Khosravi, N., Laher, I., Moriarty, T. A., Johnson, K. E., VanDusseldorp, T. A., & Zouhal, H. Differential Effects of Exercise Programs on Neuregulin 4, Body Composition and Cardiometabolic Risk Factors in Men With Obesity.	2022	7/11	1
D'Amuri, A., Sanz, J. M., Capatti, E., Di Vece, F., Vaccari, F., Lazzer, S., Zuliani, G., Dalla Nora, E., & Passaro, A. Effectiveness of high-intensity interval training for weight loss in adults with obesity: A randomized controlled non-inferiority trial.	2021	10/11	1
Roy, M., Williams, S. M., Brown, R. C., Meredith-Jones, K. A., Osborne, H., Jospe, M., & Taylor, R. W. High-Intensity Interval Training in the Real World: Outcomes from a 12-Month Intervention in Overweight Adults	2018	6/11	1
Gripp, F., Nava, R. C., Cassilhas, R. C., Esteves, E. A., Magalhães, C. O. D., Dias-Peixoto, M. F., de Castro Magalhães, F., & Amorim, F. T. HIIT is superior to MICT on cardiometabolic health during training and detraining.	2021	7/11	1
Chin, E. C., Yu, A. P., Lai, C. W., Fong, D. Y., Chan, D. K., Wong, S. H., Sun, F., Ngai, H. H., Yung, P. S. H., & Siu, P. M. Low-frequency HIIT improves body composition and aerobic capacity in overweight men	2019	7/11	1
Berge, J., Hjelmesæth, J., Kolotkin, R. L., Støren, Ø., Bratland-Sanda, S., Hertel, J. K., Gjevestad, E., Småstuen, M. C., Helgerud, J., & Bernklev, T. Effect of aerobic exercise intensity on health-related quality of life in severe obesity: a randomized controlled trial.	2022	7/11	1

The results of all articles found show that HIIT has effects related to obesity, body weight, body composition, fat mass, and others. Further details on PICO points (Population, Intervention, Comparison, and Outcome) can be seen in Table 2. Furthermore, it will explain all types of interventions used and the results of the research that discusses BMI. The following Table 3 interventions and research results will be attached in detail.

Table 2. PICO

No	Articles	Population	Intervention	Comparison	Outcome
1	Hemmatinafar, A., Fathi, M., & Ziaaldini, M. M. Effect of 8 weeks of HIIT on hepatic enzyme levels, lipid profile and body composition in overweight young men (2020)	18 samples of men with obesity	HIIT	Daily activities	HIIT reduces body fat
2	Arboleda-Serna, V. H., et al Effects of low-volume, high-intensity interval training on maximal oxygen consumption, body fat percentage and health-related quality of life in women with overweight: A randomized controlled trial (2022)	35 samples of women with overweight conditions	HIIT	MICT	HIIT has no advantage over MICT
3	Reljic, D., et al. Effects of very low volume high intensity versus moderate intensity interval training in obese metabolic syndrome patients: a randomized controlled study (2021)	117 adult patients with obesity	HIIT	MIIT dan inactive control group	HIIT, although performed at moderate intensity, is quite effective in improving cardiometabolic health in obese patients.
4	Reljic, D., et al. Low-volume high-intensity interval training improves cardiometabolic health, work ability and well-being in severely obese individuals: a randomized-controlled trial sub-study (2020)	65 adult patients with obesity	HIIT	Inactive control group	HIIT provides significant improvements in cardiometabolic health, especially VO2max and well-being in obese individuals after just 12 weeks.
5	Vaccari, F., et al. Effects of 3-month high-intensity interval training vs. moderate endurance training and 4-month follow-up on fat metabolism, cardiorespiratory function and mitochondrial respiration in obese adults (2020)	32 adult patients with obesity	MICT	HIIT	HIIT is more effective in increasing and maintaining V'O2peak and fat oxidation.
6	Saeidi, A., et al. Differential Effects of Exercise Programs on Neuregulin 4, Body Composition and Cardiometabolic Risk Factors in Men with Obesity (2022)	60 adult men with obesity	HIIT	Circuit Resistance Training (CRT), MICT, control group	HIIT and CRT had a greater effect than MICT on Nrg4 levels, metabolic and cardiovascular risk factors, and body composition variables in obese men.
7	D' Amuri, A., Sanz, J. M., Capatti, E., Di Vece, F., Vaccari, F., Lazzer, S., Zuliani, G., Dalla Nora, E., & Passaro, A. Effectiveness of high-intensity interval training for weight loss in adults with obesity: A randomised controlled non-inferiority trial (2021)	44 obese subjects	HIIT	MICT	HIIT induces weight loss compared to MICT.
8	Roy, M., Williams, S. M., Brown, R. C., Meredith-Jones, K. A., Osborne, H., Jospe, M., & Taylor, R. W. High-Intensity Interval Training in the Real World: Outcomes from a 12-Month Intervention in Overweight Adult (2018)	250 samples of adults with obesity	HIIT	New Zealand training manual	HIIT indicates weight loss and visceral fat reduction.
9	Gripp, F., Nava, R. C., Cassilhas, R. C., Esteves, E. A., Magalhães, C. O. D., Dias-Peixoto, M. F., de Castro Magalhães, F., & Amorim, F. T. HIIT is superior than MICT on cardiometabolic health during training and detraining (2021)	22 subjects with BMI >25	HIIT	MICT	HIIT reduces a greater percentage of fat compared to MICT.
10	Chin, E. C., Yu, A. P., Lai, C. W., Fong, D. Y., Chan, D. K., Wong, S. H., Sun, F., Ngai, H. H., Yung, P. S. H., & Siu, P. M. Low-frequency HIIT improves body composition and aerobic capacity in overweight men (2019)	56 adult men with obesity	No intervention	MICT, HIIT 3/week, HIIT 2/week, HIIT 1/week	HIIT which is done once a week improves body composition in obese conditions.
11	Berge, J., Hjelmesæth, J., Kolotkin, R. L., Støren, Ø., Bratland-Sanda, S., Hertel, J. K., Gjevestad, E., Småstuen, M. C., Helgerud, J., & Bernklev, T. Effect of aerobic exercise intensity on health-related quality of life in severe obesity: a randomized controlled trial (2022)	71 adult patients with obesity	HIIT	HIIT or MICT, MICT	The combined HIIT/MICT group lost an average of 3kg more than the MICT group.

Table 3. Intervention and Research Results

No	Articles	*Intervention*	*Research result*
1	Hemmatinafar, A., Fathi, M., & Ziaaldini, M. M. Effect of 8 weeks of HIIT on hepatic enzyme levels, lipid profile and body composition in overweight young men (2020)	HIIT, Daily Activities	Eight weeks of HIIT resulted in a significant decrease in BMI values ($p < 0.05$).
2	Arboleda-Serna, V. H., et al Effects of low-volume, high-intensity interval training on maximal oxygen consumption, body fat percentage and health-related quality of life in women with overweight: A randomized controlled trial (2022)	HIIT, MICT	There was no significant difference between the two groups in the BFP variable with $p = 0.82$.
3	Reljic, D., et al. Effects of very low volume high intensity versus moderate intensity interval training in obese metabolic syndrome patients: a randomized controlled study (2021)	HIIT, MIIT dan inactive control group	All three groups achieved significant weight loss, HIIT 3.9 kg p<0.001, MIIT 2 kg p=0.004, and the control group 2.8 kg p<0.001.
4	Reljic, D., et al. Low-volume high-intensity interval training improves cardiometabolic health, work ability and well-being in severely obese individuals: a randomized-controlled trial sub-study (2020)	HIIT, Inactive control group	Both groups experienced significant weight loss, HIIT -5.3 kg p<0.001, and the control group -3.7 kg p<0.001. HIIT body fat mass reduction -4.7 kg p<0.001, control group -2.8 kg p=0.001. HIIT body fluid reduction -0.4 L p=0.02, control group -0.8 L p=0.02.
5	Vaccari, F., et al. Effects of 3-month high-intensity interval training vs. moderate endurance training and 4-month follow-up on fat metabolism, cardiorespiratory function and mitochondrial respiration in obese adults (2020)	MICT, HIIT	The average weight loss was 0.15 kg p<0.001, BMI decreased by 0.05 kgm2, fat mass decreased by 0.16 kg p<0.001, and fat free mass did not change significantly in both groups.
6	Saeidi, A., et al. Differential Effects of Exercise Programs on Neuregulin 4, Body Composition and Cardiometabolic Risk Factors in Men with Obesity (2022)	HIIT, Circuit Resistance Training (CRT), MICT, control group	Body fat percentage decreased in the HIIT (−11%), CRT (−8%), and MICT protocols (−8%) compared to the control group ($p < 0.05$). There was an increase in FFM after the CRT protocol (11%) and HIIT (5%) however, this increase was only significant in the CRT protocol compared to the MICT and control groups ($p < 0.05$). There was no significant decrease in BMI and body weight after participating in the training program ($p>0.05$).
7	D' Amuri, A., Sanz, J. M., Capatti, E., Di Vece, F., Vaccari, F., Lazzer, S., Zuliani, G., Dalla Nora, E., & Passaro, A. Effectiveness of high-intensity interval training for weight loss in adults with obesity: A randomised controlled non-inferiority trial (2021)	HIIT, MICT	Weight loss on both arms. HIIT reduced body weight by −5.7 kg (−8.3 kg to −3.1 kg (p=0.001) whereas MICT was − 6.0 kg (−9.0 kg to −3.0 kg) p<0001) with no significant difference. significant between experimental groups.
8	Roy, M., Williams, S. M., Brown, R. C., Meredith-Jones, K. A., Osborne, H., Jospe, M., & Taylor, R. W. High-Intensity Interval Training in the Real World: Outcomes from a 12-Month Intervention in Overweight Adult (2018)	HIIT, Exercise guidelines New Zealand	There was no difference in body weight between the exercise groups (HIIT-adjusted vs conventional difference.
9	Gripp, F., Nava, R. C., Cassilhas, R. C., Esteves, E. A., Magalhães, C. O. D., Dias-Peixoto, M. F., de Castro Magalhães, F., & Amorim, F. T. HIIT is superior than MICT on cardiometabolic health during training and detraining (2021)	HIIT, MICT	Compared to pre-training, BMI was significantly lower after training (p<0.000, g= -0.60) and TC (training cessation) (p<0.0001, g=− 0.41) in the HIIT group. MICT also reduced BMI from pre to post exercise (p<0.01, g=− 0.13) but BMI returned to near baseline after TC (p>0.05, g= −0.08). Compared to before, body fat percentage was not affected by MICT at post-exercise (p>0.05, g=− 0.13) and TC (p>0.05, g=− 0.04). Only HIIT reduced post-exercise body fat percentage (p<0.0001, g= -0.38) and TC (p<0.001, -0.26). Visceral fat volume was significantly lower post-exercise compared to pre-exercise in both the HIIT (p<0.0001, g= −0.23) and MIC (p<0.001, g= −0.19) groups. Visceral fat volume returned to pre-training levels, which were significantly higher than post-training levels in both HIIT (p<0.001. g=0.20) and MICT (p<0.01,
10	Chin, E. C., Yu, A. P., Lai, C. W., Fong, D. Y., Chan, D. K., Wong, S. H., Sun, F., Ngai, H. H., Yung, P. S. H., & Siu, P. M. Low-frequency HIIT improves body composition and aerobic capacity in overweight men (2019)	No intervention, MICT, HIIT 3/week, HIIT 2/week, HIIT 1/week	The body fat mass and body fat mass percentages across all HIIT interventions were significantly lower than the CON group after 4 weeks of exercise, but a decrease was not observed in the MICT-3/week group after 4 weeks of exercise. In addition, all HIIT groups showed significantly higher percentage values of fat-free mass than the CON group after 4 weeks of intervention, but no significant improvement was found in the MICT-3/week group. All the group that received the HIIT intervention showed lower body fat mass values than those that did CON on the post-test. Waist circumference tended to decrease in all exercise groups, but the time-group interaction effect did not reach statistical significance (interaction effect, p=0.079; time effect, P=0.28). Body weight and BMI in the HIIT-3/week group and the HIIT-2/week group were significantly lower than the CON group at midtest and posttest. Body weight and BMI in the MICT-3/week group and the HIIT-1/week group were significantly different significantly with the HIIT-3/week group and the HIIT-2/week group at the posttest. (CON vs all exercise groups, p<0.05).
11	Berge, J., Hjelmesæth, J., Kolotkin, R. L., Støren, Ø., Bratland-Sanda, S., Hertel, J. K., Gjevestad, E., Småstuen, M. C., Helgerud, J., & Bernklev, T. Effect of aerobic exercise intensity on health-related quality of life in severe obesity: a randomized controlled trial (2022)	HIIT, HIIT or MICT, MICT	HIIT/MICT and MICT were associated with significant weight loss of 5 kg and 2 kg, respectively. BMI, body weight, and fat mass decreased significantly more in the HIIT/MICT group than in the MICT group, with a difference between groups of −1.2 (95% CI:−2.3 to −0.2) kg/m2 , −3.3 (95% CI: −6.4 to −0.2) kg, and −2.9 (95% CI: −5.3 to −0.5) kg.

Discussion

Based on the research results in Table 1, the results are presented that of the 11 articles used, there are 2 articles with a value of 6, consisting of 6 articles with a value of 7, 2 articles with a value of 8, and only 1 article with a value of 10 and included in the highest value of all the articles obtained. Then of all the journals used, 10 articles fall into the Q1 category, only 1 article in the Q3 category.

Based on the results from Table 2, all articles with a total of 11 studies used samples from obese populations in the adult age group, both female and male. All articles use HIIT as the intervention to be used and use MICT, New Zealand exercise guidelines, and inactive groups as a comparison of the treatment given in the article.

Based on the results of the study in Table 3, the results of the study stated that HIIT was able to reduce weight in obese conditions in the adult age category for 8 weeks of exercise [18]. Weight loss in the HIIT group varied from each article, namely as much as 3.9 kg, 5.3 kg, 5.7kg, and 5kg, All comparison groups from articles that discussed the relationship between HIIT and BMI also experienced weight loss, but HIIT has the advantage of losing weight compared to several other comparisons, except for the study conducted by D'Amuri et al in 2021 which showed greater weight loss results in the MICT group, which was 0.3kg more than the HIIT group which was only 5.7 kg, but in both groups did not have a significant difference [20, 21, 24, 28].

The results of research from several articles differ from the previous discussion, several articles stated that the decrease in BMI and weight was not significant after participating in an exercise program where the p-value was > 0.05 [23]. The results of another study also revealed that there was no difference in weight between exercise groups HIIT-adjusted vs. conventional differences [25].

Physical activity has direct or indirect benefits, an increase in physical activity is important in efforts to lose weight because it increases energy expenditure and plays an integral role in maintaining body weight, physical activity also reduces the risk of heart disease more than is achieved by losing weight alone [29]. In addition, an increase in physical activity can also help reduce body fat and is also able to prevent the decrease in muscle mass that often occurs in someone when there is weight loss [29].

For a person with obesity, activity should generally be increased slowly, and also done carefully to avoid injury. There are a variety of activities and/or household chores, including walking, dancing, gardening, and sports [29]. All adults should set a long-term goal of accumulating at least 30 minutes or more every day of the week [29]. Someone who does HIIT exercises every time will get an effect known as EPOC or excess oxygen consumption after exercise which can increase calorie burning [30].

There is a push in the form of having EPOC in a person's body at a higher rate for at least 10 hours thereafter and an average of 35 additional calories/hour, so this means that a person can do 4 minutes of exercise in the morning and burn more throughout the day. a lot of calories which is equal to 350 calories, thus HIIT can be the perfect weight loss exercise [30]. One of the reasons why HIIT is so popular is that it promises measurable and sustainable weight loss. If the individual is willing to work hard and of course monitor their nutrition, HIIT is more effective than other forms of exercise in losing weight [12].

Conclusion

HIIT shows results in the form of being able to lose weight for someone who is obese with the age of the adult age group. This research is expected to provide input to trainers, individuals, or groups regarding exercise in individuals who are obese, and of course, it is necessary to pay attention to a person's condition in providing this HIIT exercise, because the body capacity of each human being is different. This exercise also needs to be accompanied to avoid injury.

Declaration

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Conflicts of Interest: The authors declare no conflict of interest

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