



# The effect of gymnastics on changes in nutritional status and physical fitness levels in overweight and obese adolescents

## *Pengaruh olahraga senam kebugaran jasmani terhadap perubahan IMT dan kebugaran fisik remaja overweight dan obesitas*

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## Abstract

Gymnastics is a sport that affects the BMI and physical fitness of overweight and obese adolescents. Overweight and obesity occur due to an imbalance in energy intake and expenditure and a decrease in physical activity, which can cause adolescent health problems. This study aims to analyze the effect of physical fitness gymnastics on changes in BMI and physical fitness of overweight and obese adolescents. The research design is a quasi-experimental pre-post intervention study. The research was conducted at the 2nd and 3rd State Junior High Schools in Samarinda City, from November 2020 to January 2021. A sample of 38 people was selected using purposive sampling. Data collection was collected by weighing, measuring height, and measuring nutritional status using BMI for age. Fitness data obtained from IPFT measurement results. Statistical analysis using T-tests. The results showed that there was no difference in body weight and fitness before and after exercise intervention in the two groups (overweight and obese) ( $p > 0,05$ ), but BMI for age showed a difference before and after ( $p < 0,05$ ). With the difference in changes in body weight ( $2,35 \pm 0,85$  kg), BMI for age ( $0,52 \pm 18,43$ ), and increased fitness ( $2,86 \pm 2,50$ ). In conclusion, the physical fitness exercise intervention affected changes in body weight, BMI for age, and physical fitness of overweight and obese adolescents, which was carried out for 12 weeks with a frequency of 5 times per week for 30 minutes.

**Keywords:** Adolescents, BMI, fitness, physical activity, overweight

## Abstrak

Olahraga senam merupakan olahraga yang mempengaruhi IMT dan kebugaran fisik remaja *overweight* dan *obesity*. *Overweight* dan *obesity* terjadi akibat ketidakseimbangan asupan dan pengeluaran energi, serta terjadinya penurunan aktivitas fisik yang dapat menyebabkan masalah kesehatan remaja. Penelitian ini bertujuan untuk menganalisis pengaruh olahraga senam kebugaran jasmani terhadap perubahan IMT dan kebugaran fisik remaja *overweight* dan *obesity*. Desain penelitian adalah *quasi eksperimen pre-post intervention study*. Penelitian telah dilakukan di SMP Negeri 2 dan SMP Negeri 3 Kota Samarinda, sejak November 2020 – Januari 2021. Sampel sebanyak 38 orang, terpilih menggunakan *purposive sampling*. Pengumpulan data dilakukan dengan penimbangan berat badan, pengukuran tinggi badan, dan pengukuran status gizi dengan menggunakan IMT/U. Data kebugaran diperoleh dari hasil pengukuran TKJI. Analisis statistik menggunakan uji T-test. Hasil menunjukkan bahwa tidak ada perbedaan berat badan dan kebugaran sebelum dan sesudah intervensi olahraga pada kedua kelompok (*overweight* dan *obesity*) ( $p > 0,05$ ), namun IMT/U menunjukkan ada perbedaan sebelum dan sesudah ( $p < 0,05$ ). Dengan selisih perubahan berat badan ( $2,35 \pm 0,85$  kg), IMT/U ( $0,52 \pm 18,43$ ), dan peningkatan kebugaran ( $2,86 \pm 2,50$ ). Kesimpulan, Intervensi olahraga senam kebugaran jasmani memberikan pengaruh terhadap perubahan berat badan, IMT/U, dan kebugaran fisik remaja *overweight* dan *obesity* yang dilakukan selama 12 minggu dengan frekuensi 5 kali per minggu selama 30 menit.

**Kata Kunci:** Aktivitas fisik, kebugaran, IMT, remaja, overweight

## Introduction

Gymnastics is a sport that affects Body Mass Index (BMI) and fitness among teenage who are overweight and obese. Overweight and obesity in adolescents are factors associated with increased mortality and morbidity. In developed countries, obesity has become an epidemic, contributing 35% to the rate of pain and 15-20% to death. Obesity does not lead to immediate death but causes serious health problems that can trigger an increased risk of non-communicable diseases, such as type 2 diabetes mellitus, cardiovascular disease, kidney disease, and cancer, as well as increased rates of premature death (Al Rahmad et al., 2020; Cercato & Fonseca, 2019; Ellulu et al., 2017).

The prevalence of overweight and obesity in Indonesia among teenagers aged 13-15 increased from 10,8% in 2013 to 16% in 2018. The prevalence of overweight and obesity in Eastern Kalimantan increased from 16,3% in 2013 to 19,1% in 2018. The prevalence of overweight and obesity in the City of Samarinda was 19,4%. In addition, there was an increase in non-communicable diseases, namely heart disease (1,2%) and stroke (4,7%) (Kemenkes RI, 2018). A study of middle-aged adolescents in Surabaya showed an increase in the prevalence of overweight (28,1%) and obesity (21,9%). The problem of overweight and obesity in adolescents is caused by excessive food consumption and very mild physical activity; adolescents have a 9,5 times greater risk of obesity compared to adolescents with moderate physical activity (Praditasari & Sumarmik, 2018; Rahmad, 2021).

Being overweight and obese is caused by imbalances in intake coming from production (Rogge & Gautam, 2017; Sjarif et al., 2011). In this case, physical activity requires energy to move the body and skeletal muscles. Teenagers now spend more time playing on smartphones, playing at computers, watching TV, and spending snacks that take time to do fewer physical activities such as walking, climbing the stairs, or other sports (Vasques et al., 2012). They play more at home, especially now during the COVID-19 pandemic, making them have to be at home so that physical activity becomes reduced.

Physical activity in gymnastics is essential for teens to stay healthy and easily

concentrate during the COVID-19 pandemic and nutritional intake (Mahastuti et al., 2018). Most adolescents during the Covid-19 pandemic experience a decrease in physical activity, which will affect their health (Mi Xianga et al., 2020). Teenagers aged 16-19 in the United States during the Covid-19 pandemic showed as many as 2,98 times inactive (Ruíz-Roso et al., 2020). Moderate aerobic exercise 3 times a week, 50 minutes per session for 12 weeks, significantly lowered BMI for Age Z-score (BAZ) (Kelley et al., 2017).

Physical activity protects against viral infections and helps the immune system stay healthy, especially in children and adolescents, as it is associated with various body functions. (Jones & Davison, 2019). One way to fight COVID-19 is to physical fitness by exercising daily (Ulpi et al., 2022). Physical activity affects children's health and cognitive, emotional, and social abilities (Prasepty et al., 2017). Adolescents' physical activity in Eastern Kalimantan is still in the less active or sedentary category. Gymnastic sports intervention should be given to adolescents to improve BMI and fitness significantly in Samarinda adolescents aged 11-15. The study aims to analyze the effects of physical fitness on changes in BMI and physical fitness of overweight and obese adolescents.

## Methods

The research utilized a quasi-experimental pre-post intervention study. The study was conducted at the 2nd and 3rd State Junior High Schools in Samarinda City for 12 weeks, from November 2020 to January 2021.

The selection of research subjects using purposive sampling is class 7 and 8 students aged 11-15 who meet the inclusion and exclusion criteria. The inclusion criteria in this study are students whose nutritional status is based on BAZ, i.e., overweight (Z-Score > +1SD up to +2SD) and obese (Z Score > 2SD). The exclusion criteria are to use weight-loss medications or enroll in other weight-loss programs, follow similar studies, and suffer from congenital disabilities that cause bias in anthropometric measurements.

The sample size calculation of the intervention study was done from several

previous studies and obtained different sample calculation results. Different sample calculations are taken at the highest point in the sampling, i.e., as many as 16 people, to avoid dropout, then added 20% to obtain a large sample of 19 people. The study consisted of 2 schools, each with 19 people, making a total sample of 38 people. Sample size calculation in this study used the formulas from Sastroasmoro & Ismael (2016):

$$n = \frac{2(SD)^2(Z_{\alpha}+Z_{\beta})^2}{d^2}$$

$$n = \frac{2(1,5)^2(1,96+0,84)^2}{(1,5)^2}$$

$$n = 15,68$$

$$n = 16$$

Note:

n = Samples size of treatment group

SD = Standard deviation (1,5)

Z<sub>1-α</sub> = 95% confidence level (Z<sub>α</sub>= 1,96)

Z<sub>1-β</sub> = Power of test 84% (Z<sub>β</sub>=0,84)

d = Mean value difference between treatment and control groups (1,5)

The data collected is the characteristics of the subject (age and gender) and nutritional status (weight and height). High data was measured using a stature meter and weight measurement using the HBF-375 BIA scale (Bioelectric Impedance Analysis). The nutritional status of the subjects is determined by the age-based body mass index (BAZ). Daily physical activity measurement data using the Adolescent Physical Activity Questionnaire (APAQ). Adolescent activity levels were categorized as mild (PAL 1,4-1,6), moderate (PAL 1,7-1,9), and heavy (PAL 2,0-2,4).

Gymnastic interventions are carried out for 12 weeks (3 months) and five times a week (30 minutes) with new gymnastics. Gymnastic sports interventions are carried out daily for five days, from Monday to Friday. In addition, the physical fitness test consists of 1) running 50 meters. 2) hanging a body lift (son) and hanging an elbow (daughter) for 60 seconds. Sit up for 60 seconds. 4) Jump straight (vertical jump). 5) run a distance of 800 m (female) and

1000 m (male). The results of Indonesia Physical Fitness Test (IPFT) IPFT are good (18-21), medium (14-17), and less (10-13).

All intervention activities are carried out in school by keeping a health protocol: wearing masks, washing hands, keeping a distance, staying away from crowds with friends, and avoiding eating together. The intervention group was asked to come to the school for any physical fitness exercise based on the time specified and approved by the researchers, the head of the school, the sports teacher, the parents of the students, and the participants.

Data analysis is average, standard deviation (SD), and percentage. The normality of the data was tested using the Shapiro-Wilks test (n<50). The differences between the groups were analyzed with the T-Independent test, while the differences before and after were analyzed with the T-Dependent test at a 95% digestive rate.

The National and Political Union Agency, the Government of the Eastern Kalimantan Province, has approved the research. In addition, it has obtained ethical approval from the Research Ethics Commission involving human subjects of the Bogor Agricultural Institute with Number: 282/IT3.PJSC-IPB and SK/2020 Respondents were willing to follow this research until it was completed by signing the agreement (informed consent).

## Result and Discussion

### Characteristics of Subject

The study subjects were 38 students with nutritional status, namely overweight 63,2% of students and obese 36,8% of students. Of the characteristics of subjects based on gender, 55,3% were male and female, of only 44,7%. Male and female have different nutritional status. Male are more prone to obesity than female.

According to a study by Dupay et al. 2011, men are more likely to experience obesity than women. The statistical test results showed no differences between gender, age, height, weight, physical fitness, and physical activity (p > 0,05) between overweight and obese teens. However, BAZ is different between overweight and obesity in adolescents.

**Table 1.** Characteristics of Research Subject

Variable	Overweight (n= 24)		Obesity (n= 14)		Total	p-value
	n	%	n	%		
Sex						
Male	13	54,2	8	57,1	21 (55,3)	0,863 <sup>a)</sup>
Female	11	45,8	6	42,9	17 (44,7)	
The Variable	(Min-Max)	Mean ± SD	(Min-Max)	Mean ± SD		
Age (year)	(11 - 14)	12,42 ± 0,71	(11 - 14)	12,79 ± 0,89	12,55 ± 0,795	0,171 <sup>a)</sup>
High body (cm)	(145,4 - 174,0)	157,22 ± 8,01	(144,7 - 174,5)	160,35 ± 8,30	158,37 ± 8,15	0,269 <sup>b)</sup>
Weight of body (kg)	(53,70 - 89,50)	66,86 ± 9,61	(53,20 - 81,30)	66,58 ± 7,91	66,76 ± 8,91	0,844 <sup>b)</sup>
BAZ (z-score)	(1,00 - 1,99)	1,56 ± 0,33	(2,01 - 2,85)	2,29 ± 2,69	1,83 ± 0,47	0,000 <sup>b)</sup>
Physical fitness	(10 - 17)	11,95 ± 1,75	(10,00 - 17,00)	12,14 ± 2,14	12,03 ± 1,88	0,775 <sup>a)</sup>
Less	20	83,3	12	85,7	32 (84,2)	
Currently well	4	16,7	2	14,3	6 (15,8)	
	0	0,0	0	0,0	0 (0,0)	
Physical Activity	(1,50 - 2,74)	1,88 ± 0,27	(1,30 - 1,99)	1,75 ± 0,177	1,83 ± 0,25	0,118 <sup>a)</sup>
lightly	5	20,0	4	28,6	9 (23,7)	
Currently	11	45,8	9	64,3	20 (52,6)	
Heavy	8	33,3	1	7,1	9 (23,7)	

Significant p<0,05; <sup>a)</sup>Independent Samples Test; <sup>b)</sup>Mann-Whitney Test

**Table 2.** Differences in weight, BMI, and physical fitness

Variable	Overweight (n= 24)		Obesity (n= 14)		p-value
	(Min-Max)	Mean ± SD	(Min-Max)	Mean ± SD	
Weight of body (kg)					
Before	(53,70 - 89,50)	66,86 ± 9,61	(53,20 - 81,30)	66,58 ± 7,91	0,844 <sup>b)</sup>
After	(52,50 - 87,20)	64,84 ± 9,41	(50,30 - 78,30)	64,23 ± 7,96	
p-value		0,000 <sup>d)</sup>		0,000 <sup>d)</sup>	
BAZ					
Before	(1,06 - 1,90)	1,56 ± 0,33	(2,01 - 2,85)	2,29 ± 0,26	0,000 <sup>b)</sup>
After	(0,92 - 2,40)	1,51 ± 0,35	(0,67 - 2,43)	1,77 ± 0,45	
p-value		0,019 <sup>d)</sup>		0,001 <sup>d)</sup>	
Physical fitness					
Before	(10 - 17)	11,96 ± 1,75	(10 - 17)	12,14 ± 7,14	0,775 <sup>a)</sup>
After	(12 - 19)	16,08 ± 1,95	(12 - 18)	15,00 ± 1,79	
p-value		0,000 <sup>c)</sup>		0,006 <sup>d)</sup>	

SD (standard deviation); Significant p<0,05; <sup>a)</sup>Independent Sample test; <sup>b)</sup>Mann-Whitney test; <sup>c)</sup>Paired sample test; <sup>d)</sup>Wilcoxon test

**Table 3.** Changes in weight, BAZ, and physical fitness

Variable	Overweight (n= 24)		Obesity (n= 14)		p-value
	(Min-Max)	Mean ± SD	(Min-Max)	Mean ± SD	
Δ Weight (kg)	(0,10 - 3,70)	2,02 ± 0,81	(0,50 - 3,50)	2,35 ± 0,85	0,192
Δ BAZ (z-score)	(0,17 - 1,70)	0,05 ± 37,50	(0,17 - 1,70)	0,52 ± 18,43	0,000
Δ Physical Fitness	(1 - 7)	4,12 ± 2,09	(3 - 7)	2,86 ± 2,50	0,103

Significant p<0,05; <sup>a)</sup>Independent Samples test; <sup>b)</sup>Mann-Whitney test; Δ The difference in data before and after

**Difference and Change Between weight, BAZ, and Fitness Level**

The results of the statistical trial (Table 2) with the Mann-Whitney trial in both groups (overweight and obesity) showed that there were no differences in weight and physical fitness before and after gymnastic intervention in overweight adolescents and obese adolescents (p > 0,05). However, there were differences in BAZ before and after exercise intervention in overweight and obese adolescents (p < 0,05).

Statistical test results with the Wilcoxon test showed differences before and after exercise

intervention in overweight adolescents regarding weight, BAZ values, and adolescent physical fitness (p < 0,05). Also, in adolescents with obesity, the statistics showed differences in weight and BAZ values and the physical fitness of obese adolescents (p < 0,05).

Results of the study on changes in nutritional status after exercise intervention (Table 3), i.e., weight loss, BAZ values, and increased physical fitness versus overweight nutrition status. While the nutritional status of obesity also shows weight loss, BAZ values, and increased physical fitness. The results of

statistical tests showed no difference between weight changes and the level of physical fitness compared to the nutritional status of overweight and obesity before and after exercise interventions ( $p > 0,05$ ). However, there were differences between changes in the nutritional status of overweight and obesity in BAZ before and after exercise intervention ( $p = 0,000$ ).

The effects of exercise before and after the intervention on body weight did not differ significantly ( $p > 0,05$ ). The 12-week intervention, for 30 minutes (5 times a week), lost weight by  $2,02 \pm 0,81$  kg in overweight nutritional status and  $2,35 \pm 0,85$  kg in obese nutrition status. Exercise with moderate intensity can reduce weight. According to a 2017 study by Chiu et al., 12-week exercise interventions significantly altered body weight. The intervention of mild to high-intensity exercise for 12 weeks with high energy expenditure significantly reduces body weight (Chiu et al., 2017). Children and adolescents aged 5 to 17 with moderate-intensity physical activity performed  $\geq 5$  days per week with an average length of activity  $\geq 150$  minutes per week ( $\geq 30$  minutes per day) significantly lost weight. They provide health benefits and strengthen muscles and bones (Kemenkes RI, 2018).

The effects of gymnastics before and after intervention on BAZ were significant ( $p > 0,05$ ). The 12-week intervention reduced BAZ by  $0,05 \pm 37,50$  in overweight nutritional status and  $0,52 \pm 18,43$  in obesity. Some studies show that gymnastics with moderate intensity can lower BAZ. Research by George et al. 2017 showed that aerobic exercise 3 times a week, 50 minutes per session for 12 weeks, significantly reduces BAZ (Mean  $\pm$  SD, 95% CI: 0,05; 0,10; up to 0,15) (Kelley et al., 2017).

The effect of gymnastics on physical fitness before and after the intervention did not differ significantly ( $p > 0,05$ ). Before the intervention, most students had a poor fitness level, and there was an increase in better after the intervention. Indicates that nutritional status affects physical fitness. A person with good nutrition will have good physical fitness; on the contrary, the good physical condition requires good nutritional status (Nasrulsyah et al., 2022; Sepriadi, 2017).

The study results showed that adolescent activity was generally in the moderate category before the intervention, and activity was in the heavy category after the intervention. Generally,

before the intervention, more students spend hours playing on smartphones, playing at computers, and watching TV. Hence, they do fewer physical activities such as walking, climbing the stairs, or other sports. They play more at home, especially now during the Covid-19 pandemic, making them have to be at home so that physical activity becomes reduced. Physical activity strongly influences physical fitness (Mahastuti et al., 2018). Most adolescents during the Covid-19 pandemic experience decreased physical activity, which will affect their health (Mi Xiang et al., 2020). Children who are overweight and obese are less physically active and have lower physical fitness than children with a normal weight. Children who are overweight and obese are less physically active and have lower physical fitness than children with a normal weight (Raistenskis et al., 2016).

During the COVID-19 pandemic, all learning activities were done online at home. It causes students to be too lazy to move, more sitting in front of headphones or laptops. Gultom et al. 2022 research show a significant link between student physical fitness and learning performance and a significant relationship between nutritional status and physical fitness and student learning performance. Physical fitness contributed to student learning performance by providing an effective contribution of 39%, while nutritional status was 72,53% (Gultom et al., 2021). Physical activity scores in children and adolescents decreased significantly during pandemics (Gultom et al., 2021).

Before the Covid-19 pandemic, physical fitness in adolescents was higher than during the COVID-19 epidemic (Zhou et al., 2022). Teenagers with overweight and obesity mostly have mild to moderate physical activity. Teenagers who suffer from obesity mostly have mild physical activity and are obese. There is a link between physical activity and obesity in adolescents (Suza et al., 2020). Lower activity in adolescents is 3,3 times more likely to develop obesity than moderate physical activity (Wahyuningsih & Pratiwi, 2019).

This study shows that most of the subjects' physical activity is low due to the condition of the subject, who have a nutritional status of overweight and obese. With the intervention of gymnastics, sports are intended to improve the subject's physical fitness. It is obtained when the

subject is given gymnastic sports intervention, i.e., gymnastics of natural fitness. There is an increase in physical fitness. Results of research Lismana and Suwarni 2021, gymnastics of fitness can improve fitness in teenagers in Madrasah Aliyah Ja-Al Haq Bengkulu City (Lismana & Suwarni, 2021). Before the gymnastics of fitness, the average IPFT value was 15.77, and after the interventions of the fitness gymnasium, the mean IPFT rate increased to 17,20. Poco-Poco exercise can affect the subject's fitness level (Rafiun & Yamin, 2022). Fitness gymnastics can increase the maximum oxygen volume capacity (VO2 Max). The results of this study show that there is a significant influence on physical fitness (4,15>3,23) on the increase in VO2 max in students of class XI SMK Sukoharjo Pringsewu (Sari, 2018).

Exercise is one of the forms of physical activity that everyone should perform, including teenagers with overweight and obesity. Exercise helps improve a person's quality of life, including weight loss and fitness (Cox, 2017; Swift et al., 2018). The subjects in the study were teenagers who were still sitting on the school bench with nutritional status of overweight and obese. As a teenager, a good level of fitness is required to perform good physical activity, including learning. Gymnastics is one of the sports that can be followed by all groups in the school environment and the community because gymnastics are cheap, fun, and can be done together.

The gymnastics are often done because they are usually performed with low to moderate intensity, about 30-60 minutes (Kemenkes RI, 2018; WHO, 2020). The benefits of exercising are one of the best ways to burn calories and fat in our bodies, as large groups of muscles move dynamically from the upper and lower parts of the body. A good level of physical fitness requires a good nutritional status. The better his status, the higher his physical fitness (Pascoal & Purnomo, 2010). Sport is part of physical activity. Physical activity significantly affects a person's level of physical fitness (Pascoal et al., 2015; Yani et al., 2022). One physical activity that is suitable for increasing physical fitness is exercise. The ideal exercise is the exercise that can increase the endurance of the heart and lungs as well as train the strength and strength of the muscles. The size of the exercise can be judged based on the type of

exercise performed, frequency, intensity, and length of exercise. However, in reality, humans often ignore their physical condition.

The more frequent exercise, the more improves the physical fitness of adolescents. Researching Amiruddin (2011), Most schoolchildren do not exercise. Their average frequency of exercise activity per week was only once, with fitness levels mostly lower (69,6%). The low frequency of the subject's exercise is likely due to the less attractive type of exercise or related to the subjects' social interactions. Young women usually prefer sports if done with peers (community) or usually done together, not alone. Students in this study performed fewer sports activities because more schoolwork had to be done. Obesity in elementary school children can affect fitness levels. The higher the body mass index, the lower a person's fitness level (Soares, 2013).

Muscle and heart resistance in overweight and low obesity children. Decreased fitness levels in overweight and obese children can affect children's learning performance. The level of aerobic fitness of a child is linked to learning performance. Academic achievements were found to be fitter than unfit children (96,8%). Physical fitness has a significant relationship with academic performance in children ( $p= 0,040$ ). Children who were not fit had 5,6 times lower academic achievements than fit children. Physical fitness can improve learning performance in school children (Yulianti et al., 2017).

The disadvantage of this study is that it does not control food intake. The research was conducted during the Covid-19 pandemic, which was challenging to gather students. The advantage of this study by performing physical fitness interventions for 12 weeks can reduce weight and improve the physical fitness of overweight and obese teenagers.

## Conclusion

Interventions affect weight changes, BAZ, and physical fitness adolescents overweight and obese performed for 12 weeks with a frequency of 5 times a week for 30 minutes.

Regular and structured exercise can improve body weight, BMI, and physical fitness to prevent overweight and obesity, and non-communicable diseases.

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