

The Effect of Walking Physical Activity on Body Mass Index in an Efforts to Prevent Obesity in Adolescents at State Senior High School 1 Kundur

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Abstract

The prevalence of obesity in adolescents in Kundur District shows a figure of 13.98% with risk factors in the form of high screen time and low walking activity. This study aims to determine the effect of physical activity of walking on body mass index as an effort to prevent obesity in adolescents at SMA Negeri 1 Kundur. The study design used One Group Pretest-Posttest Design with a population of 336 students and a sample of 36 respondents selected using purposive sampling technique. The inclusion criteria were adolescents with a BMI of 25-27kg/m². The intervention in the form of physical activity of walking for 60 minutes was carried out 4 times a week for 4 weeks. Data were analyzed using the Shapiro-Wilk normality test and paired t-test. The average BMI value before the intervention was 26.13 $\pm$ 0.44kg/m², while after the intervention it became 25.59 $\pm$ 0.58kg/m². A total of 29 respondents (80.6%) experienced a decrease in BMI, 7 respondents (19.4%) maintained their BMI, and 5 respondents (13.9%) experienced a change in category from obese to normal. The paired t-test results showed a significant decrease (p-value 0.000 < 0.05) with a t-value of 5.984. There is a significant effect of walking physical activity on reducing body mass index in adolescents at SMA Negeri 1 Kundur. Walking physical activity can be an effective intervention to prevent obesity in adolescents by significantly reducing BMI.

Keywords : Adolescents; Body Mass Index; Obesity; Physical Activity; Walking

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Pengaruh Aktivitas Fisik Berjalan Kaki Terhadap Indeks Massa Tubuh Dalam Upaya Pencegahan Obesitas Pada Remaja Di SMA Negeri 1 Kundur

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Abstrak

Prevalensi obesitas pada remaja di Kecamatan Kundur menunjukkan angka 13,98% dengan faktor risiko berupa tingginya screen time dan rendahnya aktivitas berjalan kaki. Penelitian ini bertujuan untuk mengetahui pengaruh aktivitas fisik berjalan kaki terhadap indeks massa tubuh sebagai upaya mencegah obesitas pada remaja di SMA Negeri 1 Kundur. Desain penelitian menggunakan One Group Pretest-Posttest Design dengan populasi 336 siswa dan sampel 36 responden yang dipilih menggunakan teknik purposive sampling. Kriteria inklusi adalah remaja dengan IMT 25-27 kg/m². Intervensi berupa aktivitas fisik berjalan kaki selama 60 menit dilakukan 4 kali seminggu selama 4 minggu. Data dianalisis menggunakan uji normalitas Shapiro-Wilk dan uji paired t-test. Nilai rata-rata IMT sebelum intervensi adalah $26,13 \pm 0,44$ kg/m², sedangkan setelah intervensi menjadi $25,59 \pm 0,58$ kg/m². Sebanyak 29 responden (80,6%) mengalami penurunan IMT, 7 responden (19,4%) IMT tetap, dan 5 responden (13,9%) mengalami perubahan kategori dari gemuk menjadi normal. Hasil uji paired t-test menunjukkan penurunan signifikan (p value = $0,000 < 0,05$) dengan nilai $t = 5,984$. Terdapat pengaruh signifikan aktivitas fisik berjalan kaki terhadap penurunan indeks massa tubuh pada remaja di SMA Negeri 1 Kundur. Aktivitas fisik berjalan kaki dapat menjadi intervensi efektif untuk mencegah obesitas pada remaja dengan menurunkan nilai IMT secara bermakna.

Kata Kunci : Aktivitas fisik; Berjalan kaki; Indeks massa tubuh; Obesitas; Remaja

Introduction

Adolescent obesity is a global health problem with increasing prevalence. The World Health Organization (WHO) reports that the incidence of obesity worldwide nearly tripled between 1975 and 2016, with more than 340 million children and adolescents aged 5-19 experiencing obesity (Organização Mundial de Saúde, 2022). Indonesia is considered to be at high risk of obesity, ranking fourth globally in terms of the absolute number of obese school-aged children and adolescents

(Kementerian Kesehatan Republik Indonesia, 2024).

Basic Health Research data shows that the prevalence of obesity among adolescents aged 16-18 increased from 1.6% in 2013 to 4% in 2018 (Telisa et al., 2020). In the Riau Islands Province, the prevalence of obesity reached 26.8%, ranking it eighth highest in Indonesia (Pratama, 2023). Specifically, in Karimun Regency, Kundur District ranked third with 98 adolescents experiencing obesity in 2024 (Puspita & Utami, 2020).

Obesity in adolescents is caused by various factors, one of which is a lack of physical activity. The COVID-19 pandemic in 2020 exacerbated this situation by restricting activities to the home, leading to a sedentary lifestyle (Sambo et al., 2023). The majority of adolescents use public or private transportation, which reduces the frequency of walking. This, coupled with high screen time spent using electronic devices such as mobile phones and video games, further reduces physical activity and increases body mass index (BMI).

Walking is a simple intervention that has the advantages of the 5Ms (Easy, Cheap, Fun, Massive, and Beneficial). Walking can be done by anyone without the need for equipment or trained personnel, and is highly beneficial for fitness and health if done regularly (Faizah, Lawi, Toto, et al., 2025). Previous research has shown that physical activity such as walking can reduce BMI in adolescents (Górnicka et al., 2020).

According to the 2024 Adolescent Health Report, SMA Negeri 1 Kundur had the highest obesity rate, with 47 students having a BMI >25 and 12 students having a BMI >27 out of a total of 336 students, representing a 13.98% obesity risk prevalence. A preliminary survey showed that 50% of students had screen time of 2-5 hours, and 30% had screen time of more than 5 hours per day. The majority of students use transportation to school, resulting in very low walking activity.

This study aims to determine the effect of physical activity such as walking on body mass index as an

effort to prevent obesity in adolescents at SMA Negeri 1 Kundur.

Methodology

Research Design

This study used a pre-experimental design with a One Group Pretest-Posttest Design approach. This design involves one group of subjects who are observed before and after the intervention.

Population and Sample

The study population was all 336 students at SMA Negeri 1 Kundur. The sample was selected using a purposive sampling technique, with 36 respondents who met the inclusion and exclusion criteria.

Inclusion Criteria:

1. Adolescents with a BMI of 25-27 kg/m² (overweight/at-risk of obesity).
2. No physical disabilities.
3. Written informed consent from parents or guardians and participants.
4. Willingness to participate in the intervention and follow-up examination within 30 days.

Exclusion Criteria:

1. History of and/or current cardiovascular disease or kidney failure.
2. Unforeseen circumstances such as force majeure (accident, death, relocation).

Research Location and Time

The research was conducted at SMA Negeri 1 Kundur, Karimun Regency, from July 14 to August 15, 2025. BMI measurements before the intervention were conducted on July 14, 2025, and

BMI measurements after the intervention were conducted on August 15, 2025.

Intervention

The intervention consisted of walking physical activity with the following protocol:

1. Duration: 60 minutes per session.
2. Frequency: 4 times per week
3. Period: 4 weeks (16 sessions total).
4. Target steps: 6,000-9,000 steps per session.
5. Target speed: 4.8-6.5 km/h.
6. Monitoring: Using a pedometer and observation sheet.

Each session began with a 5-minute warm-up, followed by a 60-minute walk with proper posture and technique, and concluded with a 5-10 minutes cool-down.

Research Instruments

This research was involved instruments:

1. Digital scale for measuring weight.
2. Microtoise for measuring height.
3. Pedometer for counting steps.
4. Physical activity observation sheet.
5. BMI recording sheet.

Data Collection

The data collected were primary data, including:

1. Measurement of respondents' weight and height
2. Calculation of BMI using the formula: $BMI = \text{Weight (kg)} / \text{Height}^2 (\text{m}^2)$
3. Recording of daily steps using a pedometer
4. Intervention implementation observation sheet

Data collection procedures:

1. Coordination with school officials and parents
2. Socialization and signing of informed consent
3. BMI measurement before the intervention (pretest)
4. Implementation of the walking intervention for 4 weeks under researcher supervision
5. Monitoring through in-person visits and WhatsApp groups
6. BMI measurement after the intervention (posttest)

Data Analysis

Data were analyzed using SPSS with the following steps:

1. Univariate Analysis: Descriptive analysis to describe respondent characteristics and the distribution of BMI values before and after the intervention, presented as mean, standard deviation, minimum, and maximum values.
2. Normality Test: The normality test was performed using the Shapiro-Wilk test because the sample size was <100 , with the data being normally distributed if the significance value was > 0.05 Adolescents at SMA Negeri 1 Kundur.
3. Bivariate Analysis: The paired t-test was used to compare mean BMI before and after the intervention if the data were normally distributed. The significance level used was $\alpha = 0.05$. If the p-value is <0.05 , then H_0 is rejected, indicating a significant effect walking physical activity on BMI.

Research Ethics

This research has received ethical approval and research permits from the relevant parties, the description of ethical approval number in the manuscript 182P/LPPM-UNIBA/PI-EC/VIII/2025. The ethical principles applied include:

1. Informed consent from respondents and parents/guardians
2. Confidentiality of respondent data (anonymity and confidentiality)
3. Principles of beneficence and non-maleficence

4. Respondents have the right to withdraw without penalty

Results

This study involved 36 respondents with the following characteristics: based on age, 10 respondents (27.8%) were 15 years old, 14 respondents (38.9%) were 16 years old, and 12 respondents (33.3%) were 17 years old. Based on gender, 20 respondents (55.6%) were male and 16 respondents (44.4%) were female. Based on grade level, 10 respondents (27.8%) were from grade 10, 14 respondents (38.9%) were from grade 11, and 12 respondents (33.3%) were from grade 12.

Table 1. Distribution of BMI Values Before and After Walking Physical Activity Intervention in Adolescents at SMA Negeri 1 Kundur (n=36)

Variable	Mean Median	Standard deviation	Minimum-Maximum
BMI Before Intervention	26.13	0.44	25,30-26,84
BMI After Intervention	25.59	0.58	24,65-26,64

Based on Table 1, the average BMI before the intervention was 26.13 ± 0.44 kg/m², with a lowest value of 25.30 kg/m² and a highest value of 26.84 kg/m², indicating that all respondents were in the overweight category (at risk of obesity). After the intervention, the average BMI decreased to 25.59 ± 0.58 kg/m², with a lowest value of 24.65 kg/m² (normal category) and a highest value

of 26.64 kg/m² (overweight category).

Of the 36 respondents, 29 (80.6%) experienced a decrease in BMI, 7 (19.4%) experienced a stable BMI, and 5 (13.9%) experienced a change from overweight to normal category. No respondents experienced an increase in BMI during the intervention period.

Table 2. Results of the Normality Test of BMI Data Before and After Intervention

Variable	Mean Median	Saphiro-Wilk Statistic	Sig.
BMI Intervention Before		0.954	0.277
BMI Intervention After		0.951	0.116

The results of the Shapiro-Wilk normality test showed that the BMI data before the intervention had a significance value of 0.277 (>0.05) and the BMI data after the

intervention had a significance value of 0.116 (>0.05). This indicates that the data are normally distributed, allowing bivariate analysis to proceed using the paired t-test.

Table 3. Paired T-Test Results: The Effect of Walking Physical Activity on Body Mass Index

Variable	Mean Difference	Std. Deviation	t-test (2-tailed)	df	Sig
BMI Intervention Before-After	-0.537	0,539*	5.984	35	0.000

The results of the paired t-test showed a mean difference value of 0.537 with a standard deviation of 0.539. The calculated t-value was 5.984 with a degree of freedom (df) of 35 and a significance value (p-value) of 0.000. Since the p-value ($0.000 < \alpha (0.05)$), H_0 was rejected and H_a was accepted, which means there is a significant effect of walking physical activity on reducing body mass index in adolescents at SMA Negeri 1 Kundur.

Discussion

1. Body Mass Index of Adolescents Before the Walking Physical Activity Intervention

The results showed that the average BMI of respondents before the intervention was $26.13 \pm 0.44 \text{ kg/m}^2$, which is categorized as overweight or at risk of obesity according to the WHO classification. This indicates that adolescents at SMA Negeri 1 Kundur are at high risk of obesity if appropriate intervention is not implemented.

The majority of students (80%) spent more than 2 hours of screen time per day, with 30% spending more than 5 hours in sedentary activities. This is consistent with research by (Yuliana Asnita et al., 2020), which found that obese adolescents at SMUN 7 Banda Aceh engaged in highly sedentary activities, averaging more than 2 hours per day, with the main activities being watching TV, using gadgets, and doing assignments online.

Furthermore, most respondents used vehicles to get to school, even though the distance was relatively short, severely limiting opportunities for walking. This lack of physical activity causes an imbalance between energy intake through food and energy expenditure, ultimately resulting in fat accumulation and an increased BMI.

The results of this study align with those of (Juanda et al., 2023), which stated that adolescents with low physical activity have a higher risk of experiencing an increased BMI. This study found a significant association

between low physical activity and the incidence of overweight and obesity in school-aged adolescents.

Environmental factors also contribute to the high BMI among respondents. Technological advances and easy access to transportation have led to a decrease in physical activity among adolescents. Furthermore, the availability of easily accessible fast food and the promotion of high-calorie foods through social media further exacerbates adolescents' sedentary lifestyles.

2. Body Mass Index in Adolescents Following a Walking Physical Activity Intervention

After a regular walking physical activity intervention for 4 weeks (16 sessions), the average BMI decreased to 25.59 ± 0.58 kg/m². This decrease indicates that walking for 60 minutes, four times per week, with a target of 6,000-9,000 steps per session, can have a positive effect on weight loss and BMI in adolescents.

A total of 29 respondents (80.6%) experienced a reduction in BMI, and most interestingly, five respondents (13.9%) successfully changed their BMI category from overweight to normal. This indicates that the walking intervention not only statistically reduced BMI but also had a clinically significant impact in obesity prevention efforts.

The results of this study align with the recommendations of Wicaksono (2021), who stated that adolescents should engage in moderate physical activity for 60 minutes daily, or at least three to four times per week. Aerobic activities such as walking can

help increase energy expenditure, improve metabolism, and maintain a balanced weight.

The mechanism of BMI reduction through walking can be explained through several physiological aspects. First, walking increases the body's energy expenditure through calorie burning. By walking for 60 minutes at a moderate intensity (4.8-6.5 km/h), the body burns approximately 200-300 calories per session, depending on the individual's weight. In 16 sessions over four weeks, the total calorie burn reaches 3,200-4,800 calories, which is equivalent to a weight loss of approximately 0.5-0.7 kg (Kelley et al., 2015).

Second, regular walking can increase the body's basal metabolic rate, so calorie burning continues even when the body is at rest. Third, walking helps increase muscle mass and reduce body fat mass, which contributes to BMI reduction. Fourth, regular physical activity can improve insulin sensitivity and glucose metabolism, which plays a role in preventing fat accumulation (Strain et al., 2024).

The results of this study are supported by research by (Anggraini & Ekva Nanda, 2023), who provided a walking intervention for 12 sessions to two obese adolescents. After approximately 4 weeks of intervention, one participant lost 3.1 kg and the other 2 kg, demonstrating significant effectiveness in weight loss, which indirectly reduced BMI.

Research by Papadopoulou et al. (Papadopoulou et al., 2024) also supports these findings, where an

exercise program including walking or aerobic activity for 4 months significantly reduced BMI and increased distance covered on the 6-minute walk test in obese children and adolescents. A systematic review by Kelley et al. (Lawi et al., 2026), which reviewed numerous studies of exercise interventions lasting ≥ 4 weeks, 3x per week, and lasting approximately 46 minutes per session, concluded that regular exercise led to an average reduction in BMI of approximately 3.6% in overweight/obese children and adolescents.

The success of this intervention was also supported by close monitoring and social support. Researchers conducted in-person visits after each walking session and created a WhatsApp group for reminders and motivation. This support is crucial because research shows that adherence to a physical activity program is a key factor in the success of weight loss interventions in adolescents.

The reduction in BMI following the intervention has important long-term health implications. Adolescents who successfully lose weight through physical activity are at lower risk of developing metabolic diseases such as type 2 diabetes mellitus, hypertension, dyslipidemia, and cardiovascular disease later in life. Furthermore, reducing BMI can improve self-confidence, quality of life, and academic performance.

3. The Effect of Walking Physical Activity on Body Mass Index

The results of the paired t-test showed a p-value of 0.000 (<0.05), indicating

a statistically significant effect between walking physical activity and reducing body mass index in adolescents at SMA Negeri 1 Kundur. The calculated t-value of 5.984 indicates a significant effect of the intervention.

The average reduction in BMI of 0.537 kg/m² over a 4-week period indicates that the walking intervention had a clinically meaningful impact. While this reduction may seem small numerically, it is important to understand that a gradual and consistent reduction in BMI is safer and more sustainable than drastic weight loss, especially in adolescents who are still growing.

This finding aligns with the theory that lack of physical activity and an unbalanced diet will lead to the accumulation of energy as fat, which can subsequently lead to changes in body mass index (Fadila et al., 2020). Conversely, increasing physical activity through walking can reverse this process by increasing energy expenditure and helping balance calorie intake and energy expenditure.

This research aligns with research by (Wulandari et al., 2016), who found the effect of walking on reducing BMI in adolescents in Krajan Hamlet, Grobogan Regency. The study used 35 respondents and found a significant reduction in BMI after the walking intervention. Research by Fathur Afif Maulana (2019) also supports these findings, finding a highly significant relationship ($p=0.000$) between BMI and physical activity levels in 12th-grade female

students at SMA Negeri 1 Palembang.

Research by Inca (2023) on the relationship between physical activity and body mass index (BMI) and physical fitness in seventh-grade students at SMP Negeri 14 Yogyakarta also showed similar results, with a significance value of $0.003 < 0.05$ for the relationship between physical activity and BMI, and $0.000 < 0.05$ for the relationship between BMI and physical fitness.

Walking has several advantages over other types of physical activity, especially for adolescents. First, it carries a low risk of injury, making it safe for adolescents of all fitness levels. Second, walking requires no special equipment or additional costs, requiring only comfortable shoes and sportswear. Third, walking can be done in various places and at various times, making it easy to integrate into adolescents' daily routines. Fourth, walking is a social activity that can be done with friends or family, thus increasing motivation and adherence (Faizah, Lawi, Susanti, et al., 2025).

Physiologically, walking provides multi-system benefits. The cardiovascular system benefits through increased heart rate and blood circulation, which strengthens the heart and improves cardiorespiratory capacity. The musculoskeletal system benefits through strengthening the leg, back, and core muscles, as well as increasing bone density. The metabolic system benefits through increased fat burning, improved insulin sensitivity, and optimized glucose and lipid metabolism.

The success of the intervention in this study may also be attributed to the

appropriate dosage of activity. The duration of 60 minutes per session, four times per week, aligns with the WHO recommendations for adolescents, which recommend a minimum of 60 minutes of moderate-to-vigorous intensity physical activity per day. The target of 6,000-9,000 steps per session is also consistent with research by Yingxiang et al. (2021), which states that 60 minutes of walking is equivalent to 6,000-9,000 steps per day, which is effective for improving metabolic health and promoting weight loss. However, it is important to note that 7 respondents (19.4%) experienced no change in BMI despite following the full walking program. This suggests that individual responses to physical activity interventions can vary, possibly influenced by genetic factors, basal metabolic rate, diet, sleep quality, and stress levels. For respondents who did not experience a reduction in BMI, more comprehensive program modifications, including interventions on diet and other lifestyle factors, may be necessary.

The practical implications of this research indicate that walking can be an effective preventive strategy for obesity among school-aged adolescents. This program can be implemented in schools through various means, such as:

1. Holding a "School Healthy Walk" program regularly 3-4 times per week.
2. Encouraging students to walk or cycle to school if the distance allows.
3. Using break time for walking around the school.
4. Integrating walking into the physical education curriculum.

5. Forming a school healthy walk club to increase student participation.

It is also important to involve parents in supporting their children's physical activity programs at home. Parents can serve as role models by walking with their children, reducing vehicle use for short distances, and creating an environment that supports active physical activity.

Research Limitations

This study has several limitations that need to be considered when interpreting the results:

1. Research Design: The use of a One Group Pretest-Posttest design without a control group makes it difficult to confirm that changes in BMI are solely due to the walking intervention and not to other factors.
2. Intervention Duration: The intervention period was only 4 weeks, making it impossible to assess the long-term effects and sustainability of BMI reduction after the program's completion.
3. Sample Size: The sample size of 36 respondents is relatively small, so generalizing the results to a broader adolescent population requires caution.
4. Confounding Variables: This study did not strictly control for other variables that could influence BMI, such as diet, daily calorie intake, sleep quality, and stress levels.
5. Measurement Method: Using BMI as the sole indicator of obesity has limitations because it does not differentiate between muscle mass and fat mass. More comprehensive body composition measurements, such

as body fat percentage, would provide a more accurate picture.

6. Adherence: Despite close monitoring, researchers cannot be 100% certain that all respondents performed walking activities at exactly the same intensity each session.

Conclusions

Based on the research results, it can be concluded that:

1. The average body mass index of adolescents before the walking physical activity intervention was $26.13 \pm 0.44 \text{ kg/m}^2$, which is categorized as overweight (at risk of obesity).
2. The average body mass index of adolescents after the walking physical activity intervention decreased to $25.59 \pm 0.58 \text{ kg/m}^2$. A total of 80.6% of respondents experienced a decrease in BMI, and 13.9% experienced a change in category from overweight to normal.
3. There was a significant effect of walking physical activity on reducing body mass index in adolescents at SMA Negeri 1 Kundur ($p\text{-value} = 0.000 < 0.05$; $t = 5.984$).

Walking physical activity for 60 minutes, four times per week for four weeks, has been proven effective in reducing BMI and can be used as a preventive intervention to prevent obesity in adolescents.

Based on the research results, several recommendations can be made: For Schools (SMA Negeri 1 Kundur):

1. Integrate a regular walking program into school activities, such as a weekly healthy walk

or the "Healthy Friday" program.

2. Provide facilities that support physical activity, such as safe and comfortable walking paths in the school area.
3. Provide ongoing education to students about the importance of physical activity and the dangers of obesity.
4. Conduct regular BMI screenings for early detection of obesity risk in students.
5. Form a sports club or school-based healthy walking community to increase student participation.

For Respondents (Teenagers):

1. Make walking a daily habit, at least 60 minutes per day or 10,000 steps per day.
2. Reduce sedentary behavior such as excessive screen time.
3. Invite friends or family to walk together to increase motivation.
4. Use a pedometer app or smartwatch to monitor daily activity.
5. Combine walking with a healthy diet and adequate rest.

For Educational Institutions (Batam University)

1. Develop community service programs based on health promotion and obesity prevention in schools.
2. Integrate material on obesity prevention through physical activity into the community nursing curriculum.
3. Encourage students to conduct further research with a more robust design and longer duration.

For Future Researchers

1. Conduct research with an experimental design using a control group for more valid results.
2. Extend the duration of the intervention (at least 8-12 weeks) to assess the long-term effects and sustainability of BMI reduction.
3. Use a larger, more representative sample from various schools.
4. Add body composition measurements (percentage body fat, muscle mass) in addition to BMI.
5. Control for confounding variables such as dietary intake, sleep quality, and stress levels.
6. Compare the effectiveness of various types of physical activity (walking, jogging, cycling, aerobics).
7. Explore factors influencing adolescent adherence to physical activity programs.
8. Conduct long-term follow-up (3-6 months) to assess the sustainability of changes in behavior and BMI.

For Community Health Centers and Health Offices

1. Develop school-based health promotion programs with a focus on obesity prevention through physical activity.
2. Collaborate with schools to implement regular adolescent health screenings.
3. Provide standard guidelines and protocols for adolescent physical activity programs in schools.

4. Conduct ongoing evaluation and monitoring of obesity prevention programs.

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