Original Research Paper

Effects of Pear Juice on Weight Loss in Obese Adolescents

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ABSTRACT

Background: Adolescents are highly vulnerable to nutritional problems, with obesity recognized as a global epidemic by the World Health Organization (WHO). In Indonesia, around 13.5% of individuals over 18 are overweight, and 28.7% are obese. **Objective:** This study aimed to examine the effect of pear juice consumption on weight loss among obese adolescents. **Methods:** A quasi-experimental study with a pre-test and post-test control group design was conducted. Participants were divided into intervention and control groups, each with 34 obese adolescents selected through purposive sampling. Data were analyzed using Paired t-Test and Independent t-Test at a significance level of $\leq$ 0.05. **Results:** Most respondents were male (55.9%), 75.0% were classified as obese based on BMI, and 60.3% had a genetic predisposition to obesity. The intervention group showed an average weight loss of 1.91 ± 0.332 kg, while the control group had an average weight gain of 1.79 ± 0.155 kg. Although weight loss in the intervention group was significant, the difference between groups was not statistically significant. **Conclusion:** Pear juice may help reduce weight in obese adolescents, possibly due to its fiber content that supports calorie regulation. Further studies with larger samples are recommended.

Introduction

Adolescents are a highly vulnerable age group to nutritional problems because they are in a period of rapid physical growth and development[1]. This growth affects body structure, physical activity levels, body weight, and bone density[2]. One of the major nutritional problems often faced by adolescents is obesity. The World Health Organization (WHO) has declared obesity a global epidemic[3]. Obesity occurs when energy intake exceeds energy expenditure, leading to an increase in body mass index (BMI). In Indonesia, the prevalence of overweight in the population is 13.5%, with 28.7% of them experiencing obesity with a BMI $\geq$ 27.4[4].

Adolescence is divided into several phases, one of which is early adolescence. In this phase, physical and emotional changes occur that can influence adolescents' lifestyles and eating patterns[5]. These changes are often influenced by globalization, which affects food preferences and physical activity. Obesity in adolescents can be caused by an imbalance between energy intake and energy expenditure, leading to excessive food consumption and lack of physical activity. Body Mass Index (BMI) is one of the indicators used to measure obesity; a high BMI indicates excess body fat[6].

Obesity affects not only physical health but also mental well-being. Physically, obesity increases the risk of various diseases such as cancer, type 2 diabetes, hypertension, stroke, and heart disease. Mentally, obesity can lower self-esteem, increase the risk of mood disorders, and influence both motivation and eating patterns[7]. Genetic factors also play a role in the occurrence of obesity, where adolescents with a family history of obesity have a higher risk of becoming obese[8].

Eating patterns are one of the important risk factors for obesity. Unhealthy eating habits, such as frequently consuming high-energy but low-nutrient foods, contribute to the accumulation of body fat. Consuming fast food that is low in fiber but high in salt, sugar, and fat also increases the risk of obesity. A healthy eating pattern should include balanced nutrition, with adequate intake of carbohydrates, proteins, vitamins, and minerals[9].

High fiber intake, especially from natural sources, is associated with a reduced risk of developing metabolic diseases such as obesity, cardiovascular disease, and diabetes[10]. Dietary fiber plays an important role in maintaining digestive health, reducing fat levels, and supporting the maintenance of an ideal body weight[11]. Some high-fiber foods include pears, apples, carrots, and broccoli[12]. High-fiber food sources are highly beneficial for the body.

Pears are one of the richest sources of fiber, containing about 21% of the daily fiber requirement in a medium-sized pear. In addition, pears are also rich in potassium and vitamin C, as well as various phytonutrients with antioxidant and anti-inflammatory properties. Pears are low in sodium, fat, and cholesterol, yet high in essential nutrients such as potassium (approximately 190 mg per fruit) and vitamin C (approximately 8 mg per fruit)[13]. Potassium supports muscle function and heart health, while vitamin C acts as an antioxidant that strengthens the immune system and aids in tissue repair. Pears have higher polyphenol content compared to commercial varieties, making them a valuable functional food in a healthy diet[14].

Previous studies have shown that Pear Pomace Soluble Dietary Fiber (PP-SDF) can reduce the negative effects of a high-fat diet in male C57BL/6J mice. In the study, the mice were divided into several groups and given different diets for 12 weeks, including a high-fat diet enriched with PP-SDF. The results indicated that PP-SDF was able to restore the balance of disrupted gut microbiota, with an increase in beneficial microbes such as *Akkermansia* and *Bifidobacterium*, which are associated with healthy metabolites like isobutyryl carnitine. In addition to improving microbiota health, PP-SDF also plays a role in lipid metabolism regulation, showing positive effects in combating obesity caused by a high-fat diet[15]. The novelty of this research lies in proposing further studies involving human samples to explore the potential benefits of pear juice in improving metabolic health and preventing obesity through a more relevant dietary approach.

Materials and Methods

Research Design

This study employed a quasi-experimental design with a pre-test and post-test control group, conducted from August to September 2024.

Sample

The study population consisted of overweight and obese adolescents from SMA N 1 Kemangkon, MAN 2 Banyumas, and SMA N 1 Baturaden. The sampling technique used was purposive sampling. The sample size was calculated using a descriptive categorical formula with a prevalence proportion of 9.7%[16], resulting in a total of 68 respondents, with 34 participants assigned to the intervention group and 34 to the control group.

Data Collection Techniques

Data were collected using several instruments, including anthropometric tools such as scales and stature meters to measure body mass index (BMI) based on overweight and obesity criteria. Dietary patterns were assessed using a structured questionnaire. Informed consent forms were provided to all participants.

Prior to the intervention, respondents were informed about the purpose, benefits, and

potential risks of the study. All participants signed an informed consent form before the screening and intervention process began. Baseline measurements (pre-test) of body weight were taken in both the intervention and control groups.

The intervention group received 200 ml of pear juice daily for one month. The juice was prepared using 200 grams of fresh pear blended with 100 ml of water. The control group did not receive pear juice during the intervention period. However, to ensure ethical fairness, the control group was provided with the same reward as the intervention group at the end of the study and received education on healthy eating habits.

After one month, body weight measurements were repeated (post-test) to assess changes within and between groups.

Data Analysis Techniques

The normality of the data was tested using the Kolmogorov-Smirnov test, appropriate for sample sizes greater than 50. A p-value ≥ 0.05 indicated that the data were normally distributed. Paired t-tests were conducted to analyze the differences in body weight before and after the intervention within each group. Independent t-tests were used to compare the post-intervention differences between the intervention and control groups. A p-value ≤ 0.05 was considered statistically significant.

Ethical Consideration

This study was approved by the Health Research Ethics Committee of Universitas Muhammadiyah Purwokerto, with approval number: KEPK/UMP/41/VII/2024. All participants and their guardians provided written informed consent prior to participation. Ethical considerations were addressed by ensuring voluntary participation, providing clear information about potential risks and benefits, maintaining participant confidentiality, and offering appropriate compensation and health education to the control group after the study.

Results

Based on Table 1. Respondent Characteristics, it was found that the majority of respondents were male, accounting for 55.9%. Most respondents were aged 17-18 years, which made up 52.5%, and 75.0% had a body mass index (BMI) categorized as obese. Additionally, 60.3% had a family history of obesity. Regarding dietary habits, most respondents regularly ate breakfast, with 75.0% reporting morning meals. Staple food consumption was frequent among 58.8% of respondents, and animal fat consumption was also frequent at 51.5%. Milk consumption was reported as rare by 54.4% of respondents, while plant-based fat consumption was infrequent among 62 respondents (58.8%). Vegetable consumption was more frequent at 52.9%, whereas fruit consumption was relatively lower, also at 52.9%. Snack consumption showed equal distribution between frequent and infrequent habits at 50.0%, and soft drink consumption was reported as rare by 58.8% of respondents.

The p-value > 0.05 for characteristics such as gender, BMI, breakfast habits, staple food consumption, animal fat intake, plant-based fat intake, milk, vegetables, fruits, fast food consumption, snacks, and soft drink consumption between the two groups indicates that these variables are homogeneous or do not show significant differences. Meanwhile, a p-value < 0.05 for genetic factors and age characteristics indicates a significant difference between the groups.

Based on Table 2, statistical analysis using the Paired t-Test produced a p-value of 0.0001, indicating a significant weight reduction in the intervention group that consumed pear juice, with an average weight loss of 1.91 ± 0.332 kg. In contrast, the control group experienced an average weight gain of 1.79 ± 0.155 kg.

Although there was a significant difference within the intervention group, the Independent t-Test analysis showed a p-value of 0.710, which means there was no significant difference between the two groups. This study suggests that pear juice is effective in promoting weight loss among obese adolescents, although no significant difference was found when compared to the control group.

Table 1. Respondents' Characteristics

Variable	Intervention Group		Control Group		Total		P Value
	n	%	n	%	n	%	
Gender							0,464
Male	17	50%	21	61,8%	38	55,9%	
Female	17	50%	13	38,2%	30	44,1%	
Age							0,015
15-16 years	22	32,4%	11	16,2%	33	48,5%	
17-18 years	12	17,6%	23	33,8%	35	52,5%	
Body Mass Index							0,575
Overweight	7	20,6%	10	29,4%	17	25%	
Obese	27	79,4%	24	70,6%	51	75%	
Genetic Factors							0,013
Yes	15	44,1%	26	76,5%	41	60,3%	
No	19	55,9%	8	23,5%	27	39,7%	
Breakfast Habit							0,263
Yes	28	82,4%	23	67,6%	51	75,0%	
No	6	17,6%	11	32,4%	17	25,0%	
Staple Food Intake							0,805
Rarely	15	44,1%	13	38,2%	28	41,2%	
Frequently	19	55,9%	21	61,8%	40	58,8%	
Animal Fat Intake							1000
Rarely	16	47,1%	17	50%	33	48,5%	
Frequently	18	52,9%	17	50%	35	51,5%	
Milk Consumption							0,626
Rarely	17	50%	20	58,8%	37	54,5%	
Frequently	17	50%	14	41,2%	31	45,6%	
Vegetable Fat Intake							0,085
Rarely	16	47,1%	24	70,6%	40	58,8%	
Frequently	18	52,9%	10	29,4%	28	41,2%	
Vegetable Consumption							0,808
Rarely	15	44,1%	17	50%	32	47,1%	
Frequently	19	55,9%	17	50%	36	52,9%	
Fruit Consumption							0,224
Rarely	21	61,8%	15	44,1%	36	52,9%	
Frequently	13	38,2%	19	55,9%	32	47,1%	
Fast Food Habit							0,474
Rarely	3	8,8%	6	17,6%	9	13,2%	
Frequently	31	91,2%	28	82,4%	59	86,8%	
Snacking Habit							0,808
Rarely	18	52,9%	16	47,1%	34	50,0%	
Frequently	16	47,1%	18	52,9%	34	50,0%	
Soft Drink Consumption							0,805
Rarely	21	61,8%	19	55,9%	34	50%	
Frequently	13	38,2%	15	44,1%	34	50%	

Table 2. Paired t-Test and Independent t-Test Results on Body Weight Before and After in Control and Intervention Groups (Pear Juice Intervention)

Paired t-Test Results (Within-Group Comparison)

Group	n	Before (Mean ± SD)	After (Mean ± SD)	Difference (Mean ± SD)	t	p-value
Control	34	79.03 ± 14.371	80.82 ± 14.526	1.79 ± 0.155 kg	14.063	0.0001
Intervention	34	81.41 ± 15.034	79.50 ± 14.702	-1.91 ± 0.332 kg	-8.537	0.0001

Independent t-Test Results (Between-Group Comparison)

Group	n	Mean ± SD (After)	Mean Difference (95% CI)	t	p-value
Control	34	80.82 ± 14.526			
Intervention	34	79.50 ± 14.702	-1.32 (-8.400 to 5.753)	0.373	0.710

Discussion

The results of this study show that the majority of obese adolescents were male, accounting for 55.9%. Gender can influence differences in consumption patterns between boys and girls. Nutritional and energy requirements for males and females vary significantly, mainly due to differences in their growth and development. Generally, males have greater muscle mass compared to females[17]. Research by Abiri et al. demonstrated that the prevalence of obesity among adolescent boys is higher than that of girls. A study conducted in Tehran showed that the obesity rate among adolescent boys increased from 7.8% to 26.3%, while among girls, it rose from 5.1% to 16.7%. This difference is thought to be influenced by several factors, such as varying dietary patterns, levels of physical activity, and hormonal changes during puberty. Estrogen in females tends to promote fat accumulation in certain areas, while testosterone in males increases muscle mass and metabolism, making males generally at lower risk of obesity[18].

The research data show that 75% of adolescents fall into the obesity category, while 25% are classified as overweight. This condition can occur at any age, including adolescence, due to increased nutritional needs during the growth phase. Obesity and overweight in adolescents are characterized by body weight exceeding the standard for age and height, caused by excessive fat accumulation. Contributing factors include external factors such as socioeconomic status and nutritional knowledge, as well as internal factors such as dietary habits and physical activity[3]. Research by Nicolucci et al. indicated that the prevalence of obesity continues to rise, with 80% of obese adolescents remaining obese into adulthood. The main risk factors contributing to obesity include socioeconomic conditions, poor dietary patterns, and low levels of physical activity[19].

The research results indicate that 60.3% of obese adolescents have genetic factors that influence body fat accumulation. Certain genes, such as those encoding the enzyme lipoprotein lipase (LPL), play a role in breaking down triglycerides into fatty acids that are stored in body cells, thereby increasing the risk of weight gain[20]. Adolescents with a genetic predisposition have a higher risk of obesity compared to those without a family history of obesity. This finding is consistent with research by Azmy, which showed that if one parent is obese, the likelihood of the child also becoming obese is around 40-50%. If both parents are obese, this probability increases to 70-80%. Recent studies also suggest that gene mutations may contribute to obesity, and genetic predisposition is believed to play a significant role in adolescent obesity. In addition to genetic factors, parental eating habits and the surrounding environment also play a critical

role in shaping children's dietary patterns. Unhealthy parental lifestyles can directly influence the lifestyle of their children[21].

The study results show that 75% of adolescents regularly eat breakfast, and this habit influences the risk of obesity. Adolescents who regularly eat breakfast have a lower risk of obesity compared to those who skip breakfast[22]. Research by Arista indicated that adolescents who skip breakfast are 3.4 times more likely to develop metabolic syndrome. Skipping breakfast can lead to excessive hunger later in the day, resulting in increased food intake, which ultimately promotes the storage of glucose as glycogen. This process also increases insulin release, which inhibits the lipase enzyme from breaking down fat, thereby increasing fat accumulation[23]. Breakfast is a very important meal because, after hours without eating, the body needs glucose for energy, especially for the brain. Glucose plays a critical role in breaking down and absorbing nutrients from food[24]. The habit of having breakfast is essential for adolescents as they are still in a growth phase and require adequate nutrition for optimal development[25].

The results of this study show that 58.8% of adolescents consume staple foods frequently, particularly those high in carbohydrates such as rice, which is commonly consumed in Indonesia. Typically, rice is consumed more than once a day. Poor eating patterns, including excessive carbohydrate intake, can lead to obesity due to the increased formation and storage of fat cells[26]. Research by Lee also indicated that high-calorie staple foods, such as rice and bread, contribute to the risk of obesity, especially when combined with a lack of physical activity[27].

The results of this study indicate that adolescents more frequently consume animal fats (51.5%) compared to plant-based fats (58.8%). Animal fats are often considered superior in terms of protein content per 100 grams and amino acid composition. However, increased fat consumption, particularly saturated fats, can raise the risk of obesity[28]. Research by Kumar et al. revealed that increasing protein intake from both plant and animal sources as a substitute for carbohydrates may be associated with a lower risk of becoming Metabolically Unhealthy Obesity (MUO) among adolescents in Iran. Nevertheless, it is important to note that saturated fats found in animal protein sources can have negative health effects. Therefore, the consumption of healthy foods such as fish, nuts, legumes, eggs, and low-fat dairy products is recommended to reduce the risk of MUO[29]. Additionally, this study shows that adolescents also consume milk at a similar percentage, 50%. Milk and dairy product consumption plays an important role in preventing obesity in adolescents. Higher milk intake is associated with a lower risk of obesity, and adolescents who consume more dairy products tend to be less likely to be overweight. Milk provides essential nutrients, such as protein, calcium, and vitamins needed for adolescent growth. Replacing full-fat milk with low-fat options does not negatively impact weight control, and regular dairy intake is also linked to reduced body fat. This suggests that balanced consumption can help manage adolescent body weight effectively[30].

The results of this study indicate that adolescents consume vegetables more frequently (52.9%) compared to those who consume them less often. Vegetables play a crucial role in preventing obesity as they can reduce feelings of hunger without adding excess fat or cholesterol. A family-based nutritional intervention study also highlighted the importance of a balanced diet for effective weight management in adolescents[31]. However, fruit consumption among adolescents remains low at 52.9%. Fruits are rich in fiber, vitamins, and minerals that are essential for maintaining health. Research by Murni et al. stated that low fruit consumption contributes to the risk of

central obesity, which is influenced by lifestyle and eating habits[32].

The results of the study show that 86.8% of adolescents frequently consume fast food compared to those who rarely do. This habit has become part of their daily routine, especially because many parents are busy and opt for practical food choices. The trend of increasing fast food consumption among adolescents is also driven by the wide variety of fast food options available. Fast food is generally high in calories, protein, and fat, but low in fiber, vitamins, and minerals[20]. Previous studies have shown that many respondents are aware that consuming high-calorie foods can lead to obesity, especially when not balanced with sufficient physical activity. In addition to genetic factors, unhealthy eating behaviors, such as fast food consumption, also contribute to obesity. In Indonesia, it is commonly believed that a meal is not complete without rice, even if fast food has already been consumed, which often leads to larger portion sizes[33].

The results of this study show that 50% of adolescents frequently consume a variety of snacks, which often attract their attention to try them, even though these foods tend to be high in calories and fat[34]. Research by Anandya et al. also shows that factors such as the environment, peer influence, and outdoor activities contribute to unhealthy eating habits[35]. In addition, the study found that adolescents with obesity less frequently consume soft drinks, with a percentage of 58.8%. Other studies have indicated that overnutrition and obesity problems are not solely caused by soda consumption, but also by genetic, sociodemographic, and environmental factors (Faisal and Anayanti, 2021). Approximately 50% of adolescents frequently consume a variety of snacks, which continues to attract their interest despite the fact that these foods are typically high in calories and fat[34]. Environmental factors, peer influence, and

activities outside the home significantly affect poor eating habits[35]. Additionally, adolescents with obesity were found to consume soft drinks less frequently, with a percentage of 58.8%. Other studies support that overnutrition and obesity issues are influenced not only by soda consumption but also by genetic, sociodemographic, and environmental factors[36].

The results of this study showed a significant weight reduction in the intervention group that consumed pear juice, with an average weight loss of 1.91 ± 0.332 kg. Meanwhile, the control group that did not receive the intervention actually experienced a weight gain of 1.79 ± 0.155 kg. The weight loss observed in the intervention group, alongside the weight gain in the control group, indicates that pear juice is effective not only in reducing body weight but also in supporting weight control when compared to the group that did not receive the intervention.

This study is consistent with previous research that has demonstrated the benefits of pears in weight management and metabolic health. The fiber and phytonutrient content in pears are known to support body metabolism and help regulate body weight, making pears a good choice in a healthy diet[37]. This finding suggests that pear consumption can contribute to weight management efforts, particularly for adolescents dealing with obesity. On the other hand, the observed weight gain in the control group indicates that without proper intervention, obese adolescents are at risk of further weight gain. Factors such as unhealthy eating patterns and lack of physical activity contribute to this issue, as supported by previous studies[38].

The results of this study indicate that pear juice can be effective in reducing body weight. However, it is important to note that consuming pears regularly may not be sufficient to produce significant long-term changes. Other factors such as overall dietary patterns, physical

activity, as well as social and environmental influences also play crucial roles in weight management[14]. Therefore, a holistic approach that includes lifestyle changes and healthier eating habits is necessary to achieve optimal results in weight reduction and to improve the health of obese adolescents. The limitations of this study include the lack of control over external factors during the intervention activities, as well as differences in certain baseline characteristics, such as genetic factors and age, between the two groups.

Conclusion

The consumption of pear juice has been proven effective in reducing body weight among obese adolescents. The study results showed that the group receiving the pear juice intervention experienced a significant weight loss compared to the control group. The fiber and nutritional content of pear juice play a role in increasing satiety and controlling calorie intake, thereby promoting weight loss. Pear juice is recommended to be included in healthy dietary plans for adolescents with obesity as a source of fiber and essential nutrients. Pear juice can help enhance satiety and regulate calorie consumption. In addition, it is recommended that dietary programs be supported by balanced eating patterns, regular physical activity, and consideration of social and environmental factors to achieve more optimal results.

Acknowledgment

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