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Original Article

Correlation of Excess Body Weight and Socio-Physical Health Impact among Adolescents in Indonesia

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ABSTRACT

The prevalence of overweight and obesity in adolescents is increasing in the world, predicted to rank 4th in the risk of obesity in Indonesia in 2030, high risk of adverse effects on the quality of life of adolescents in the form of metabolic disorders, physical discomfort, absenteeism from school, low achievement, and low self-esteem. The purpose of the study was to analyze the correlation between overweight and the impact of physical social health on adolescents. This study used a cross-sectional design. The study population was 242 adolescents with a sample size of 151 overweight adolescents from seven schools in Palu City. The research instruments were weight scales, height measuring microtoice, body mass index standards according to the Ministry of Health in 2020, tensimeter, blood sugar, cholesterol, uric acid, interview format related to physical complaints and self-esteem felt in the last three months, and academic and non-academic grades asked to the homeroom teacher. Data analysis was univariate and bivariate Pearson test and Spearman test. The results of the study were obese 21 (13.91%), overweight 130 (86.09%). Correlation test between overweight and cholesterol score (p=0.000; r=0.373), academic score (p=0.026; r= -0.18), self-esteem (p=0.004), systole blood pressure (p=0.53), diastole blood pressure (p=0.278), fasting blood sugar value (p=0.22), uric acid value (p=0.107), absenteeism (p=0.099), complaints (p=0.167). The study concluded that there was a positive correlation between overweight and high cholesterol levels, as well as adolescent self-esteem, while a negative correlation was found with academic grades. The research recommendation is to further analyze the behavior and sociocultural of overweight adolescents before nursing/health interventions.

Keywords: *Adolescents; overweight; obesity; socio-physical health*

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INTRODUCTION

The prevalence of overweight and obesity among adolescents is an increasing global health issue. The 4% of cases in 1975 increased to 18% (more than 340 million) of children and adolescents aged 5-19 years experiencing overweight in 2016 globally.[1] According to the World Obesity Federation, Indonesia ranks 4th for obesity risk globally and is predicted to have the highest number among school-aged children and adolescents by 2030. One in seven adolescents in Indonesia is overweight.[2]

The Basic Health Research of the Indonesian Ministry of Health found a significant increase in the prevalence of overweight among adolescents (13-18 years) over the last five years, from 18.1% in 2013 to

29.5% in 2018. The prevalence of overweight among adolescents in Central Sulawesi is higher than the national prevalence, at 22.3% in 2013 and 22.5% in 2018, even surpassing the incidence of thinness and severe thinness, which stands at 17.5% [3]. Approximately 55% of children who are obese will continue to be obese during adolescence, about 80% of obese adolescents will remain obese into adulthood, and around 70% will be obese by the age of 30.[4]

Overweight is a major determinant of disability and mortality in the European region [5], contributing to 5.5% of deaths, whereas underweight contributes only 0.7%.[6] A meta-analysis study showed that the relative hazard ratio (HR) for all-cause mortality increases with a higher body mass index,[7] and healthy life expectancy decreases in various countries due to high body mass index.[8] Obesity is a major risk factor for non-communicable diseases (NCDs) such as heart disease and stroke, diabetes, musculoskeletal disorders, especially osteoarthritis, and some types of cancer,[1] contributing to more than 73% of all NCD-related deaths.[2] Thus, controlling NCDs is one of the 2030 SDG's agendas.

Several studies in Depok City, Iran, and China have shown a low quality of life among children and adolescents due to overweight, including cardiovascular disease risk, hypertension, decreased vision, and above-normal blood sugar levels [9–11], high total cholesterol and low-density lipoprotein cholesterol levels among adolescents in Brazil and Syria[12,13], and hyperuricemia,[14–16] increasing the risk of headaches by 40%-80%,[17] with the risk of primary headaches increasing in patients with a BMI > 25.[18] The social impact includes a decline in academic performance, body image disturbances, and low self-esteem.[19–21] Overweight leads to various physical and social health problems and is even a cause of death, despite some positive perceptions of overweight in society.

The phenomenon of overweight among adolescents serves as a warning for the world, the Indonesian government, and society to control it. UNICEF (2022) analysis states that the commitment and implementation of handling overweight among children and adolescents in Indonesia remain low, including the Nusantara Movement to Reduce Obesity (GENTAS) program. According to the Head of the Nutrition Section of the Palu City Health Office, health programs related to handling overweight are very minimal. Even though the results of overweight screening among some adolescents in Palu City increased from 5.33% in 2021 to 5.99% in 2022. The person in charge of UKS at the Sangurara Health Center also stated that there have been no UKS activities (work programs) focusing on preventing and controlling overweight among children and adolescents, limited to weight screening without further intervention.

According to the Head of the Nutrition Section of the Palu City Health Office, health programs related to handling overweight are very minimal. Even though the results of overweight screening among some adolescents in Palu City increased from 5.33% in 2021 to 5.99% in 2022. The person in charge of UKS at the Sangurara Health Center also stated that there have been no UKS activities (work programs) focusing on preventing and controlling overweight among children and adolescents, limited to weight screening without further intervention.

The prevalence of overweight is increasing globally, nationally, at the Central Sulawesi province level, and in Palu City and poses a high risk of causing various social health problems. Therefore, if not addressed properly and promptly, nutritional problems among adolescents will contribute to various chronic diseases in the future.

The perception that overweight children are not yet considered a problem and the lack of data and research related to the social health impact on overweight adolescents.

What is the describing of physical social health problems in adolescents who are overweight? There is evidence regarding the poor quality of life experienced by teenagers, so the relevant parties (parents, community, schools, health services, community health centers) are expected to be motivated to create or support weight maintenance/health interventions for teenagers, the GENTAS program and preventing disease. not contagious or accelerate the achievement of SDG's point 3 in Palu City. The aim of the research is to analyze the health-social impact on overweight adolescents in Palu City.

METHODS

This descriptive correlational study employed a cross-sectional design to examine the relationship between overweight and the

physical-social health impacts on adolescents. The study was conducted from May to August 2022 in seven schools representing four health center working areas in Palu City, Indonesia, namely Karunadipa High School, Karunadipa Middle School (Sangurara Health Center), Catholic High School, Catholic Middle School (Kamonji Health Center), High School 3 (Bulili Health Center), and Vocational High School 1 (Birobuli Health Center). The study population consisted of 242 adolescents identified as overweight based on health service records from 2021. The sample size of 151 participants was determined using the Slovin formula. Sampling began with the accidental collection of all students considered overweight by the target schools, who were then included in the sample if their BMI measurement exceeded +1 Standard Deviation (SD) based on the anthropometric standards of the Indonesian Ministry of Health Regulation No. 2 of 2020 by the research team. Parental consent was obtained through an informed consent form before the examination and respondent interviews on the second day.

Ethical approval for the study was granted by the Institutional Review Board of Tadulako University (approval number 3984/UN.28.1.30/KL/2022). The research procedure involved two stages. On the first day, eligible participants were identified and informed consent was obtained. The second day comprised measurements and interviews. Anthropometric measurements, including height and weight, were taken using a microtoise and weighing scales to calculate body mass index (BMI). BMI was then classified as overweight ($1 < SD < 2$) or obese (>2 SD) according to the Indonesian Ministry of Health's standards (Regulation No. 2 of 2020). Blood pressure was measured using a sphygmomanometer and stethoscope, while blood sugar, cholesterol, and uric acid levels were assessed using an Accupro blood testing device, after the equipment was calibrated at the "Aesculapius" medical equipment sales center in Palu City.

Interviews were conducted to gather biographical data, information on physical complaints and discomfort, self-perception of being overweight, and school absences due to illness in the past three months. Academic achievement was evaluated using the cumulative grade point average, while non-academic achievements in arts and sports were also recorded.

Interviews involved open-ended questions related to physical complaints and discomfort experienced, as well as social impacts, including school absenteeism due to illness over the past three months, and self-esteem and body image concerning being overweight. Academic and non-academic performance assessments were inquired from class guardians or value administrators and recorded in observation sheets.

Data analysis was performed using SPSS Version 21, with a 95% confidence interval. The Kolmogorov-Smirnov test was used to assess data normality, and univariate and bivariate analyses were conducted using Pearson's and Spearman's correlation tests, respectively, with a significance level of $p < 0.050$.

RESULTS

Table 1. Gender, Age, and Ethnics of Respondents (n=151)

Characteristics	n	%
Gender		
Male	78	51.7
Female	73	48.3
Age group		
11-15 years (junior high school)	90	59.6
16-18 years (high school)	61	41.4
Ethnics		
Kaili	32	21.2
Bugis	3	2.0
Sangir	3	2.0
Chinese	1	0.7
Toraja	1	0.7
Mixture	111	73.5

Source: Primary Data, 2022

Table 1 presents the demographic characteristics of the overweight adolescents who participated in the study. It includes the distribution of participants by gender (male and female), age group (11-15 years and 16-18 years), and parental ethnicity (Kaili, Bugis, Sangir, Chinese, Toraja, and mixed). These findings offer valuable insights into the demographic composition of overweight adolescents in the study sample, which can inform targeted interventions and public health strategies to address excess body weight in this population.

Table 2. Excess weight category and Social health impacts of respondents (n=151)

Variables	n	%
Excess Weight Category		
Overweight	130	86.09
Obesity	21	13.91
Social Health Impacts		
Non-Academic Achievements		
Exist	12	7.95
Nothing	139	92.05
Presence		
Present	100	66,22
Absence	51	33.78
Self-esteem		
High	72	47.68
Low	79	52.32
Physical Health Impacts		
Physical Complaints		
Nothing	35	23.17
There are a number of complaints:	116	76.82
1 Complaint	43	37.06
2 Complaints	44	37,93
3 Complaints	14	12.06
≥ 4 Complaints	14	12.06
Complaint type		
Acute Respiratory Infections	64	55,17
Headache	41	35.34
Muscle/Cramp/ Joint Pain	19	16.38
Allergies/Hives	11	9.48
Dizzy	9	7.76
Insomnia	15	12.93
Ulcer/Pain Stomach	12	10.34
Ear Inflammation	2	1.72
Toothache	2	1.72
Polyuria	3	2.59
Menstrual Problem	2	1.72
BP Systole *(112-128 mm Hg)*		
Low	60	39.74
Normal	51	33.77
High	40	26.49
BP Blood *(66-80 mm Hg)*		
Low	10	6.62
Normal	60	39.74
High	81	53.64
Fasting Blood Sugar *(70-150 mg/dl)*	147	97.35
Normal	4	2.65
High		
Cholesterol *(< 170 mg/dl)*		
Normal (≤ 169 mg/dl)	53	35.10
High Limit (170-199 mg/dl)	31	20.53
High (≥ 200 mg/dl)	67	44.37
Uric Acid *(men:3.6-5.5 mg/dl;women: 3.6-4 mg/dl)*		
Low	21	13.91
Normal	57	37.75
High	73	48.34

Source: Primary Data, 2022
BP: Blood Pressure

The excess weight category and health impacts in Table 2 highlight the complex effects of excess weight on social and health-related factors. These results highlight the necessity for comprehensive interventions that address the physical health as well as the social and psychological well-being of people who struggle with excess weight. They can also provide important new insights into public health efforts.

Table 3. Correlation Social Healths Impacts and Exess Weight Respondents

Health Impacts	p-value	r	Statistical test
Academic Grades Absence	0.026 *	0.18	Spearman's test
	0.099	-	Spearman's test
Self esteem	0.004 *	-	Chi-Square
Risk Non-Communicable Diseases			
BP Systole	0.53	-	Spearman's test
BP Diastolic	0.278	-	Spearman's test
Fasting Blood Sugar	0.22	-	Spearman's test
Cholesterol	0.000*	0.373	Pearson's test
Uric Acid	0.107	-	Pearson's test

Source: Primary Data, 2022
**Significants* ($p < 0.05$)

Bivariate analysis, using Pearson, Chi-Square, and Spearman tests as appropriate, revealed significant relationships between excess body weight and several health parameters. A positive correlation was found between body mass index (BMI) and cholesterol levels ($p < 0.001$), indicating that higher BMI was associated with elevated cholesterol. Conversely, a negative correlation was observed between BMI and academic scores ($p<0.026$), suggesting that higher BMI was linked to lower academic performance. Additionally, a significant association was found between excess body weight and low self-esteem ($p<0.004$). However, no significant correlations were found between BMI and school absences, uric acid levels, systolic blood pressure, diastolic blood pressure, or blood sugar levels.

DISCUSSION

In this study, the majority of participants were male, aligning with observations from the WHO Regional Office for Europe and a survey in Kuwait, which found a higher prevalence of overweight and obesity among adolescent males[Error! Reference source not found.]. However, this finding contrasts with other studies that have reported a higher prevalence among females[22,23]. Notably, research in Ibadan, Oyo State, and Nigeria has shown an increasing trend of overweight and obesity among female adolescents [24]. These discrepancies highlight the complex interplay of factors influencing gender differences in overweight and obesity prevalence, which may vary across populations and regions.

The study also found that more than half of the overweight participants were between 11 and 15 years old, corresponding to the junior high school age range. This finding underscores the importance of focusing on early adolescence as a critical period for obesity prevention and intervention efforts. Additionally, the predominance of the Kaili tribe among parents of overweight participants reflects the local demographic context, as the Kaili tribe is indigenous to Palu City. This observation suggests that cultural factors may play a role in the development of overweight and obesity, and that culturally tailored interventions may be necessary to effectively address this issue in the local population. Hence it, WHO recommends behavior change interventions for overweight control with the BCI (Behavioural and Cultural Insights) approach.[25] Health problems are not only solved by medical personnel, it requires the involvement of health anthropology that can explore socio-cultural phenomena that have an impact on certain community health behaviors [26], including ethnic Kaili eating behavior that may be at risk of increasing cases of overweight and related diseases. In line with the findings of Prayugi et al who found that the daily diet of ethnic Kaili tends to be cooked with thick coconut milk or sautéed, although coconut milk is widely used.[27] Contains high nutritional values such as protein, calcium, vitamins[28], but if consumed excessively it will pose a risk of vascular disease[29] or improper processing can increase lipid content 253% after cooking, 198% after frying which causes an increase in calories contributing to weight gain.[30] Cultural factors of Kaili ethnicity related to dietary practices as a predisposition to weight gain need further research.

The negative correlation observed in this study between body mass index (BMI) and academic performance is consistent with existing research that suggests a link between excess weight and lower cognitive function and academic achievement in adolescents [31,32]. This study did not identify the specific subjects with low achievement, but previous research has shown that obese adolescents tend to have low math skills, but not reading or language skills [33]. However, it is important to note that not all studies have found this association[33,34]. The potential reasons for the negative correlation observed in this study could be due to the physiological effects of excess weight, such as insulin resistance and cardiometabolic risks, which have been linked to reduced hippocampal volume, a brain region crucial for memory and learning,[35,36] also associated with Alzheimer's disease.[37]

In addition to academic challenges, overweight adolescents in this study generally did not report non-academic achievements. Interviews revealed that feelings of embarrassment and insecurity about their body image led many to avoid public activities where they could showcase their talents. This aligns with previous research highlighting the negative self-image, social isolation, and lack of empathy often associated with overweight and obesity in young people [38,39]. However, some studies have shown that physical activity interventions can improve cognitive function, academic achievement, and brain function in this population.[36]

Physical activity is associated with increased volume of gray matter in the frontal and hippocampal regions of the brain, improving brain function by increasing blood flow, increasing glucose, and lipid metabolism resulting in better cognition and academic performance compared to sedentary individuals, a diet high in vegetables, fruits, high-fiber grain products, and fish, and low in fast food, saturated fat, and refined carbohydrates is associated with better cognition and academic performance in children and adolescents.[37]

Interventions to increase physical activity and healthy eating patterns can reduce excess weight which has implications for improving academic and non-academic achievement. The recommendations of the Ministry of Health (2023) related to diet for

adolescents are to follow the principle of balanced nutrition "fill my plate" 2/3 of half a plate is staple food, 1/3 of half a plate is side dishes, 2/3 of half a plate is vegetables and 1/3 of half a plate is fruit and do physical activity regularly 3-5 times for 30 minutes every week.[40] Counseling on the practice of balanced nutrition principles needs to be carried out continuously both directly in schools and through various media.

The significant association found between excess body weight and low self-esteem in this study is consistent with previous research[39]. This highlights the psychosocial burden of excess weight, which can be worsened by weight stigma and discrimination. These negative experiences can lead to unhealthy weight control behaviors, disordered eating, and various psychosocial disorders.[38] Therefore, addressing the psychological and social aspects of overweight and obesity is as crucial as addressing the physical health aspects.

This study also revealed a cyclical relationship between weight stigma, stress, depression, and physical health. Chronic stress resulting from weight stigma can disrupt hormonal balance, leading to increased blood pressure, blood glucose levels, and decreased immunity.[38,39] This can create a self-perpetuating cycle where excess weight leads to psychological distress, which in turn worsens metabolic and hormonal disturbances, potentially causing further weight gain [38]. This complex interplay underscores the need for comprehensive interventions that target both physical and mental health in adolescents with excess weight.

The World Health Organization (WHO) acknowledges the importance of reducing weight stigma and advocates for collaborative efforts to develop effective strategies,[41] through school nurse[41] and family interventions[42] taking into account cultural diversity.[43] The findings of this study support this recommendation, emphasizing the need for culturally sensitive interventions in diverse settings like Palu City. By addressing the root causes of overweight and obesity and mitigating the negative social and psychological consequences, it may be possible to interrupt the cycle of weight gain and enhance the overall well-being of adolescents in this population.

Health issues in children and adolescents can lead to school absences. In this study, one-third of the participants reported missing school due to illness, while many others attended school despite feeling unwell. The most common complaints among participants who missed school were acute respiratory infections (ARI), headaches, muscle or joint pain, sleep difficulties, and gastrointestinal issues. These findings align with previous research that has established a positive correlation between excess weight and physical and mental impairments.

The health risks associated with being overweight are extensive and include cardiovascular, respiratory, endocrine, musculoskeletal, digestive, and liver problems, as well as an increased risk of cancer.[14,44–46] Excess body weight is linked to increased adipose tissue, which triggers the secretion of leptin and adiponectin.[47] Leptin can stimulate the release of proinflammatory cytokines, while adiponectin acts as an anti-inflammatory agent.[48,49] While anti-inflammatory compounds are essential for regulating the immune response, their overactivity can suppress immunity and increase susceptibility to illness. Research has shown that elevated leptin levels are associated with increased dental inflammatory disease in individuals with a BMI of 23 or higher.[48]

Headaches were the second most common complaint among participants in this study, consistent with previous research linking various types of headaches to a higher BMI.[50] Studies have shown that overweight and obesity can increase the risk of headaches by 40.0% to 80.0%, with a higher risk of primary headaches observed in individuals with a BMI over 25.[51]

The study also found that muscle and joint pain were common complaints among overweight participants. This finding is supported by research linking excess weight to musculoskeletal problems, including osteoarthritis and hyperuricemia.[18,52] Obesity can strain the back and lower extremities due to the increased load on muscles and joints, potentially leading to musculoskeletal disorders.[53]

Sleep difficulties, another common complaint among participants, can have far-reaching consequences for health, mood, anxiety, and concentration. Previous studies have identified insomnia as a significant mediator of the negative effects of being overweight, contributing to psychological distress and reduced quality of life in

adolescents.[54]

The results of blood pressure, cholesterol and uric acid examinations were more than normal in this finding, although there was no correlation in statistical tests, only the fasting blood sugar values were generally in the normal category. This finding contradicts previous research that found more high fasting blood sugar values in groups of overweight and obese teenagers.[2,55] Excess body weight causes insulin resistance which has implications for increasing blood sugar.[47,56]

The study also examined the impact of excess body weight on the risk of non-communicable diseases, such as hypertension. A significant proportion of participants had elevated blood pressure, particularly diastolic blood pressure, which is a well-established risk factor for hypertension.[57] This finding is consistent with research demonstrating a positive correlation between excess weight, hypertension, and increased systolic and diastolic blood pressure in adolescents.[58] The underlying mechanisms may involve increased blood volume, abnormal vasoconstriction, and decreased vascular relaxation, leading to increased cardiac output.[57] Another fact shows that adolescents with overweight and obesity have lower blood pressure and fewer depressive symptoms in those who under perceive their weight than those who perceive themselves as overweight.[59] This strategy needs further research as one of the additional interventions in overcoming the adverse effects of being overweight.

Furthermore, the study found a positive correlation between overweight and cholesterol levels, aligning with previous research that has identified high cholesterol as a major metabolic risk factor in overweight individuals.[**Error! Reference source not found.**,**Error! Reference source not found.**] Elevated cholesterol levels can contribute to the narrowing and stiffening of blood vessels, forcing the heart to work harder to pump blood and increasing the risk of cardiovascular disease.[**Error! Reference source not found.**]

While a high prevalence of elevated uric acid levels was observed among participants, there was no significant relationship with BMI. This finding contrasts with some studies that have reported a positive correlation between BMI and uric acid levels in adolescents with obesity.[14,60] The role of uric acid in metabolic syndrome remains a subject of ongoing research, and further investigation is needed to clarify its association with excess body weight in this population[61]. Overweight people tend to consume excessive protein. Proteins generally contain purines that cause an increase in uric acid levels in the blood. The release of high amounts of free fatty acids in overweight people results in insulin resistance. Hyperinsulinemia promotes the reabsorption of uric acid, leading to hyperuricemia.[62]

In the research findings, the results of the examination should be carried out repeatedly and be satisfied beforehand so that the results are more accurate, as well as for in-depth interviews it takes more time. This is a limitation of the research, the time given by the school in collecting data is very limited because students will carry out the learning process, some students have had breakfast before blood tests are carried out.

The discovery of several physical and social health impacts in adolescents that can be the result of overweight shows evidence of the need for interventions in controlling overweight in the form of Health Education related to the concept of overweight and how to control it and non-pharmacological therapies in overcoming physical and mental complaints through research or community service in collaboration with public health centers, schools and families of adolescents, in line with the GENTAS program by the Ministry of Health

CONCLUSION

This study reveals a significant correlation between excess body weight and several adverse health outcomes in adolescents from Palu City, Indonesia. Notably, higher body mass index (BMI) was associated with lower academic performance, decreased self-esteem, and elevated cholesterol levels. These findings highlight the multifaceted impact of excess weight on adolescents' physical and psychosocial well-being. Furthermore, the study identified a high prevalence of physical complaints among overweight adolescents, including acute respiratory infections, headaches, muscle and joint pain, and sleep difficulties. These complaints often led to school absences, further emphasizing the negative impact of excess weight on adolescents' daily lives. These findings suggest the need for further studies on ethnically diverse behavioral and sociocultural factors associated with the incidence of excess body weight before

conducting culture-based behavioral interventions.

This finding is an input for health agencies and schools, the need for further research on determinant factors such as ethnically diverse behavior and sociocultural factors related to the incidence of overweight before conducting health education interventions and improving eating behavior and physical activity in line with the principles of balanced nutrition based on local wisdom culture.

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