

Factors Related to Metabolic Syndrome Risk Behavior in Adolescents of Public High Schools in Jakarta Capital City

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ABSTRACT

Metabolic Syndrome is a collection of risk factors for metabolic disorders associated with non-communicable diseases such as dyslipidemia, hyperglycemia, and hypertension, cardiovascular atherosclerotic and central obesity. Adolescents living in Jakarta area have risky behaviors that can cause metabolic syndrome. These risky behaviors include diet, physical inactivity and stress. This risky behaviors of metabolic syndrome in adolescents is influenced by several factors such as knowledge, attitudes, peers and parents. The purpose of this study was to analyze factors related to metabolic syndrome risk behavior in adolescents of state high schools in DKI Jakarta. The research design used descriptive analytics with a cross sectional design. The total sample of 210 respondents was obtained through calculations with the G*Power application version 3.1.9.7 with an effect size of 0.3 (medium), alpha 0.05 and power 0.95 with Df 3. The results of the study using the Chi Square statistical test analysis, obtained no relationship between knowledge ($P_v = 0.337$) and attitudes ($P_v = 0.053$) with metabolic syndrome risk behavior in adolescents of state high schools in DKI Jakarta. Meanwhile, factors related to metabolic syndrome risk behavior in adolescents in DKI Jakarta are peers ($P_v = 0.000$) and parents ($P_v = 0.013$). Suggestions, prevention of metabolic syndrome risk behaviors in adolescents can be done through education by involving peers and increasing the role of parents.

Keywords: Risky behavior, metabolic syndrome, knowledge, attitudes, peers, and parents

BACKGROUND

Metabolic Syndrome is a collection of risk factors for metabolic disorders associated with non-communicable diseases such as dyslipidemia (increased triglyceride levels and decreased high density lipoprotein/HDL), hyperglycemia, hypertension, cardiovascular atherosclerotic and central obesity (Murningtya FS et al 2020; Christijani, 2019) [1,2].

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Metabolic syndrome diagnosis criteria are currently recommended on the diagnosis criteria from the World Health Organization (WHO), National Cholesterol Education Program (NCEP), Adult Treatment Panel (ATP) III, and the International Diabetes Federation (IDF) which include central obesity, hypertriglyceridemia, hypertension, hyperglycemia, and micro albuminuria (Rustika, Driyah, Oemiati, & Hartati, 2019) [3].

The main factors that are thought to contribute to the occurrence of metabolic syndrome are due to lifestyle factors, especially physical activity and diet (Jauharany & Widyastuti, 2017) [4]. The IDF explains that the underlying causes of metabolic syndrome are insulin resistance and central obesity, both of which are considered significant factors. But genetics, physical activity, aging, pro-inflammatory states and hormonal changes can also have causal effects, however these roles can vary depending on the ethnic group (International Diabetes Federation, 2006) [5]. Currently, metabolic syndrome is a global problem with the incidence rate continuing to increase every year. This is not only the case in developed countries but also in developing countries.

The prevalence of metabolic syndrome varies considerably due to the presence of differences in the criteria used, such as ethnicity, age, and sex groups (Listyandini, Pertiwi, & Riana, 2020) [6]. The IDF says it is estimated that 20 to 25% of the world's adult population has metabolic syndrome, which puts them twice as likely to die and three times more likely to have a heart attack or stroke than those without metabolic syndrome. (International Diabetes Federation, 2006) [5]. In Indonesia, data on the prevalence of metabolic syndrome is still very limited, but data related to the group of non-communicable diseases that are indicative of metabolic syndrome can be described as follows: 1) Hypertension, as much as 31.3% in men and 36.9% in women, 2) Diabetes, amounting to 1.2% in men and 1.8% in women, 3) Heart disease 1.3% in men and 1.6% in women and 4) Central obesity as much as 31.0% in 2018 (Riskasdas, 2018) [7].

In the Jakarta area, the prevalence of metabolic syndrome was reported at 28.4% of which 25.4% in men and 30.4% in women. In men, the prevalence of metabolic syndrome has more than doubled in the 30s compared to the 20s age group, while in the 50s to 60s age group, it is relatively flat. Likewise, the prevalence of metabolic syndrome in women tripled in the 30s age group compared to the 20s age group,

while for the 40s age group it was relatively flat. The largest metabolic syndrome factors in men were hypertension (84.7%) followed by hypertriglyceridemia (83.4%), central obesity (75.5%), hyperglycemia (50.9%), and low HDL levels (43.6%). Meanwhile, in women, the largest metabolic syndrome factors were central obesity (91.3%), followed by hypertension (84.1%), hypertriglyceridemia (66.1%), low HDL levels (57.8%), and hyperglycemia (50.2%) (Soewondo, Purnamasari, Oemardi, Waspadji, & Soegondo, 2010) [8].

The incidence of metabolic syndrome is not only experienced by adults but also at a young age such as the adolescent group. From the data obtained in 2010 shows that the prevalence of metabolic syndrome in children and adolescents in the United States is 4.2% based on the ATP III criteria and by 8.4% based on the WHO criteria (Chrystal Wittcopp, MD, Rushika Conroy, MD, 2016) [9]. Likewise, from the results of a study conducted in the Jakarta area on 50 obese adolescents aged 10 to 19 years with a prevalence of metabolic syndrome of 34%. Another study was also conducted in Jakarta on obese adolescents aged 12 to 15 years using IDF criteria of 19.6% experiencing metabolic syndrome (Munawar, 2015) [10]. From the results of the study, it is clear that the incidence of metabolic syndrome in adolescents, especially adolescents who are obese, shows a fairly high rate. Of course, this needs further attention so that it does not develop into health problems in the future such as an increase in cases of Non-Communicable Diseases (NCDs).

Adolescence is a period of change from childhood that leads to adulthood. Adolescence is an important period where various changes occur, including physical changes, brain development, maturation of reproductive organs, and psychosocial development that affect health-related behaviors (Prihaningtyas, Widjaja, Hanindita, & Irawan, 2020) [11]. High school teenagers are people who are 15-18 years old. At this age, teenagers have begun to seek independence and identity (Utami & Setyarini, 2017) [12]. Characteristic in adolescence is the presence of instability over time as a result of attempts to adapt to new behaviors and social expectations, being ambivalent at any change, they want and demand freedom, the existence of self-adjustment to group standards rather than individualists, and always wanting to show personal identity in order to draw attention to oneself and maintain self-identity towards one's peers (Masri, 2019) [13]. Adolescents are among the groups at risk

for metabolic syndrome; this is due to unhealthy lifestyles such as wrong diet or diet, lack of physical activity and increased sedentary activity. If this metabolic syndrome has occurred in adolescence, then non-communicable diseases such as cardiovascular, diabetes mellitus, stroke and even cancer can occur at an early age with all the consequences including loss of productivity and reduced quality of life.

Adolescents living in Jakarta area have risky behaviors that can cause metabolic syndrome. These risky behaviors include diet, physical inactivity and stress. Pramono and Sullchan (2014) [14] said that as many as 87% of teenagers like to consume fast food and junk food. Teenagers are often more interested in eating from outside the home such as those sold in school cafeterias and at street vendors. Meanwhile, food/snacks found at street vendors or in school cafeterias often contain high fat and low fiber, lack vitamins and minerals (Silalahi, 2019) [15]. Riskesdas reported that adolescents aged 15 to 19 years who had the habit of consuming sweet foods ≥ 1 time per day as much as 35%, consumption of sugary drinks as much as 57.10%, consumption of salty foods as much as 10.94%, consumption of fatty / cholesterol / fried foods as much as 38.22%, consumption of processed meat / chicken / fish foods with preservatives as much as 8.38%, and consumption of instant noodles / other instant foods as much as 10.94% (Riskesdas, 2018) [16].

The next risky behavior that causes the occurrence of metabolic syndrome is physical inactivity. The development of technology that is now increasingly rapid causes teenagers to do less physical activity. The behaviors in question are such as the behavior of sitting, sleeping, lying down, playing the computer and watching television. This is justified by research conducted by Utami LWP, et al. (2016) [17] where the results were obtained that the average level of physical activity and exercise habits of subjects who experienced metabolic syndrome was much lower than subjects who did not experience metabolic syndrome (Utami, P., Dieny, 2016) [12].

The next risky behavior that causes metabolic syndrome is stress. Chronic psychosocial stress can have destructive effects, cause physiological and structural changes in the body, resulting in insulin resistance, atherosclerosis, and ultimately cardiovascular disease (Listyandini et al., 2020) [6]. However, in a study conducted by Sutadarma IWG, et al. [18] a weak negative relationship was found between

stress levels and metabolic syndrome parameters which were statistically insignificant, which means that an inverse relationship was obtained between stress levels and metabolic syndrome (IWG, S, & IMW, 2011) [18].

Behavior at risk of metabolic syndrome in adolescents is influenced by several factors such as knowledge, attitudes, peers and parents. Notoatmojo (2010) [19] said that knowledge or cognitive is a very important area in the formation of a person's actions. Behavior based on knowledge will be more fixed than behavior that is not based on knowledge (Tanaefeto & Ulfiana, 2004) [20]. This is justified by research conducted by Lidiawati, et al, [21] in 2020 obtained results that there is an influence of knowledge on eating behavior in obese adolescents with a value ($p = 0.006 < p = 0.05$). This can be interpreted to mean that adolescents have a diet at risk of obesity which can be influenced by nutritional knowledge factors about how adolescents consume foods that can increase weight over/obesity (Lidiawati, Lumongga, & Anto, 2020) [21].

The next factor is attitude; attitude is a person's response which is one of the important factors in a process of behavior formation (Prasida, Indriani, & Kartika, 2020) [22]. This is reinforced from the results of research by Lidiawati, et al. [21] who said that there is an influence of attitudes on the eating behavior of obese adolescents. This can be interpreted if a negative adolescent response can cause them to consume foods that can be at risk of obesity (Lidiawati et al., 2020) [21].

The next factor is peers, Brown said that the influence of peers has an important role; this is because the time a person spends outside the home is more and feels in agreement with his peers (R. A. Putri, Shaluhayah, & Kusumawati, 2020) [23]. This is confirmed based on the results of a study conducted by Muetia, et al. [24] which showed a meaningful relationship between peers and the incidence of obesity in students at SMA Negeri 2 Banda Aceh City in 2019, with a p -value = 0.021 and OR = 2,841, this shows that peers play a role has a risk of obesity almost twice as high as peers who do not play a role (Ratna, Nazhira, & Ramadaniah, 2021) [25].

The last factor is parents, parents play an important role as role models or examples for their children in terms of healthy eating behaviors, parents are responsible for food problems at home, types of food served, and must provide education about important things about food to their children, so that

later they are able to determine what foods are healthy when they are away from home. (Sulistyoningsih in Putri et al., 2020) [26]. This is evidenced by research conducted by Arisdani and Buanasita which found that there is a negative relationship between the role of parents and body mass index (BMI). The less the role of parents, the higher the BMI / U will tend to be higher (closer to more nutrition) (Sulistyoningsih in Arisdanni & Buanasita, 2018) [27].

According to the Central Statistics Agency (BPS) the number of adolescents aged 15 to 19 years in DKI Jakarta in 2020 was 840,344 people, 430,311 were male and 410,033 were female (BPS, 2020) [28]. Public High Schools in DKI Jakarta number 117 schools, and it is estimated that the number of public high school students in DKI Jakarta is 91,858 people (Dinas Komunikasi, Informatika, 2021) [29]. No data have been obtained related to the incidence of metabolic

syndrome in this group.

RESEARCH METHODS

This research is an analytical descriptive study with a cross sectional approach. The sample in this study was 210 state high school teenagers in DKI Jakarta who were selected using the Purposive sampling technique with criteria of samples. The inclusion criteria for this study include, among others, teenagers who attend DKI Jakarta State High School grades 10-12, willing to become respondents. Data processing through univariate and bivariate data analysis using Chi-Square with a confidence level of 95%.

RESEARCH RESULTS

Frequency Distribution of Respondents by Age, Gender, Class, Region, and Genetics

Table 1: Frequency Distribution of Respondents by Age, Gender, Class, Region, and Genetics, (n=210)

Variable	Category	Frequency	
		Σ	%
Age	14	1	0,5
	15	11	5,2
	16	62	29,5
	17	92	43,8
	18	44	21,0
Total		210	100
Sex	Female	180	85,7
	Male	30	14,3
Grade	X	38	18,1
	XI	91	43,3
	XII	81	38,6
Location	Center of Jakarta	18	8,5
	North Jakarta	42	20,0
	West Jakarta	23	11,0
	South Jakarta	66	31,4
	East Jakarta	56	26,7
	Seribu Island	5	2,4
Genetic (parents)	Hypertension	34	16,2
	Diabetes Mellitus (DM)	12	5,7
	Stroke	4	1,9
	Heart diseases	8	3,8
	Obesity	6	2,9
	None	146	69,5

Based on table 5.1, based on the characteristics of respondents obtained from 210 respondents, most of them were 17 years of age with 92 respondents (43.8%), the majority was female as many as 180 respondents (85.7%), and then the most class was class XI, which was 91 respondents (43.3%). In

addition, it was found that most of the respondents were in the South Jakarta area, namely 66 respondents (31.4%) and the majority of respondents did not have a family history of disease, namely 146 respondents (69.5%).

Frequency Distribution of Respondents Based on Dependent Variables

Table 2: Respondent Frequency Distribution Based on Dependent Variables, (n=210)

Variable	Category	Frequency	
		Σ	%
High risk Syndrome Metabolic	Risk	106	50,5
	Without risk	104	49,5
Total		100	

Based on table 2, based on the dependent variables obtained from 210 respondents, there were 106 respondents (50.5%)

with the risk category and 104 respondents (49.5%) with the non-risk category.

Frequency Distribution Based on Independent Variables

Table 3: Respondent Frequency Distribution Based on Independent Variables, (n=210)

Variable	Category	Frequency	
		Σ	%
Knowledge	Less	81	38,6
	Good	129	61,4
Attitude	Negative	88	41,9
	Positive	122	58,1
Friends	Negative	114	54,3
	Positive	96	45,7
Parents	Less	116	55,2
	Good	94	44,8

Based on table 3 based on independent variables obtained from 210 respondents, most of the knowledge of adolescents was good with 129 respondents (61.4%) and the majority of adolescent attitudes were positive with 122 respondents

(58.1%). In addition, it was found that 114 respondents (54.3%) had a negative peer influence and 116 respondents (55.2%) respondents had less parental roles.

The Relationship between Knowledge and Metabolic Syndrome Risk Behavior in State High School Adolescents in DKI Jakarta

Table 4: Relationship of Knowledge to Metabolic Syndrome Risk Behaviors

Independent Variable	High Risk Syndrome Metabolic				Total		OR	95% CI	P value
	High Risk		Without Risk		Σ	%			
	Σ	%	Σ	%					
Knowledge									
Less	37	34,9	44	42,3	81	100,0	0,731	0,419 – 1,277	0,337
Good	69	65,1	60	57,7	129	100,0			
Total	106	38,6	104	61,4	210	100,0			

Based on table 4, it is known that the results of the analysis of the relationship between knowledge and metabolic syndrome risk behavior in adolescents of State High Schools in DKI Jakarta, namely there were 69 respondents (65.1%) with knowledge that good adolescents had metabolic syndrome risk behaviors and 37 respondents (34.9%) with knowledge that adolescents were not good at having

metabolic syndrome risk behaviors. Based on the results of statistical tests using the Chi Square test, a p value = 0.337 was obtained. This means that at alpha 5% there is no relationship between knowledge and metabolic syndrome risk behavior in adolescents of state high schools in DKI Jakarta.

The Relationship between Attitudes and Metabolic Syndrome Risk Behaviors in State High School Adolescents in DKI Jakarta

Table 5: Relationship of Attitudes to Metabolic Syndrome Risk Behaviors

Independent Variable	High Risk Syndrome Metabolic				Total		OR	95% CI	P value
	Risk		Without Risk		Σ	%			
	Σ	%	Σ	%					
Attitude									
Negative	37	34,9	51	49,0	88	100,0	0,557	0,320 – 0,970	0,053
Positive	69	65,1	53	51,0	122	100,0			
Total	106	41,9	104	58,1	210	100,0			

Based on table 5, it is known that the results of the analysis of the relationship between attitudes and metabolic syndrome risk behaviors in adolescents of State High Schools in DKI Jakarta, namely there were 69 respondents (65.1%) with positive adolescent attitudes having metabolic syndrome risk behaviors and 37 respondents (34.9%) with negative

adolescent attitudes having metabolic syndrome risk behaviors. Based on the results of statistical tests using the Chi Square test, a p value = 0.053 was obtained. This means that at alpha 5% there is no relationship between attitudes and metabolic syndrome risk behaviors in adolescents of state high schools in DKI Jakarta.

Peer Relationship with Metabolic Syndrome Risk Behavior in State High School Adolescents in DKI Jakarta

Table 6: Peer Relationships with Metabolic Syndrome Risk Behaviors.

Independent Variable	High Risk Syndrome Metabolic				Total		OR	95% CI	P value
	High Risk		Without Risk		Σ	%			
	Σ	%	Σ	%					
Friends									
Negative	71	67,0	43	41,3	114	100,0	2,878	1,640 – 5,050	0,000
Positive	35	33,0	61	53,8	96	100,0			
Total	106	54,3	104	45,7	210	100,0			

Based on table 6, it is known that the results of the analysis of the relationship between peers and metabolic syndrome risk behaviors in adolescents of State High Schools in DKI Jakarta, namely there were 71 respondents (67.0%) with the influence of negative peers having metabolic syndrome risk behaviors and 35 respondents (33.0%) with the influence of positive peers having metabolic syndrome risk behaviors. Based on the results of statistical tests using the Chi Square

test, a p value = 0.000 was obtained. That is, at alpha 5% there is a relationship between peers and metabolic syndrome risk behaviors in adolescents of State High Schools in DKI Jakarta. In addition, from the results of statistical tests, OR = 2,878 was obtained, meaning that respondents who had a negative peer influence had a 2,878 times chance of having metabolic syndrome risk behaviors.

Parents' Relationship with Metabolic Syndrome Risk Behavior in Adolescents of State High Schools in DKI Jakarta

Table 7: Relationship of Parents to Metabolic Syndrome Risk Behaviors

Independent Variable	High Risk Syndrome Metabolic				Total		OR	95% CI	P value
	Risk		Without risk		Σ	%			
	Σ	%	Σ	%					
Parent									
Less	68	64,2	48	46,2	106	100,0	2,088	1,200 – 3,631	0,013
Good	38	35,8	56	53,8	104	100,0			
Total	106	55,2	104	44,8	210	100,0			

Based on table 5.7, it is known that the results of the analysis of the relationship between parents and metabolic syndrome risk behaviors in adolescents of State High Schools in DKI Jakarta, namely there were 68 respondents (64.2%) with negative parental roles having metabolic syndrome risk behaviors and 38 respondents (35.8%) with the role of good parents having metabolic syndrome risk behaviors.

Based on the results of statistical tests using the Chi Square test, a p value = 0.013 was obtained. That is, at alpha 5% there is a relationship between parents and metabolic syndrome risk behaviors in adolescents of State High Schools in DKI Jakarta. In addition, from the results of statistical tests, OR = 2,088 was obtained, meaning that respondents who had a parental role were less likely to have a 2,088 times chance of having metabolic syndrome risk behaviors.

DISCUSSION

Characteristics of Respondents Based on Age, Gender, Class, Region, and Genetics, Based on the results of the study, it was found that most of the 17-year-olds were 92 respondents (43.8%). then the most class was class XI, which was 91 respondents (43.3%). Basically, the results of the research above are interrelated. In this study, most of the respondents were students aged 17 years and from grade 11. In general, students who are 17 years old are students who are at level 2 or class XI. According to Monks, Knoers, and Haditono ages 15-18 are middle adolescence. Adolescence is a transition period from childhood to adulthood that experiences the development of all aspects / functions to enter adolescence (W. S. R. Putri, Nurwati, & S., 2016) [26]. Adolescents are among the groups at risk for metabolic syndrome; this is due to unhealthy lifestyles such as wrong diet or diet, lack of physical activity and increased sedentary activity. If this metabolic syndrome has occurred in adolescence, then non-communicable diseases such as cardiovascular, diabetes mellitus, stroke and even cancer can occur at an early age with all the consequences including loss of productivity and reduced quality of life.

Based on the results of the study, it was found that most of them were female as many as 180 respondents (85.7%). In this study, the majority of respondents were found with female gender; this happened because those who were more interested in filling out the questionnaire were women than men. According to the results of research conducted by Adam Hermawansyah and Ahmad R P in 2021, the results were obtained if the most social media users were women, namely as much as 80% compared to men.

Based on the results of the study, it was found that most of them were in the South Jakarta area, namely 66 respondents (31.4%). In this study, more respondents were found to be in the South Jakarta area, this happened because the teenagers who responded more to researchers and were more enthusiastic were teenagers who went to school in the South Jakarta area. Based on the results of the study, it was found that most respondents did not have a family history of disease, namely 146 respondents (69.5%), High Blood 34 respondents (16.2%), DM (diabetes) 12 respondents (12%), Stroke 4 respondents (1.9%), Heart Disorders 8 respondents (3.8%), Obesity / obese 6 respondents (2.9%). According to Iskandar, Agustin et al. (2018) the magnitude of genetic

influence varies from 5-70%. This is because genetic factors are multifactor and often do not stand alone. But for some, genetics is the main determining factor. Genetic factors can affect every component of metabolic syndrome, and metabolic syndrome itself. The presence of a family history of obesity, type 2 diabetes, and insulin resistance increases the likelihood of metabolic syndrome.

Characteristics of Respondents Based on Independent Variables

Knowledge

Based on the results of the study, it was found that out of 210 respondents, most of them had good adolescent knowledge with a total of 129 respondents (61.4%). This is in line with the results of research by Lefni Lasimpala, et al (2021) [30] obtained results that more respondents had good knowledge as many as 76 respondents (82.6%), and fewer respondents had less knowledge as many as 16 respondents (17.4%).

Knowledge is the result of "knowing" and this happens after people have made a search for a particular object. Sensing occurs through the five senses of human beings, namely vision, hearing, smell, taste, and groping. Most of the human knowledge is obtained through eyes and ears. Knowledge and cognitive are important areas to shape one's actions (Notoatmojo 2010 in Murniati, et al 2022) [24]. Good knowledge can influence the formation of a person's behavior; for example behavior in determining how to choose and consume the right food so that it can prevent metabolic syndrome (Magdalena 2014 in Lasimpala, et al (2021) [30]. In this study, more respondents were found to have good knowledge; this may be because students have received education from their schools about diet and physical activity.

Attitude

This is in line with the results of Devi Cahya Sukma's research (2014) [31] obtained results that the attitude of the subjects in choosing snack foods was included in the good category as many as 57 people (86.4%), while in the category enough as many as 8 people (12.1%) and less only 1 person (1.5%).

Attitude is the readiness to react to an object in a particular environment as a passion for the object. A good attitude does not necessarily lead to good eating habits. This can happen because a person's attitude can be formed by social interactions that can affect individuals. Attitude consists of positive and negative attitudes (Devi Cahya Sukma, 2014)

[31]. Adolescents usually tend to consume foods that are sweet, rich in energy derived from carbohydrates and high in fat. If the situation continues for a long time, it is possible that the teenager may be obese (Lidiawati et al., 2020) [32].

Peers

This research is in line with the results of the research of Lidiawati, et al (2020) [21], namely from 268 respondents, it was found that the results of peer roles were not good as many as 147 people (54.9%). It is Keller's opinion that the strength of peers is very strong in childhood and young adulthood because they spend most of their time at school or elsewhere with their peers, so that peers can change good and healthy behaviors and habits related to diet (Lidiawati et al., 2020) [21].

Parents

Based on the results of the study, it was found that out of 210 respondents, most had less parental wars as many as 116 (55.2%). This is in line with the results of research by Lidiawati, et al (2020) [21], namely from 268 respondents, 150 people (56%) found that the results of family roles were not good.

According to Skardal, there is an influence on the role of parents on obesity eating behavior due to parents' income. Family economic conditions affect the food behavior of adolescents. Parents can serve various types of food that are quite expensive but contain substances that easily increase weight (Lidiawati et al., 2020) [21].

Characteristics of Respondents Based on Dependent Variables

The results of the research of Fillah Fithra Dieny, et al (2015) [31] obtained the results that most subjects have experienced metabolic syndrome (68.4%) and some have pre-metabolic syndrome (31.6%). The behavior of metabolic syndrome in this study consists of diet, physical activity and stress. Eating intake is one of the determining factors for the occurrence of obesity, which can later proceed to metabolic syndrome. Excessive eating intake that has the potential to cause obesity is the intake of fats and carbohydrates because both will be stored in the body on fat cells if consumed in quantities that exceed the needs (Dieny, Widyastuti, & Fitranti, 2015) [32]. In this study, respondents mostly consumed high-fat foods such as chicken skin, mutton and meatballs, then often bought snacks such as seblak, Cireng, cilor and the like

at school. This may be due to environmental factors, where around the school there are various types of food peddled by vendors. Then, after school, teenagers prefer to hang out at culinary delights selling various foods located on the side of the capital's roads.

Then physical activity, a theoretical source in line with this study says that at the time of exercising calories will be burned, the more frequent exercise the more calories are lost. Calories will indirectly affect the basal metabolic system. Basal metabolism is reduced in people who sit at work all day. Lack of physical activity will trigger a great cycle, obesity makes sports activities very difficult and less enjoyable and lack of exercise will indirectly affect the decrease in the basal metabolism of the person's body (Ratna et al., 2021) [25]. In this study, respondents mostly rarely exercised (jongging) for at least 30 minutes a day, rarely made a plan to start exercising regularly, never visited a sports fitness center and more often had minimal activities such as watching TV, playing games and sleeping for more than 1 hour. Many factors are related to the inactivity of adolescents, namely gender, physiological characteristics, exercise classes, watching TV, seasons, weather, environmental safety, parental influence and peer influence (Utami, P., Dieny, 2016) [17].

The last is stress, chronic psychosocial stress can cause destructive effects, cause physiological and structural changes in the body so that it results in a condition of insulin resistance, atherosclerosis, and can eventually become a cardiovascular disease (Listyandini et al., 2020) [].

The Relationship between Knowledge and Metabolic Syndrome Risk Behavior in State High School Adolescents in DKI Jakarta

Based on the results of bivariate analysis using the chi square statistic test, a p value = 0.337 was obtained. This means that at alpha 5% there is no relationship between knowledge and metabolic syndrome risk behavior in state high school adolescents in DKI Jakarta. This is in line with the results of research by Murningtyas, et al (2020) [] who said that there is no relationship between knowledge and the incidence of metabolic syndrome.

The absence of meaningful relationships in this study was due to the fact that respondents' knowledge was almost entirely homogeneous, namely having good adolescent knowledge as many as 129 respondents (61.4%), only a few

respondents were found to have insufficient knowledge. This homogeneity can occur because the contents of the questionnaires used are easy for respondents to answer, making the results of statistical tests show the absence of meaningful relationships.

High knowledge alone is not enough to be able to change a person's eating habits. There are 3 factors that can affect knowledge, namely individual characteristics, eating characteristics and the environment. The knowledge gained by a person cannot necessarily change their eating habits, because they may understand about the proteins, carbohydrates, vitamins, and other nutrients necessary for the balance of their diet but they never apply that knowledge in their daily lives. Good knowledge is expected to affect good food consumption, so that it can lead to good nutritional status as well (Devi Cahya Sukma, 2014) [31].

The Relationship between Attitudes and Metabolic Syndrome Risk Behaviors in State High School Adolescents in DKI Jakarta

Based on the results of bivariate analysis using the chi square statistic test, a p value = 0.053 was obtained. This means that at alpha 5% there is no relationship between attitudes and metabolic syndrome risk behaviors in state high school adolescents in DKI Jakarta. This is in line with the results of Devi Cahya Sukma's research (2014) [31] which said that there is no meaningful relationship between attitudes in choosing snack foods and obesity in adolescents.

There was no meaningful association in this study between attitudes and metabolic syndrome risk behaviors can be caused by several factors. According to Azwar, the factors that can influence the formation of attitudes are personal experience, the influence of others considered important and cultural influences. The influence caused by these factors can change a positive attitude into a negative one, school-age children will generally imitate the attitude of their parents. If the attitude of their parents in choosing snacks is quite careful or disciplined by prioritizing their health, the child will follow the attitude of his parents in choosing snacks at school. This attitude can influence adolescents in choosing snack foods which of course can also have an impact on their nutritional status. Teenagers usually consume foods/snacks rich in energy derived from carbohydrates and fats. If the situation lasts continuously for a long time, it is possible that the teenager can be obese (Devi Cahya Sukma, 2014) [31].

Peer Relationship with Metabolic Syndrome Risk Behavior in State High School Adolescents in DKI Jakarta

Based on the results of bivariate analysis using the chi square statistic test, a p value = 0.000 was obtained. That is, at alpha 5% there is a relationship between peers and metabolic syndrome risk behaviors in state high school adolescents in DKI Jakarta. In addition, from the results of statistical tests, OR = 2,878 was obtained, meaning that respondents who had a negative peer influence had a 2,878 times chance of having metabolic syndrome risk behaviors.

The results of this study are in line with the results of research by Ratna, et al (2021) [25] who said that there is a relationship between peers and the incidence of obesity in students at SMA Negeri 2 Banda Aceh City in 2019. In adolescence there is a transition towards independence, so the interests, behaviors and routines of adolescents will undergo changes. One of the changes that has occurred is that teenagers spend more time outdoors with their peers. One of the activities carried out with peers is to consume food together. Eating together is usually done at school or other places together with their friends. Eating together with peers can have an impact on the habit of choosing unhealthy foods that will have an effect on weight gain. Peers have a strong influence on adolescents because peers can also change good behaviors and habits related to diet (Fatmawati et al., 2021) [32].

Another source of theory that is in line with this research is the theory according to Amarita (2015) [17] in Ratna, et al. (2021) [25] which says that peers can influence a person's eating habits. The selection of food is no longer based on nutritional content but simply socializing, for pleasure, and also so as not to lose status. The influence of peers becomes stronger because peers replace parents as the main source of social encouragement and peers can have both negative and positive influences on food intake. There are 2 types of movements in the social development of adolescents, namely the movement of separating oneself from parents and the movement of approaching peers.

Parents' Relationship with Metabolic Syndrome Risk Behavior in Adolescents of State High Schools in DKI Jakarta

Based on the results of bivariate analysis using the chi square statistic test, a p value = 0.013 was obtained. That is, at alpha

5% there is a relationship between parents and metabolic syndrome risk behaviors in state high school teenagers in DKI Jakarta. In addition, from the results of statistical tests, OR = 2,088 was obtained, meaning that respondents who had a parental role were less likely to have a 2,088 times chance of having metabolic syndrome risk behaviors.

This is in line with the results of research by Arisdanni & Buanasita (2018) [27] that there is a significant relationship between the role of parents and the incidence of more nutrition in schoolchildren. This can be seen from the results of research that shows that most of the roles of parents are not good. This lack of parental role can be caused by the busyness of parents to work outside the home so that they do not have time to supervise children who go to school every day and as a result their children get less attention. Generally, parents only give pocket money to their children, so that their children have freedom and often consume snack foods around the school. This means that the family has an influence and determines the success or failure of children in good nutritional behavior as well as the behavior of consuming snack foods (Afni, 2018) [33].

According to (Sulistyoningsih in Putri et al., 2020) [23] Parents have an important role as role models or examples for their children in terms of healthy eating behaviors, parents are responsible for food problems at home, types of food served, and must provide education about important things about food to their children, so that later they are able to choose what foods are healthy when they are away from home.

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