Volume 6, No. 1 January, 2025
p ISSN 2723-6927-e ISSN 2723-4339

The Relationship Between Physical Activity, Stress And Sleep Duration With Hypertension In Senior High School Adolescents In Palembang City

Siti Aisyah[1], Andra Kurnianto[2], Sri Nita[3]
Fakultas Kedokteran, Universitas Sriwijaya, Indonesia
Email: ichaashaa7@gmail.com

Abstract
Hypertension in adolescents is an emerging public health concern, with its prevalence in Indonesia increasing from 3.11%–4.6% in 2005 to 8.3% in 2008, and it is predicted to continue rising annually. Adolescent hypertension often goes undetected, leading to severe health complications in adulthood if left uncontrolled and untreated. Several lifestyle factors, including physical activity, stress levels, and sleep duration, have been identified as potential contributors to the incidence of hypertension in adolescents. This study aims to analyze the relationship between physical activity, stress, and sleep duration with the incidence of hypertension among high school students in Palembang City.This research adopts an analytical cross-sectional study design, with a total sample of 467 high school students selected based on inclusion and exclusion criteria. Data were analyzed using the Chi-Square statistical test to determine associations between variables. The results indicate a significant relationship between physical activity and hypertension ($p = 0.008$), as well as between stress and hypertension ($p = 0.005$). However, no significant relationship was found between sleep duration and hypertension ($p = 0.054$) These findings suggest that low physical activity and high-stress levels contribute to hypertension in adolescents, emphasizing the need for preventive strategies such as promoting regular physical exercise and stress management programs in schools. Future research should explore longitudinal studies to assess the long-term effects of adolescent hypertension, intervention-based research to determine the effectiveness of physical activity programs, and the potential role of sleep quality rather than duration in blood pressure regulation. This study highlights the importance of early lifestyle modifications to prevent hypertension-related complications in adulthood.
Keywords: Hypertension; Adolescents; Physical Activity; Stress; Sleep Duration

Introduction
Hypertension is a state of blood pressure values above normal, which are categorized into two types, namely primary or essential hypertension and secondary hypertension. The cause of primary hypertension is not known for sure and usually appears in adolescents aged 13 to 18 years (Saing, 2005a). Meanwhile, secondary hypertension is in the background due to conditions such as kidney disease, endocrine disease, heart disease and kidney disorders (Taler, 2008). Primary hypertension in adolescents is rarely detected, so in adulthood it can manifest badly due to uncontrolled and untreated (Saing, 2005b).

The World Health Organization (2011) states that as many as one billion people in the world suffer from hypertension. In Indonesia, there has been an increase in the prevalence of hypertension, which in 2013 was 25.8% and then reached 34.1% in 2018 (Riskesdas, 2018). As well as the increase in the prevalence of hypertension in general, hypertension in children and adolescents has also increased in prevalence, from 3.11%-4.6% in 2005 then to 8.3% in 2008 in Indonesia (Depkes, 2008). Research conducted by Nurmayanti in 2014 in Jakarta, found that 15.5% of high school teenagers experienced hypertension. Meanwhile, in Yusrizal's research in Pangkal Pinang in 2016, the incidence of hypertension among high school adolescents was 22.5% (Angesti et al., 2018a).

Hypertension is caused by endogenous and exogenous factors. Endogenous factors are such

as hormones and genetics, while exogenous factors are cigarettes, nutrition, stressors and others. Exogenous factors or lifestyle are factors that can be controlled by humans. A healthy lifestyle can help prevent and slow down the increase in blood pressure values. Kania in his research published in (Angesti et al., 2018a), stated that lifestyle factors such as lack of sleep duration, stress and low physical activity can have an influence on the incidence of hypertension in adolescents.

Insufficient sleep duration can lead to neuroendocrine disorders (Van Cauter et al., 2007). Stress as a component that is able to trigger an increase in sympathetic nerve activity (Robert M. Kliegman, 2004). Lack of physical activity can lead to low cardiorespiratory power (Whyte, 2006). These factors will have an influence on a person's blood pressure value. Research conducted by (Xu et al., 2014) in China showed a link between stress and hypertension in high school students, a study conducted by (Nasution et al., 2017) on students in North Sumatra regarding the duration of sleep that is lacking with the incidence of hypertension, as well as research conducted by Leary and Gidding which is published in (Pardede et al., 2017) showed an increase in systolic blood pressure in adolescents with low physical activity.

Adolescents are the capital of nation building, so their condition must be prepared to remain excellent. Adolescents will be a burden on development in the future if they are not in prime condition (Agustini & Arsani, 2013). Research on the relationship between physical activity, stress and sleep duration and adolescent hypertension has never been conducted in the city of Palembang. This study was aimed at finding out the relationship between physical activity, stress and sleep duration and the incidence of hypertension in adolescents in high schools in Palembang.

This study generally aims to determine the relationship between physical activity, stress and sleep duration and hypertension in high school adolescents in the city of Palembang.

Adolescence according to WHO is a stage of development where humans reach the stage of physical maturity which is characterized by menstruation in women and wet dreams in men starting around the age of 10-18 years. Meanwhile, based on Law of the Republic of Indonesia Number 4 of 1979 article 1 chapter 1, adolescents are men or women who are less than 21 years old and have never been married (Pusat Data Dan Informasi Kementerian Kesehatan RI, 2017).

Adolescents are divided into 3 stages, namely: Early Adolescence, Middle Adolescence and late adolescence. Early adolescence is in the age range of 10-14 years which is characterized by rapid physical growth and maturation and there are several psycholoigic changes such as identity crises and unstable psyche. Middle adolescence are in the age range of 15-17 years which is characterized by almost complete puberty growth and well-established emotional and psychological development such as paying close attention to appearance, attention to the opposite sex and being consistent with goals. Late adolesecence Starting at the age of 18 which is marked by preparation towards becoming an increasingly mature adult, including job clarification and internalization of the personal value system (Christie & Viner, 2005)

Research Methods

Type of Research

The study was an analysis with a cross-sectional study design to determine the relationship between physical activity, stress and sleep duration and the incidence of hypertension in high school adolescents in Palembang.

Time and Place of Research

This research will be conducted from May 2019 to December 2019 at high schools in the

city of Palembang.

Population and Sample

Population

The population in the study is divided into two, namely the target population and the affordable population. The target population in this study is high school teenagers in the city of Palembang. The affordable population is high school teenagers from 10% of Ulu High School and 10% of Ilir Palembang High School.

Sample

The sample in this study was taken from the research population, namely by taking data from all high school students in Palembang, namely SMAN 9, SMAN 8, SMAN 19, SMAN 22, SMAN 1, SMAN 2, SMAN 18, SMAN 13, SMAN 17, SMAN 3, SMA Muhammadiyah 1, SMA Xaverius 1 Palembang who met the inclusion and exclusion criteria.

Sample Size

Sample size calculation for analytical research with cross-section studies i.e. (Didik, 2013):

$$n = \frac{(\text{Z}\alpha)^2 \text{ x PQ}}{d^2}$$

Information:

n : Minimum number of samples

Zα : alpha standard derivative (Zα value = 1.96 with 95% confidence level)

P : the proportion of at-risk groups is 8.3% (Depkes, 2008b)

Q : 1-P (proportion of non-risk groups)

D : The limit of error or absolute precision is 0.025

It is known that the sample size is 467 people. And 5% of the samples were added so that the total sample became 491 samples.

The data collection process involved structured questionnaires, which were distributed to selected students to assess physical activity levels, stress levels, and sleep duration. Additionally, blood pressure measurements were conducted using a digital sphygmomanometer following standard clinical procedures to determine the incidence of hypertension. Further demographic and lifestyle data, including age, gender, family history of hypertension, and dietary habits, were recorded to control for potential confounding factors. The collected data were then analyzed using Chi-Square tests to examine statistical relationships between the independent variables (physical activity, stress, and sleep duration) and the incidence of hypertension. A p-value <0.05 was considered statistically significant in determining the associations among these variables.

How to Sampling

Samples were taken by the proportional stratified random sampling namely random sampling that is carried out gradually and proportionately (Sedgwick, 2015). Because the respondents in this study are high school teenagers in the city of Palembang, Arikunto (2008) stated that sampling was carried out proportionally as much as 10% of the total target population, where the target population in this study is teenagers in high schools in the city of Palembang. The percentage of 10% is based on the large number of population, which exceeds 100 people and adjusts to the time and manpower limitations of researchers.

Proportional sampling is carried out by taking samples of the intended high school first, namely by dividing the Palembang area so that sampling becomes easier and the Seberang Ulu and Seberang Ilir Palembang areas are obtained. Then using a proportional percentage of 10%, schools were taken from 83 schools in Ulu and 36 schools in Din Ilir, then a total sample of

schools was obtained, namely 8 schools from Seberang Ulu and 4 schools from Seberang Ilir. The schools chosen are the schools with the highest number of students and sorted from the largest number of students to the least, 8 schools from Seberang Ilir are obtained, namely SMAN 1, SMA Xaverius 1, SMA Muhammadiyah 1, SMAN 3, SMAN 2, SMAN 17, SMAN 13 and SMAN 18 while 4 schools from Seberang Ulu are SMAN 19, SMAN 9, SMAN 22, SMAN 8. The school with the largest number of students is considered representative of the population. Furthermore, sampling is carried out in even smaller units, namely by determining the total number of student samples to be taken at each school and then followed by sampling students in each class in the school

Results and Discussion

This research was conducted from June to December 2019 in 12 schools in Palembang, namely SMAN 1, SMAN 2, SMAN 3, SMAN 8, SMAN 9, SMAN 13, SMAN 17, SMAN 18, SMAN 19, SMAN 22, SMA Muhammadiyah 1 and SMA Xaverius 1 Palembang through filling out the PAQ-A, PSS-10 questionnaire and sleep duration and blood pressure measurement preceded by informed *consent* before the study) and an explanation of the procedures for filling out the questionnaire and the blood pressure measurement procedure that will be carried out. There were a total of 491 samples at the beginning of the study. A total of 24 samples refused to sign informed consent so that the number of samples in this study was 467 samples. Of the 467 samples, all of them met the inclusion criteria so that the number of research subjects obtained was as large as the calculation of the sample size formula.

Univariate Analysis

Distribution of Respondent Characteristics

Based on data obtained from 467 research subjects, the highest age distribution is 16 years old (32.5%), while the least age distribution is 14 years old (16.9%). The most gender distribution data among high school teenagers in the city of Palembang is female (60.6%). High school teenagers in the city of Palembang have the most good physical activity distribution, which is 63.2% which is determined based on the median value of the PAQ-A questionnaire of 60. There were 28.1% of adolescents with stress and as many as 72.4% of adolescents had less sleep duration. The distribution of respondent characteristics can be seen in the following table 5.

Table 5. Distribution of Frequency of Age, Gender, Blood Pressure, Physical Activity, Stress and Sleep Duration in High School Teenagers in the city of Palembang

Distribution of Respondent Characteristics	n	Percentage (%)
Age		
14 - <15 years old	79	16,9%
15 - <16 years old	150	32,1%
16 - <17 years old	152	32,5%
17 - <18 years old	86	18,5%
Gender		
Man	184	39,4%
Woman	283	60,6%
Physical Activity		
Less	172	36,8%
Good	295	63,2%

Distribution of Respondent Characteristics	n	Percentage (%)
Stress		
Stress	131	28,1%
No Stress	283	71,9%
Sleep Duration		
Less	338	72,4%
Enough	129	27,6%

Bivariate Analysis

The Relationship between Physical Activity and Hypertension

From the group of high school adolescents with poor physical activity, 53 adolescents (30.8%) suffered from hypertension and 119 adolescents (69.2%) did not suffer from hypertension whereas, from the group of high school adolescents with good physical activity, 59 adolescents (20%) suffered from hypertension while 236 adolescents (80%) did not suffer from hypertension.

A p value of 0.008 was obtained so that it can be concluded that statistically there is a significant relationship between physical activity and hypertension with a PR value of 1.5, which means that high school teenagers with poor physical activity have a 1.5 times risk of suffering from hypertension. The relationship between physical activity and hypertension can be seen in the following table 6.

Table 6. The Relationship between Physical Activity and Hypertension

Physical Activity	Blood pressure				P *value*	PR (95%CI)
	Hypertension		No Hypertension			
	n	(%)	N	(%)		
Bad	53	30,8%	119	69,2%	0,008	1,5 (1,1-2,1)
Good	59	20%	236	80%		

The Relationship between Stress and Hypertension

Table 7 below presents data on the relationship between stress and hypertension. From the group of high school adolescents with stress, 43 adolescents (32.8%) suffered from hypertension and 88 adolescents (67.2%) did not suffer from hypertension whereas, from the group of high school adolescents who were not stressed, 69 adolescents (20.5%) experienced hypertension while 267 adolescents (75.2%) did not experience hypertension.

The p-value obtained based on the results of the Chi-Square test is 0.005 so it can be concluded that statistically there is a significant relationship between stress and hypertension with a PR value of 1.6, which means that high school teenagers with stressful conditions have a 1.6 times risk of suffering from hypertension.

Table 7. The Relationship between Stress and Hypertension

Stress	Blood pressure				P *value*	PR (95%CI)
	Hypertension		No Hypertension			
	N	(%)	N	(%)		
Stress	43	32,8 %	88	67,2 %	0,005	1,6 (1,2-2,2)
No Stress	69	20,5 %	267	79,5 %		

The Relationship between Sleep Duration and Hypertension

Table 8 below presents data on the relationship between sleep duration and hypertension. From the group of high school adolescents with insufficient sleep duration, 89 people (26.3%) suffered from hypertension and 249 adolescents (73.7%) did not suffer from hypertension whereas, from the group of high school adolescents with sufficient sleep duration, 23 adolescents (17.8%) suffered from hypertension while 106 adolescents (82.2%) did not suffer from hypertension.

The p-value was 0.054, so it can be concluded that there is no statistically significant relationship between sleep duration and hypertension.

Table 8. The Relationship between Sleep Duration and Hypertension

Sleep Duration	Blood pressure				P *value*
	Hypertension		No Hypertension		
	n	(%)	n	(%)	
Less	89	26,3 %	249	73,7%	0,054
Enough	23	17,6%	106	82,2%	

Discussion

Distribution of Respondent Characteristics

The highest age distribution was 16 years old (32.5%). This is in line with the increase in the number of adolescents aged 15-16 years in Indonesia who are enrolled in high school, which is 8.09% to 8.5% in 2013-2017 compared to other age groups (Kementerian Kesehatan RI, 2017). The results of a survey conducted by the Central Statistics Agency in 2017 in (Surhariyanto, 2018), found that the School Participation Rate (APS) for children aged 13-15 years was 95.08% and for children aged 16-17 years was 80.26%, which indicates that the higher the age group, the lower the percentage of children attending school.

Research data shows that the largest gender distribution among high school teenagers in the city of Palembang is female (60.6%). This is in accordance with data from the Central Statistics Agency, (2014) which states that the distribution of the population in the city of Palembang at the age of 13-18 years is 77,068 people for women and 75,096 people for men. So it can be concluded that the population of adolescent girls in the city of Palembang is more than men.

Based on data obtained from 467 research subjects, it is known that more high school teenagers in the city of Palembang (63.2%) have good physical activity. Quoting Djoko's statement in (Aini, 2014), this is because high school teenagers are categorized as individuals who are active in activities, in addition to the existence of physical education or sports activities

applied in schools make the distribution of good physical activity more dominant among teenagers. Literature studies conducted by (Bauman et al., 2012) and research conducted by (Veugelers & Fitzgerald, 2005) In 5200 children, it was also shown that policies enacted in schools helped to increase the distribution of good physical activity among school-age adolescents.

From the results of the study, as many as 131 high school teenagers were classified as stressed (28.1%) and 336 high school teenagers (71.9%) were classified as not stressed. The small number of adolescents who experience stress indicates that in adolescence, the problems and obstacles experienced are not so great that they can trigger stressful situations. The stress experienced by an individual is related to how the individual interprets an event that is being faced (Chen et al., 2004). Each individual has different endurance and adaptation to exposure to the stress of life experienced, where in the research subject the biological and physiological adaptation process is stable (Carissa A. Low, Phd, Kristen Salomon, Phd, And Karen A. Matthews, 2009). These results are in line with research (Jayashri et al., 2015) in 495 adolescents aged 10-19 years who were conducted in Hospital & Research Centre of Department Community Medicine which found that as many as 305 adolescents were classified as normal and 190 adolescents were classified as stressed

A total of 338 high school teenagers (72.4%) had insufficient sleep duration and 129 high school teenagers (27.6%) had sufficient sleep duration. The prevalence of sleep disorders in adolescents tends to increase every year. Research conducted by (Ohida et al., 2004) found that the prevalence of sleep disorders that occurred in junior high and high school students varied greatly, ranging from 15.3% to 39.2%. Research (LeBourgeois et al., 2005) in adolescents in Italy and America shows that one of the components of good sleep quality is sufficient sleep duration. According to (Hansen et al., 2005) School schedules are one of the causes of lack of sleep in adolescents. The occurrence of sleep quality disorders is caused by changes in sleep schedules on holidays. In addition, the large number of adolescents with less sleep duration is likely to be related to lifestyle factors such as use of Gadgets Where to use Gadgets excessively has an impact on decreasing sleep quality, one of which is sleep duration (Amelia & Ramdani, 2019). Use Gadgets in adolescents in Indonesia has increased in line with technological advances, where as many as 83% of adolescents use Gadgets more than 5 hours in one day and as many as 68.2% use it shortly before bed (Amelia & Ramdani, 2019; Purniti, 2011). Use Gadgets Just before bedtime can decrease the production of melatonin which functions as a regulator of sleep circadian rhythms. The decrease in melatonin has an impact on sleep quality, one of which is the reduction in sleep duration (Purniti, 2011b).

The Relationship between Physical Activity and Hypertension

The results of the Chi-square statistical test found that there was a significant relationship between physical activity and hypertension in high school adolescents in the city of Palembang with a value of $p = 0.008$ ($p < 0.05$), so the hypothesis of this study was accepted. Good physical activity has an impact on the condition of the heart rate, breathing and blood vessels. The enlargement of the heart muscle that occurs results in the blood content of the whole body being pumped more effectively.

These results are in line with research conducted by (Fitriana et al., 2013; Huai et al., 2013; Leary et al., 2015) that good physical activity is able to reduce blood pressure values in adolescents, where there are similarities between physical activity classification indicators using qualitative Physical Activity to the research conducted. Results of a literature study conducted by

(Strong et al., 2005) In 850 articles also found the fact that regular physical activity can lower blood pressure.

However, the results obtained are contrary to previous research. The study was conducted by Insani et al. (2010) on 73 adolescents aged 15-18 years. This is because there are differences in methods in categorizing physical activity, where in the research conducted by Insani et al. (2010), the standard instrument in categorizing physical activity is the global physical activity qualifier, different in this study where the categorization is based on the qualitative physical activity specifically for children and adolescents. Pires et al. in a study conducted by Tsioufis (2010) stated that although good physical activity has a positive impact on health, some of the latest research results in the last decade show development and differences in results, especially in adolescents from various ethnicities.

The Relationship between Stress and Hypertension

The results of the Chi-square statistical test showed that there was a significant relationship between stress and hypertension with a value of $p = 0.005$ ($p < 0.05$) which indicates that the hypothesis in this study was accepted. Stressors that occur for a long time will result in a gradual and persistent increase in blood pressure (Kliegman, 2004). Stress will activate the hypothalamus and affect the neuroendocrine system, namely the sympathetic system and the adrenal cortex system. The sympathetic nervous system responds to nerve impulses from the hypothalamus by activating the organs under its control, one of which is an increase in heart rate. Corticotrophin Releasing Factor (CRF) will be released from the hypothalamus towards the bloodstream until it reaches the pituitary gland which is located under the hypothalamus. Furthermore, CRF will stimulate the release of adenocorticotrophin hormone (ACTH) by the pituitary, which will later function to stimulate the adrenal glands to release various hormones (Lisdiana, 2012). The adrenal medulla will release epinephrine and norepinephrine into the bloodstream. Adrenaline, thyroxine, and cortisol as the main stress hormones will increase in number and have an effect on the homeostasis system. Adrenaline works against an increase in heart rate, and blood pressure (Subramaniam, 2017).

Studies conducted in Poland, studies conducted on adolescents aged 15-24 years in Texas and studies on children aged 5-7 years in Amsterdam found the fact that life stress can affect blood pressure values (Saputri, 2010; Shipp et al., 2019; van Dijk et al., 2012). In a study conducted by Carissa et al., (2009) on 213 adolescents aged 14-16 years in Pittsburgh, Pennsylvani found the fact that exposure to stress was able to have an impact on increasing cardiovascular reactivity. However, some studies found different results. Jayashri et al. (2015) in their study did not find a relationship between stress and hypertension in adolescents, this is due to differences in stress level measurement instruments, where in the study used interview techniques about situations that respondents subjectively felt such as anxiety when starting an exam, anxiety about the death of parents and others that cannot be measured so that there can be bias in determining the level stress in the study.

The Relationship between Sleep Duration and Hypertension

From the results of statistical tests Chi-square The value of $p = 0.054$ was obtained so that it can be concluded that statistically there is no significant relationship between sleep duration and hypertension, so the hypothesis of this study is rejected. These results are in line with research conducted by (Bayer et al., 2009) In 7701 children aged 3-10 years in Germany found that less sleep duration was not associated with hypertension. Drastic increases in blood pressure occur in certain people who are sensitive to reduced sleep time. Research conducted by (Wells et al., 2008)

In 4452 adolescents aged 10-12 years in Brazil found no association between sleep deprivation and hypertension. This study found that insufficient sleep duration cannot be associated with changes in physical activity and obesity which is a risk factor for hypertension in adolescents, in contrast to adulthood where less sleep duration can be associated and has an influence on physical activity and obesity which is one of the factors that cause hypertension (Wells et al., 2008). Research conducted by (Shaikh et al., 2010) In 489 adolescents in India aged 16-19 years, there was also no association between the duration of sleep deprivation and hypertension. In the study, it was found that adolescents with less sleep duration tend to have good physical activity, this is what is able to balance blood pressure conditions as well as in adolescents with sufficient sleep duration. Meanwhile, according to Paciência et al., (2013) hypertension in adolescents is generally associated with individuals with excessive sleep time and low physical activity, while the explanation of the mechanism of excessive sleep that causes a direct increase in blood pressure has not been clearly discussed in most studies that have been conducted.

This result contradicts several previous studies, namely in adolescents in Depok and adolescents at SMA Negeri 2 Lhoksumawe which found a meaningful relationship between lack of sleep duration and hypertension (Angesti et al., 2018b; Sabiq & Fitriany, 2016; Shaikh et al., 2010). According to Gottlieb et al., (2006) the duration of sleep is insufficient, able to increase systolic blood pressure by 4-5mmHg.

Research Limitations

The researcher did not observe the variables of physical activity, stress and sleep duration over a long period of time to find out how long the relationship between exposure to variables and hypertension in high school adolescents in the city of Palembang was more specific. In addition, this study uses a questionnaire instrument as a tool to think about quite a large number of respondents who cannot remember well about physical activity and sleep duration during the previous week, but this limitation can be minimized by provoking the respondents' memory by describing the physical activity, sleep duration and condition of the respondents.

Conclusion

The findings of this study indicate a significant relationship between physical activity and hypertension in high school adolescents in Palembang, where adolescents with low physical activity levels have a 1.5 times higher risk of developing hypertension compared to those with adequate physical activity. Additionally, stress levels were also found to be significantly associated with hypertension, with stressed adolescents having a 1.6 times higher risk of suffering from hypertension than their non-stressed counterparts. However, no significant relationship was found between sleep duration and hypertension, suggesting that sleep duration alone may not be a direct contributing factor to increased blood pressure in adolescents.

These results emphasize the need for preventive strategies, particularly through promoting regular physical activity and stress management programs in schools to reduce the risk of hypertension in adolescents. Future research should explore the long-term impact of lifestyle modifications, including exercise interventions and stress reduction techniques, on adolescent blood pressure regulation. Additionally, further studies should investigate the role of sleep quality rather than just duration, as well as other potential lifestyle and genetic factors that may contribute to hypertension in adolescents. Expanding research across different demographic groups and geographic regions will also provide a broader understanding of hypertension risk factors in young populations, aiding in the development of more effective public health policies and

intervention programs.

Reference

Agustini, N. N. M., & Arsani, N. L. K. A. (2013). Remaja Sehat Melalui Pelayanan Kesehatan Peduli Remaja Di Tingkat Puskesmas. Jurnal Kesehatan Masyarakat. Https://Doi.Org/Issn 1858-1196

Aini, S. N. (2014). Faktor Risiko Yang Berhubungan Dengan Kejadian Gizi Lebih Pada Remaja Di Perkotaan. Faktor Risiko Yang Berhubungan Dengan Kejadian Gizi Lebih Pada Remaja Di Perkotaan, 3(1), 1–10.

Amelia, V. L., & Ramdani, M. L. (2019a). Screen Time Activity And Its Impact To Sleep Duration Of School-Aged. Medisains, 17(1), 3. Https://Doi.Org/10.30595/Medisains.V17i1.4823

Amelia, V. L., & Ramdani, M. L. (2019b). Screen Time Activity And Its Impact To Sleep Duration Of School-Aged. Medisains, 17(1), 3. Https://Doi.Org/10.30595/Medisains.V17i1.4823

Angesti, A. N., Triyanti, T., & Sartika, R. A. D. (2018a). Riwayat Hipertensi Keluarga Sebagai Faktor Dominan Hipertensi Pada Remaja Kelas Xi Sma Sejahtera 1 Depok Tahun 2017. Buletin Penelitian Kesehatan. Https://Doi.Org/10.22435/Bpk.V46i1.41

Angesti, A. N., Triyanti, T., & Sartika, R. A. D. (2018b). Riwayat Hipertensi Keluarga Sebagai Faktor Dominan Hipertensi Pada Remaja Kelas Xi Sma Sejahtera 1 Depok Tahun 2017. Buletin Penelitian Kesehatan. Https://Doi.Org/10.22435/Bpk.V46i1.41

Angesti, A. N., Triyanti, T., & Sartika, R. A. D. (2018c). Riwayat Hipertensi Keluarga Sebagai Faktor Dominan Hipertensi Pada Remaja Kelas Xi Sma Sejahtera 1 Depok Tahun 2017. Buletin Penelitian Kesehatan, 46(1), 1–10. Https://Doi.Org/10.22435/Bpk.V46i1.41

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J. F., Martin, B. W., Alkandari, J. R., Andersen, L. B., Blair, S. N., Brownson, R. C., Bull, F. C., Craig, C. L., Ekelund, U., Goenka, S., Guthold, R., Hallal, P. C., Haskell, W. L., Heath, G. W., Inoue, S., … Sarmiento, O. L. (2012). Correlates Of Physical Activity: Why Are Some People Physically Active And Others Not? The Lancet, 380(9838), 258–271. Https://Doi.Org/10.1016/S0140-6736(12)60735-1

Bayer, O., Neuhauser, H., & Von Kries, R. (2009). Sleep Duration And Blood Pressure In Children: A Cross-Sectional Study. Journal Of Hypertension, 27(9), 1789–1793. Https://Doi.Org/10.1097/Hjh.0b013e32832e49ef

Carissa A. Low, Phd, Kristen Salomon, Phd, And Karen A. Matthews, P. (2009). Chronic Life Stress, Cardiovascular Reactivity, And Subclinical Cardiovascular Disease In Adolescents. 927–931. Https://Doi.Org/10.1097/Psy.0b013e3181ba18ed

Chen, E., Langer, D. A., Raphaelson, Y. E., & Matthews, K. A. (2004). Socioeconomic Status And Health In Adolescents : The Role Of Stress Interpretations. 75(4), 1039–1052.

Christie, D., & Viner, R. (2005). Adolescent Development. Abc Of Adolescence, 12(1), 21–29. Https://Doi.Org/10.1136/Bmj.330.7486.301

Depkes. (2008a). Riset Kesehatan Dasar 2007. Kementerian Kesehatan Republik Indonesia, 1–384. Https://Doi.Org/1 Desember 2013

Depkes. (2008b). Riset Kesehatan Dasar 2007. Kementerian Kesehatan Republik Indonesia, 1–384. Https://Doi.Org/1 Desember 2013

Didik, B. (2013). Populasi, Sampling. Pusdatin-Kemkes Ri.

Fitriana, R., Lipoeto, N. I., & Triana, V. (2013). Faktor Resiko Kejadian Hipertensi Pada Remaja Di Wilayah Kerja Puskesmas Rawat Inap Sidomulyo Kota Pekanbaru. Jurnal Kesehatan Masyarakat, 7(7), 10–15.

Hansen, M., Janssen, I., Schiff, A., Zee, P. C., & Dubocovich, M. L. (2005). The Impact Of School Daily Schedule On Adolescent Sleep. Pediatrics, 115(6), 1555–1561. Https://Doi.Org/10.1542/Peds.2004-1649

Huai, P., Xun, H., Reilly, K. H., Wang, Y., Ma, W., & Xi, B. (2013). Physical Activity And Risk Of Hypertension A Meta-Analysis Of Prospective Cohort Studies. Hypertension, 62(6), 1021–1026. Https://Doi.Org/10.1161/Hypertensionaha.113.01965

Jayashri, B., Aarti, S., Vinod, A., & Harilal, D. (2015). Pre-Hypertension And Hypertension And Its Determinants Among School Adolescents Of Rural Area Of Indore - A Cross Sectional Study. National Journal Of Community Medicine, 6(3 Pg-358–363), 358–363.

Kementerian Kesehatan Ri. (2017). Profil Kesehatan Indonesia 2017.

Leary, S. D., Ness, A. R., Smith, G. D., Mattocks, C., Deere, K., Blair, S. N., & Riddoch, C. (2015). Physical Activity And Blood Pressure In Childhood Findings From A Population-Based Study. 92–99. Https://Doi.Org/10.1161/Hypertensionaha.107.099051

Lebourgeois, M. K., Giannotti, F., Cortesi, F., Wolfson, A. R., & Harsh, J. (2005). The Relationship Between Reported Sleep Quality And Sleep Hygiene In Italian And American Adolescents. Pediatrics, 115(1), 257–265. Https://Doi.Org/10.1542/Peds.2004-0815h

Nasution, A. T. P., Ramayati, R., Sofyani, S., Ramayani, O. Rr., & Siregar, R. (2017). Quality Of Sleep And Hypertension In Adolescents. Paediatrica Indonesiana, 56(5), 272. Https://Doi.Org/10.14238/Pi56.5.2016.272-6

Ohida, T., Osaki, Y., Doi, Y., Tanihata, T., Minowa, M., Suzuki, K., Wada, K., & Suzuki, K. (2004). An Epidemiologic Study Of Self-Reported Sleep Problems Among Japanese Adolescents.

Pardede, S. O., Yunilasari, & Setyanto, D. B. (2017). Prevalence And Factors That Influence Hypertension In Adolescents In Central Jakarta. American Journal Of Clinical Medicine Research, 5(4), 43–48. Https://Doi.Org/10.12691/Ajcmr-5-4-1

Purniti, P. S. (2011a). Melatonin Level And Sleep Disorders In Adolescent. 51(4), 207–212. Https://Doi.Org/10.14238/Pi

Purniti, P. S. (2011b). Melatonin Level And Sleep Disorders In Adolescent. 51(4), 207–212. Https://Doi.Org/10.14238/Pi

Pusat Data Dan Informasi Kementerian Kesehatan Ri. (2017). Infodatin Reproduksi Remaja-Ed.Pdf. In Situasi Kesehatan Reproduksi Remaja (Issue Remaja, Pp. 1–8).

Riskesdas. (2018). Hasil Utama Riskesdas Tentang Prevalensi Diabetes Mellitus Di Indonesia 2018. Hasil Utama Riskesdas Tentang Prevalensi Diabetes Melitus Di Indonesia 2018, 8. Https://Doi.Org/1 Desember 2013

Robert M. Kliegman, M. (2004). Nelson Text Book Of Pediatrics 20th Edition. Fenxi Huaxue. Https://Doi.Org/10.1017/Cbo9781107415324.004

Sabiq, A., & Fitriany, J. (2016). Tekanan Darah Pada Remaja Di Sekolah Menegah Atas (Sma) Negeri 2 Lhokseumawe. 1–15.

Saing, J. H. (2005a). Hipertensi Pada Remaja. Sari Pediatri. Https://Doi.Org/10.14238/Sp6.4.2005.159-65

Saing, J. H. (2005b). Hipertensi Pada Remaja. Sari Pediatri. Https://Doi.Org/10.14238/Sp6.4.2005.159-65

Sedgwick, P. (2015). Units Of Sampling, Observation, And Analysis. Bmj (Online), 351(October), 9–10. Https://Doi.Org/10.1136/Bmj.H5396

Shaikh, W., Patel, M., & Singh, S. (2010a). Association Of Sleep Duration With Arterial Blood Pressure Profile Of Gujarati Indian Adolescents. Indian Journal Of Community Medicine, 35(1), 125. Https://Doi.Org/10.4103/0970-0218.62571

Shaikh, W., Patel, M., & Singh, S. (2010b). Association Of Sleep Duration With Arterial Blood Pressure Profile Of Gujarati Indian Adolescents. Indian Journal Of Community Medicine, 35(1), 125. Https://Doi.Org/10.4103/0970-0218.62571

Strong, W. B., Malina, R. M., Blimkie, C. J. R., Daniels, S. R., Dishman, R. K., Gutin, B., Hergenroeder, A. C., Must, A., Nixon, P. A., Pivarnik, J. M., Rowland, T., Trost, S., & Trudeau, F. (2005). Evidence Based Physical Activity For School-Age Youth. Journal Of

Pediatrics, 146(6), 732–737. Https://Doi.Org/10.1016/J.Jpeds.2005.01.055
Surhariyanto. (2018). Buku Profil Anak Indonesia.
Taler, S. J. (2008). Secondary Causes Of Hypertension. Primary Care - Clinics In Office Practice, 35(3), 489–500. Https://Doi.Org/10.1016/J.Pop.2008.06.001
Van Cauter, E., Holmbäck, U., Knutson, K., Leproult, R., Miller, A., Nedeltcheva, A., Pannain, S., Penev, P., Tasali, E., & Spiegel, K. (2007). Impact Of Sleep And Sleep Loss On Neuroendocrine And Metabolic Function. Hormone Research, 67(Suppl. 1), 2–9. Https://Doi.Org/10.1159/000097543
Veugelers, P. J., & Fitzgerald, A. L. (2005). Effectiveness Of School Programs In Preventing Childhood Obesity: A Multilevel Comparison. American Journal Of Public Health, 95(3), 432–435. Https://Doi.Org/10.2105/Ajph.2004.045898
Wells, J. C. K., Hallal, P. C., Reichert, F. F., Menezes, A. M. B., Araújo, C. L. P., & Victora, C. G. (2008a). Sleep Patterns And Television Viewing In Relation To Obesity And Blood Pressure: Evidence From An Adolescent Brazilian Birth Cohort. International Journal Of Obesity, 32(7), 1042–1049. Https://Doi.Org/10.1038/Ijo.2008.37
Wells, J. C. K., Hallal, P. C., Reichert, F. F., Menezes, A. M. B., Araújo, C. L. P., & Victora, C. G. (2008b). Sleep Patterns And Television Viewing In Relation To Obesity And Blood Pressure: Evidence From An Adolescent Brazilian Birth Cohort. International Journal Of Obesity, 32(7), 1042–1049. Https://Doi.Org/10.1038/Ijo.2008.37
Whyte, G. (2006). (Tekstbok) The Physiology Oftraining.
Xu, S., Yu, B., Zepei, J., Chang, H., Guo, J., Li, B., & Wan, Z. (2014). School Performance Affects Adolescent Blood Pressure. Cardiology In The Young, 24(3), 459–463. Https://Doi.Org/10.1017/S1047951113000619