NPAKISTAN JOURNAL OF UTRITION

CrossMark
← click for updates

Relationship Between Physical Activity and Concentration of Study of Teenagers in Yogyakarta, Indonesia

Wieke Apriana[1], Izka Sofiyya[1], Madarina Julia[2] and Emy Huriyati[1]
[1]Department of Health Nutrition, Faculty of Medicine, Gadjah Mada University, Yogyakarta, Indonesia
[2]Department of Paediatric, Dr. Sardjito Yogyakarta Hospital, Yogyakarta, Indonesia

Abstract: Obesity is global epidemic phenomena in both developed and developing country as in Indonesia, especially in urban area. Genetic, overeating, low physical activity and lack of sleep are risk factors of obesity. Daily activities should increase quality of sleep. In fact, lifestyle changes in teenagers like overeating and low physical activity affect their whole health, either the physical health (causing obesity) or the sleep quality. The poor quality of sleeping in teenagers with obesity cause drowsiness during learning process in the school and hypoventilation so that occurs the decreasing concentration of study in the school. The aim of this study was to investigate the relationship between physical activity and concentration of study of teenagers in Yogyakarta. The study design was observational study with cross-sectional methods. Subject were 360 high school students grades X and XI in Yogyakarta. Modified International Physical Activity Questionnaire (IPAQ), Pittsburgh Sleep Quality Index (PSQI) and Wechsler Adult Intelligence Scale (WAIS) were utilized to collect the data. Data were analyzed univariate and bivariate and tested using chi-square test. 54.7% teenagers had moderate physical activity level over 45.3% teenagers had heavy level of physical activity. Most of teenagers had good concentration of study (71.1%) and the rest of them had poor concentration of study (28.9%). Chi square test showed, there was a relationship between physical activity and concentration of study (p = 0.005) with OR value 1.98 which explains heavy activity brings about better concentration of study. So, physical activity significantly affects concentration of study of teenagers in Yogyakarta (p<0.05).

Key words: Physical activity, sleep quality, concentration of study, teenagers

INTRODUCTION

Obesity is a global epidemic phenomena in both developed and developing countries such as in Indonesia, especially in urban areas, with an increasing prevalence. In Indonesia, the prevalence of obesity is increasing shown by the prevalence of fat adolescents aged 16-18 years old that is as much as 7.3%, which consists of 5.7% fat adolescents and 1.6% being obese. Daerah Istimewa Yogyakarta/the Special Region of Yogyakarta (DIY) is one of fifteen provinces that have an overweight prevalence above the national prevalence, which is 7.6% (Badan Litbang Kesehatan, 2013).

Teenagers who suffer from obesity throughout their life, will be at a higher risk of having serious diseases, e.g., cardiovascular disease, stroke, diabetes, asthma, various kinds of cancer and psychosocial stress (Suryaputra *et al.*, 2012). The stigma on obesity also brings social psychological effects to the teenager, e.g., experiencing depression more often due to rejection by peers and being mocked and left out due to their weight (Puhl and Latner, 2007).

In general, obesity is denoted as an energy imbalance due to excessive food intake compared to energy output in a certain period of time (Arisman, 2013). Several factors causing obesity other than excessive food intake

are eating instant processed food, drinking soft drinks and eating junk foods and eating other similar types of food. Other factors causing obesity is low level of physical activity, both in daily and structured physical exercise. Other than that, another obesity risk factor in children and adolescents is the decrease in sleeping time (Wahyu, 2009).

Sleeping, which is defined as a process of change of consciousness that occurs repetitively in a certain period of time where the person can still be awakened by giving sensory stimuli and other types of stimuli, is a basic human necessity (Guyton and Hall, 2007; Potter and Perry, 2005). Adequate sleep is not only determined by the hours of sleep (sleep quantity), but also by the depth of sleep (sleep quality). Illnesses, exercise and fatigue, psychological stress, drugs, nutrition, environment and motivation influence quality and quantity of sleep.

Daily routine activity is also recommended for increasing the quality and quantity of sleep (Pesonen *et al.*, 2011). Physical activities that are performed consist of all types of sports, all movements of the body, work, recreation, daily activities and also activities done in the weekends and leisure time (Tandra, 2009). Exercise and fatigue can affect the quality and quantity of sleep due to high levels of activities that require more sleep to maintain

Corresponding Author: Wieke Apriana, Department of Health Nutrition, Faculty of Medicine, Gadjah Mada University, Yogyakarta, Indonesia

the balance of energy that has been exerted. This can be seen in people who have done activities and reached exhaustion, causing them to fall asleep faster due to the shortening of the slow-wave stage of sleeping or Non Rapid Eye Movement (NREM) (Hidayat and Hidayat, 2008). Most of the physical activities done routinely may result in a better quality of sleep (Ekstedt *et al.*, 2013).

Other theories state that the reduction of sleep hours can be a potential contributor towards the obesity epidemic. This is caused by the dysregulation in the neuroendocrine control for appetite, combined with the decrease of satiety factor leptin and the increase of the hunger hormone, ghrelin (Knutson and Van Cauter, 2008). One of the impacts of obesity is respiratory disorder, which results in sleep apnoea, a type of sleep disorder (World Health Organization, 2000). This condition may affect the quality of sleep in teenagers.

Bad quality of sleep in teenagers with an obese nutritional status may result in sleepiness when they receive lessons at school and may lead to hypoventilation causing neurocognitive defects (Lowry, 2012). Hypoventilation in obese teenagers or Obesity Hypoventilation Syndrome (OHS) results in excessive drowsiness in the afternoon causing the decrease of learning concentration and poor performance at school due to difficulties in carrying out tasks (Calleto, 2011).

There is currently a shift in society's lifestyle, especially in teenagers. Now, most teenagers have excessive food intake especially for fast food (junk food), not to mention the low physical activities due to advances in technology. These conditions highly affect the health of teenagers and may influence the quality of sleep. From the theory above, stating that poor quality of sleep can affect concentrating ability in teenagers who are still in school and the insufficient research explaining the relationship between physical activities and learning concentration, it is necessary to do a study regarding the relationship between physical activity and quality of sleep in teenagers in Yogyakarta.

MATERIALS AND METHODS

The type of study performed was a quantitative study using an analytical (observational) survey method that uses the cross-sectional design. The study was conducted in January 2015 in high schools in the city of Yogyakarta; they are SMAN 4 Yogyakarta, SMAN 9 Yogyakarta, SMA Piri 1 Yogyakarta, SMA Muhammadiyah 3 Yogyakarta and SMA Muhammadiyah 5 Yogyakarta, which were chosen randomly.

The total number of respondents in this study was 360 students, consisting of grade X and XI students that were chosen by the quota sampling method. Inclusion criteria were students who were ready to become a respondent by signing the informed consent, registered as a high school student in Yogyakarta city currently in grade X and XI, aged 15-21 years old and in a healthy condition. Exclusion criteria in this study were students who were absent during data collection and were using medication to help them sleep.

Personal data and respondent characteristics were obtained from the questionnaire; anthropometric data was obtained by measuring the respondents' body weight using calibrated Electronic Digital Scale and body height using Microtoise with standardized protocols. Physical activity data was obtained from the modified IPAQ questionnaire, containing information regarding type of activity, duration, frequency and MET scores in each activity. Physical activity score can be calculated using this formula:

$$MET/min = MET \text{ classification} \times \text{duration (min)} \times \text{activity frequency}$$

Calculation results are grouped into mild, moderate and heavy activity. Physical activity is categorized as mild if the activity score is <600 MET-minute/week. Physical activity is categorized as moderate if the activity score is 600-2999 MET-min/week. Physical activity is categorized as heavy if the activity score is >3000 MET-min/week. Quality of sleep is calculated subjectively using the standard Pittsburgh Sleep Quality Index (PSQI), results of the calculation is considered as good sleep quality if the score is <5 and poor sleep quality if the score is >5. Learning concentration is measured using the Weschler Adult Intelligence Scale (WAIS) for age 15-89, a test with sub-digits symbol B, which was tested and analyzed by a psychologist. It is considered as a good concentration category if the respondent's score is above the median according to the current age category and considered as poor concentration if their score is below or equivalent to the median.

Data management consists of editing, coding and data entry. Univariate and bivariate analysis was done for data analysis. Characteristic data of the respondent was described as frequency distribution and percentage. Correlation between the two variables in this study was analyzed using chi-square test.

RESULTS AND DISCUSSION

General description of the study's location: In the city of Yogyakarta, there are 11 state high schools and 34 private high schools. The high schools chosen as the location for this study are SMAN 4 Yogyakarta, SMAN 9 Yogyakarta, SMA Piri 1 Yogyakarta, SMA Muhammadiyah 3 Yogyakarta and SMA Muhammadiyah 5 Yogyakarta, which are located in different areas of Yogyakarta city. SMAN 4 Yogyakarta is located in Magelang road, Karangwaru Lor district, Tegalrejo sub-district. SMAN 9 Yogyakarta is located in Sagan 1 road, Gondokusuman sub-district. SMA Piri 1 Yogyakarta is located in Kemuning 14 road, Gondokusuman sub-district. SMA

Muhammadiyah 3 Yogyakarta is located in Kapten P. Tendean 58 road, Wirobrajan sub-district. SMA Muhammadiyah 5 Yogyakarta is located in Purwodiningratan, Ngampilan sub-district. The total number of students in each class is about 20-35 students. All of these high school students have been divided into Science and Social classes since grade X. The total number of students who completed the questionnaire in this study is 393 students, unfortunately there are 7 students who did not meet the age inclusion criteria and 26 students who preceded or skipped filling the learning concentration questionnaire, resulting in 33 students who did not participate in the study. There are presenting in Fig. 1.

General characteristics of the study subjects: In this study, there were 360 subjects from grade X and XI, which met the inclusion criteria and have completed the study's questionnaire. The characteristics of the subjects provided in this study are socio-demographic characteristic e.g., age, gender, nutritional status, school origin, class, physical activity, quality of sleep and learning concentration can be seen in Table 1.

Relationship between physical activity and learning concentration: Crosstab result of the chi-square test between physical activity with learning concentration is $p = 0.00$ where $p<0.05$, thus H_0 is rejected meaning that the level of physical activity has a correlation with learning concentration of teenagers, where heavy physical activity results in better learning concentration, OR (95% CI): 1.98 (1.23-3.17) that can be seenn Table 2.

The same result shows that physical activity can increase concentration ability of adult females (Wiraputri, 2011). Being mentally and physically healthy contributes to good concentration. Routine physical activity that is done daily can train the cardiovascular and respiratory system thus restoring blood flow to the brain and can restore a person's mood where it would then increase concentration ability. If the brain does not receive adequate blood supply, it can cause an increase in the physical and mental reaction of a person (National Cardiovascular Center Harapan Kita, 2010; Hellmich, 2010).

The results of this study supports the previous theory stating that concentration power may be increased after physical activity (Barclay *et al.*, 1998). Other theories also suggest that physical activity helps to centre the student's concentration in class and helps them to memorize by encoding learning through the body's neuro-musculator (Brysch and Dickinson, 1996). Other studies concluded that mental focus and level of concentration in students increased significantly after they perform structured activities (Blaydes, 2001). In students, physical activity resulted in the increase of

Table 1: Frequency distribution of subjects' characteristics (n = 360)

Characteristic	Frequency	Percentage
Age		
15-16 years old	277	76.9
17-19 years old	83	23.1
Gender		
Male	163	45.3
Female	197	54.7
Nutritional status		
Obese	37	10.3
Not obese	323	89.7
School origin		
State	136	37.8
Private	224	62.2
Physical activity		
Moderate	197	54.7
High	163	45.3
Sleep quality		
Poor	205	56.9
Good	155	43.1
Sleep concentration		
Poor	104	28.9
Good	256	71.1

motivation and reduction of boredom, which ultimately leads to the increase of learning concentration (Podulka *et al.*, 2006). Learning concentration itself is influenced by external factors (factors from outside the student's self) and internal factors (factors from within the student's self) e.g. physiological factor (normal physical condition and primary health), nutritional sufficiency factor, psychological factor, interest, physical, age, preparedness towards objects being confronted, knowledge and experience (Suryabrata, 2002).

The result of this study showed that students who conduct heavy physical activity did not only do routine learning activities in school but also participated in physical activities out of school like football, basketball, swimming, table tennis, running/jogging, taekwondo, cycling, gymnastics, walking and volley. To achieve heavy physical activity, they do sport activities everyday on average 30-60 minutes. This result can be used as a recommendation for teenagers that in order to have good concentration, physical activity should be increased by doing activities/sports everyday for 30-60 min. For those who rarely exercise, other activities can be done such as chores as in sweeping, mopping, washing, water the plants, etc.

Physical activities correlate positively with cardio-respiration and metabolic health in children and teens. A few studies suggest that moderate to high level of activities for 60 minutes per day can help to maintain cardio-respiratory health and metabolic risk profile. Other than that, physical activities done 2-3 times/week significantly increases muscle strength (World Health Organization, 2010).

Relationship between respondent's characteristics with learning concentration: To see the effect of the relationship between respondent's characteristics with

Table 2: Relationship between physical activity and learning concentration of subjects (n = 360)

| Physical activity | Learning concentration | | OR (95% CI) | p |
	Poor	Good		
Moderate	69 (35%)	128 (65%)	1.98 (1.23-3.17)	0.005
Heavy	35 (21.5%)	128 (78.5%)		

Table 3: Crosstab between respondent's characteristics with their learning concentration in high schools of yogyakarta city, January 2015 (n = 360)

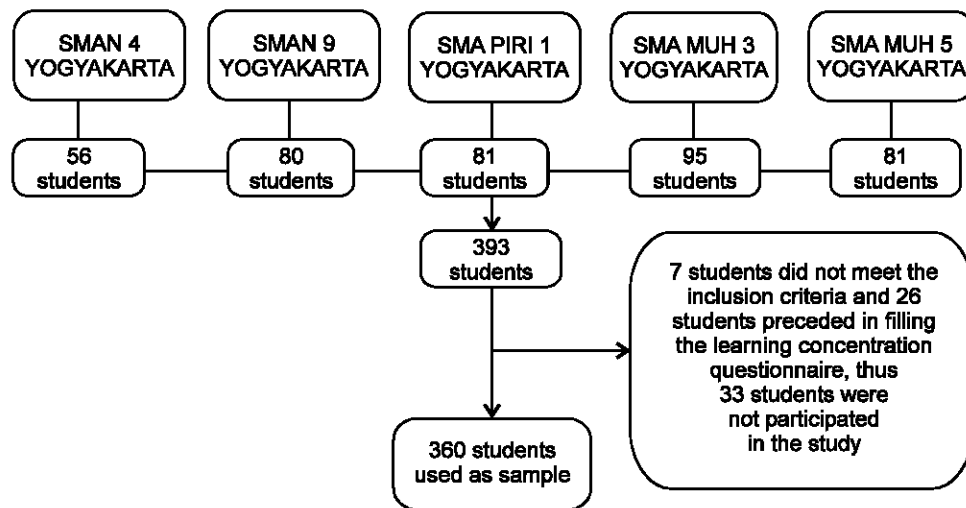| | Learning concentration | | OR (95% CI) | p |
	Poor	Good		
Age				
15-16 year old	76 (27.5%)	201 (72.5%)	0.74 (0.44-1.26)	0.27
17-19 year old	28 (33.3%)	55 (66.7%)		
Gender				
Male	61 (37.4%)	102 (62.6%)	2.14 (1.35-3.40)	0.001
Female	43 (21.8%)	154 (78.2%)		
Obesity status				
Obese	14 (37.9%)	23 (62.1%)	1.58 (0.78-3.20)	0.20
Not obese	90 (27.9%)	233 (72.1%)		
School origin				
State	10 (7.4%)	126 (92.6%)	0.11 (0.05-0.22)	<0.000
Private	94 (42%)	130 (58%)		
Sleep quality				
Poor	69 (33.7%)	136 (66.3%)	1.74 (1.08-2.80)	0.02
Good	35 (22.6%)	120 (77.4%)		

Fig. 1: Sample collection scheme

their learning concentration, chi-square test was done between the respondent's characteristics with their sleep quality that is presented Table 3.

Table 3 shows that there are a few respondents characteristics that have a significant relationship with learning concentration, such as gender, school origin and quality of sleep ($p<0.05$). If viewed from the quality of sleep, the students that have good quality of sleep mostly have good learning concentration compared to the latter. Statistically it is shown that there is a significant relationship between quality of sleep with learning concentration ($p = 0.02$).

This corresponds to previous studies showing that students who experience inadequate sleep will experience difficulties during the learning process in class, due to an increase cognitive ability limit (Hakam, 2006). The result of this study shows that sleep plays an important role in the learning process and memory consolidation (Giannotti et al., 2002). Students with higher concentration reported longer sleep hours, a better rest time at night before school and reducing the hours of late night sleep schedule on weekends compared to students with lower learning concentration. Students with poor quality of sleep showed a poor performance at school, a higher tendency to sleep in class and difficulties in concentrating.

Other than that, when sleep quality and the sleep cycle is disturbed, problems will arise due to the cycle of

Table 4: Multiple logistic regression analysis between sleep quality, physical activity, nutritional status, gender and school origin, with learning concentration

Variable	OR	95 % CI	p
Gender			
Male	2.45	1.45-4.14	0.001
Female	2.45	1.45-4.14	0.001
School origin			
State	0.16	0.05-0.22	<0.000
Private	0.16	0.05-0.22	<0.000
Nutritional status			
Obese	1.25	0.56-2.78	0.58
Not obese	1.25	0.56-2.78	0.58
Physical activity			
Moderate	2.18	1.28-3.70	0.004
High	2.18	1.28-3.70	0.004
Sleep quality			
Poor	1.87	1.10-3.16	0.02
Good	1.87	1.10-3.16	0.02

melatonin production still being high. High production of melatonin can cause the body and brain to work slowly and become unprepared to function (Banks, 2001). Inadequate sleep at night contributes to sleeping in class, lack of concentration and inability to be alert, also emotional and problematic behaviour towards friends (Malhi, 1999). In teenagers, with the ever-increasing modern lifestyle demand, poor quality of sleep may occur, causing the teens to have excessive daytime sleepiness (Potter and Perry, 2005). When teenagers at school experience sleepiness and fatigue due to lack of sleep, the learning concentration ability automatically reduces and may even cause teens to easily forget and have difficulty in understanding learning materials.

According to the Chi Square test, it is shown that there is no influence between sleeping patterns with student's learning concentration (p = 0.06, x^2 = 5.77) (Evanora, 2012). Other than that, other studies which evaluate the relationship between sleep quality and concentration of university students, show that the number of respondents that have good quality of sleep and good concentration is 18 people (39.13%), the number of respondents that have good quality of sleep and poor concentration is 13 people (28.26%), the number of respondents that have poor quality of sleep and good concentration is 10 people (21.73%) and the number of respondents that have poor quality of sleep and poor concentration is 5 people (10.86%) (William, 2013). According to the Chi-square test results, it is shown that there is no significant relationship between quality of sleep and concentration (p = 0.575).

Multivariate analysis: Other than studying the bivariate relationship, this research also studies the multivariate relationship of several variables in correlation with learning concentration. The analysis used is the regression logistic analysis as the dependent variable is a dichotomous variable. Results of the regression logistic analysis between the variables of gender,

nutritional status, school origin, sleep quality and physical activity can be seen (Table 4).

According to the analysis, the variable that most influences learning concentration is School Origin (p<0.001), while other variables like Physical Activity, Sleep Quality, Nutritional Status and Gender have less influence towards learning concentration.

Conclusion and suggestion: Teenagers in Yogyakarta city with a moderate level of physical activity are 54.7%, while the rest have high level of physical activity (45.3%). From the learning concentration data, most teenagers in Yogyakarta city have good learning concentration (71.1%) while the rest (28.9%) have poor learning concentration. Chi-square test results show that the level of physical activity correlates with learning concentration, in which teens who have high level of physical activity have good learning concentration, OR (95% CI): 1.98 (1.23-3.17).

Teenagers should increase their daily level of physical activity by doing activities/sports for 30-60 min/day, in order to achieve good learning concentration. For those that rarely do sports, they can increase their activity by doing chores like sweeping, mopping, washing, watering plants, etc.

REFERENCES

Arisman, 2013. Obesitas, Diabetes Mellitus, dan Dislipidemia, Konsep, Teori, dan Penanganan Aplikatif. Jakarta: EGC.

Badan Litbang Kesehatan, 2013. Laporan Hasil Riset Kesehatan Dasar (Riskesdas) Indonesia Tahun 2013. Jakarta: Kementerian Kesehatan Republik Indonesia.

Barclay, Michael J., Clifford W. Smith Jr. and Ross L. Watts, 1998. The determination of corporate leverage and dividend policies. The New Corporate Finance. Second Edition, Editor Donald H. Chew, Jr., Malaysia: Irwin Mcgraw-Hill.

Brysch, Karl A. and Dickinson John, 1996. Studies In Cognitive Maps: The Equiavailability Principle and Symmetry. Environ. and Behav., 28: 183.

Blaydes, Jean, 2001. A Case for Daily Quality Physical Education. Am. J. Pub. Health, 90: 4.

Banks, Karen, 2001. What Research Says About Teenagers and Sleep. Research Watch E and R Report 01(25).

Calleto, Marry, 2011. Pedriatic Obesity-Hypoventilation Syndrome. New York: State University of New York at Stony Brook.

Ekstedt, Mirjam, Nyberg Gisela, Ingre Michael, Ekblom Orjan and Marcus Claude, 2013. Sleep, Physical Activity and BMI in Six to ten Year-Old Children Measured by Accelerometry: a cross-sectional study. Int. J. Behavioral Nutr. and Physical Activity, 10: 1-10.

Evanora, Reni, 2012. Pengaruh Tidur Terhadap Konsentrasi Belajar Siswa SMA Negeri 4 Yogyakarta. Skripsi. Universitas Gadjah Mada.

Guyton and Hall, 2007. Fisiologi Kedokteran. Jakarta: EGC.

Giannotti, F., F. Cortesi, T. Sebastiani and S. Ottaviano, 2002. Circadianpreference, Sleep and Daytime Behaviour in Adolescence. J. Sleep Res., 11: 191-199.

Hidayat, Musrifatul and Hidayat A. Aziz Alimul, 2008. Keterampilan Dasar Praktik Klinik Untuk Kebidanan. Jakarta: Salemba Medika.

Hellmich, Nanci, 2010. Physical Activity Can Boost Student Performance. http://www.usatoday.com/news/education/2010-0414letsmoveinschool 15_ST_N.htm, diakses pada 14 April 2015.

Hakam, Abdul Kama, 2006. Pendidikan Nilai. Bandung: Value Press.

Knutson, K.L. and Van E. Cauter, 2008. Associations Between Sleep Loss and Increased Risk of Obesity and Diabetes. Ann. New York Academy of Sci., 1129: 287-304.

Richard Lowry, Danice K. Eaton, Kathryn Foti, Lela McKnight-Eily, Geraldine Perry and Deborah A. Galuska, 2012. Association of Sleep Duration with Obesity Among US High School Students. J. Obes., pp: 1-9.

Malhi, P., 1999. Ill effects of sleep deprivation. Tribune in Education. Chandigarh: Department of Pedriatric.

National Cardiovascular Center Harapan Kita, 2010. Sehat Mental Dengan Olahraga. http://www.pjnhk.go.id/index2.php?option=com_content&do_pdf=1 &id=3260. Diakses pada 14 April 2015.

Puhl, Rebecca M. and Latner D. Janet, 2007. Stigma, Obesity and The Health of the Nation's Children. Psycholog. Bull., 133: 557-580.

Potter and Perry, 2005. Fundamental Keperawatan. Jakarta: EGC.

Pesonen, Anu-K., Sjosten M. Noora, Matthews A. Karen, Heinonen Kati, Martikainen Silja, Kajantie Eero, Tammelin Tuija, Eriksson G. Johan, Strandberg, Timo and Raikkonen Katri, 2011. Temporal Association Between Daytime Physical Activity and Sleep in Children. PLoS ONE, 6: 1-6.

Podulka, Dwan, Pivarnik M. James and C.J. Womack, 2006. Effect of Physical Education and Activity Levels on Academic Achievment in Children. Med. Sci. Sports Exerc., 38: 1515-1519.

Suryaputra, Kartika, Nadhiroh and Siti Rahayu, 2012. Perbedaan Pola Makan dan Aktivitas Fisik Antara Remaja Obesitas dengan Non Obesitas. Makara, Kesehatan, 16: 45-50.

Suryabrata, S., 2002. Psikologi Pendidikan. Jakarta: Raja Grafindo Persada.

Tandra, Hans, 2009. Segala Sesuatu Yang Harus Anda Ketahui Tentang Osteoporosis, Mengenal, Mengatasi, dan Mencegah Tulang Keropos. Jakarta: Gramedia.

Wahyu, Genis Ginanjar, 2009. Obesitas Pada Anak. Jakarta: Bentang Pustaka.

World Health Organization, 2000. Obesity:Preventing and ManagingThe Global Epidemic. Geneva: WHO.

Wiraputri, Nariswari Anggapadmi, 2011. Pengaruh Aktivitas Fisik (Modifikasi Harvard Step Up Test) Terhadap Daya Konsentrasi Wanita Dewasa. Skripsi. Fakultas Kedokteran, Universitas Kristen Maranatha, Bandung.

World Health Organization, 2010. Global Recommendations on Physical Activity for Health. Geneva: WHO.

William, Mellia Cyntia, 2013. Hubungan Kualitas Tidur Dengan Konsentrasi Pada Mahasiswa Angkatan 2009 Fakultas Kedokteran Universitas Sumatera Utara. Skripsi. Fakultas Kedokteran Universitas Sumatera Utara: Medan.