HALAMAN OLAHRAGA NUSANTARA (HON)
Jurnal Ilmu Keolahragaan

Volume 7 No I
Tahun 2024

ISSN 2614-2775 (Print)
ISSN 2621-8143 (Online)

CORRELATION OF SEDENTARY BEHAVIOR AND SLEEP DURATION WITH VISUOSPATIAL MEMORY IN EARLY CHILDREN

Shidqi Maulida[1], Kuston Sultoni[2], Surdiniaty Ugelta[3]

Institut Teknologi Bandung[1], Universitas Pendidikan Indonesia[2,3]
shidqiimaulida@gmail.com

Abstract
Sedentary behavior and sleep duration are indicated as contributors to the emergence of health problems. Especially in early children's cognitive function abilities, including nerve signal abilities, concentration levels and memory. So this research was carried out with the aim of exploring how much sedentary behavior and sleep duration are related to cognitive function (visuospatial memory) in early childhood. The quantitative correlation test is used to test how much the relationship both of variable. The research subjects were 45 children aged 4 years in Bandung city, West Java. The instruments used in data collection were the Accelerometer Actigraph GT3X and the Early Years Toolbox (Mr.Ant). The results of research data analysis stated that there was a significant relationship between sedentary behavior and visuospatial memory, p=.047 with a correlation coefficient of -.514. Sleep duration is related to cognitive function with a value of p = .028 and a correlation coefficient value of .360. The duration of sedentary behavior carried out by young children in daily life is negatively correlated with cognitive function, while the duration of sleep is positively correlated with cognitive function.

Keywords: *Sedentary Behavior; Sleep Duration; Cognitive Function; Early Childhood*
Submitted : 05th of October 2023
Accepted : 19th of November 2023
Published : 20th of November 2023
Correspondence Author: Shidqi Maulida, Institut Teknologi Bandung, Indonesia.
E-Mail: shidqiimaulida@gmail.com

DOI http://dx.doi.org/10.31851/hon.v7i1.13507

INTRODUCTION

The development of technological progress is felt very rapidly, the most complex thing felt in life is cellphones/gadgets. Starting from necessities to entertainment, anytime and anywhere, everything can be accessed as close as your hand. There are many conveniences and benefits, all close and easy to reach. However without realizing it, behind the many benefits and conveniences provided, there is something that can actually increase the potential of people who

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

run into health problems, namely spending too long time in screen-based activities (sedentary behavior). Increasingly advanced technology is indirectly changing the ways and patterns of people's daily lifestyles. According to (Callender, Borghese, & Janssen, 2019) sedentary behavior in society can reach 40% in everyday life. In Indonesia, on average, they spend 5-8 hours/day in screen-based activities (sedentary behavior). This means that this condition has become a daily habit that has become part of people's lifestyle.

Sedentary behavior is activities (except sleep) that expend no more than 1.5 METs (Metabolic Equivalents) of energy/calories, activities include sitting, lying, or screen-based activities such as watching TV, using a cellphone/computer (Ferreira, Urteaga, De Moraes, Moreno, & Carvalho, 2019). Sedentary behavior can be categorized as "physical inactivity". In the past few years, sedentary behavior has become a new habit that has become a problem in various countries, including Indonesia. High levels of sedentary behavior can increase an individual's chances of run into health problems (Park, Moon, Kim, Kong, & Oh, 2020), in fact, several media reported that the impact of high levels of sedentary behavior in daily life is as dangerous as the risks experienced by smokers. These include the risk of developing cardio-metabolic disease, diabetes, problems of the immune system and also cancer in several organs of the body (Salmon, Tremblay, Marshall, & Hume, 2011). Meanwhile, in children, high levels of sedentary behavior can be more specific, namely, disrupting the process of growth and development of cognitive function abilities (Madigan, Browne, Racine, Mori, & Tough, 2019). Interferes with the ability of nerves to send signals, decreases concentration (Chau et al., 2013) and also memory (Lövdén, Xu, & Wang, 2013). So high sedentary behavior in children is associated as a strong contributor to decreased achievement at school.

Based on research conducted (Balitbangkes RI, 2018; Heni & Mujahid, 2018) as many as 72.3% of Indonesian children are classified as frequently using cellphones, and more than 60% are less active in carrying out physical activities.

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

This condition should be a concern for everyone, especially for academics and parents, this condition is worrying, Indonesian children have an active lifestyle. Therefore, WHO and the Indonesian Ministry of Health urge that the length of time children spend in sedentary behavior must be limited, to no more than 2 hours a day, the rest of the time children must be involved in more active activities involving movement. If not, the possibility of stunting symptoms or delays in the growth and development of cognitive abilities (memory) will occur. The early childhood period is an important period which is the initial process of developing various aspects of development, including the development of physical abilities, motor skills, social and cognitive abilities (Carson, Tremblay, & Chastin, 2017; Chen et al., 2020) which will become a provision for future life. Therefore, it is important to carry out further research, namely as an effort to identify the correlation that occurs between sedentary behavior and visuospatial memory. In order to minimize the possibility of a decline in cognitive function (visuospatial memory) in early childhood related to the length of time sedentary behavior has become a habit in society.

Apart from the length of time for sedentary behavior, the length of time sleeping should also be a concern for parents in the early childhood group. In early childhood, sleep is an important need not only for health, but also for the anatomical and physiological growth and development of the body (Miller, Lumeng, & Lebourgeois, 2015). So most of the children's age group (3-6 years) need to spend half of their day sleeping (Bathory & Tomopoulos, 2017). It is not surprising that sleep problems/disorders are often found in children related to a lack of quantity (length of time) of sleep (Oliver-Landry, 2016). So it is important for parents to pay attention to ensure that their children sleep for sufficient duration. Because of course everything that is needed and can be accepted by the body has a good dose/measure to give.

Evidence shows that in children under 5 years old, short total sleep duration is associated with physiological health problems, including higher levels

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

of adiposity (Chaput, Gray, et al., 2017) and less optimal body metabolic performance (Killgore, 2010) and reduces the ability of cognitive functions (Buman & Youngstedt, 2015), specifically the ability of short-term memory function and working memory (Mehta, Kamble, Gadhvi, & Kaushal, 2017). When sleep occurs, that is where the process of growth and development of the child's increasingly mature cognitive function abilities, many brain systems depend on functionally on the sustainability of sleep (Curcio, Ferrara, & De Gennaro, 2006). Plus, this period is a period when behavior and sleep patterns begin to form (Staton, Smith, & Thorpe, 2015). Therefore, it is important to identify the correlation between sleep duration and cognitive abilities (visuospatial memory) in early childhood, in order to minimize the possibility of an impact on the visuospatial memory abilities of young children in Indonesia.

METHOD

This research was conducted in nine early childhood schools (TK/PAUD) in Bandung City. The aim of the research was to explore how big the relationship between sedentary behavior and sleep duration is with visuospatial memory in early childhood. This research is observational, with a descriptive-quantitative correlation test approach. Correlation testing is carried out using a single Pearson correlation test, which produces a correlation coefficient value. The coefficient value indicates an indication of the closeness of the interaction between the two variables.

The population chosen was early childhood children aged 4 years in the city of Bandung. In determining the sample, the researcher used a purposive sampling technique, so that he used special criteria in determining the sample group. The inclusion criteria used include early childhood children must be aged 4 years 0 months to 4 years 11 months, the child is a student at a kindergarten/PAUD school located in the Bandung City area, the sample and their parents/guardians are willing to be research samples and take part in research activities until they are completed.

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

For the visuospatial memory measurement instrument, the Early Years Toolbox (EYT) application is used on the device (Ipad) provided by the research team. EYT is a game application created and developed by the University of Wollongong Australia. EYT has been validated and reliable in measuring cognitive function abilities in children (Howard & Melhuish, 2017), one of the cognitive aspects measured is visuospatial memory function in children. The name of the game is “Mr. Ant”, in this game you will be presented with a picture of the cartoon character an ant – with a number of colored stickers attached to various parts of its body. After a predetermined period of time, the sticker will disappear, and the child is then asked to remember the location of the sticker by tapping the location on the body part of the cartoon ant that they believe was previously holding the sticker. This task tests children's memory abilities (Working-Memory) in a structured manner. As the levels increase, the level of complexity also increases (from one to eight stickers). The Mr. Ant game has a score range from 0.00-8.00, with an increasing scale of 0.33 for each level. The duration ranges from 5-8 minutes.

Meanwhile, for measuring the length of time of sedentary behavior and duration of sleep, it was measured using the Actigraph GT3X accelerometer activity recording device, daily activities were recorded for 24 hours for 5 days of use without being removed except for water activities (swimming/showering). The Actigraph accelerometer is installed on the right side of the hip, tied with an elastic rubber belt, details as in Figure 1. The data collected is the length of time/duration spent in sedentary behavior and sleeping activities, both of which

Figure 1. Appearance of the Correctly Installed Actigraph GT3X Accelerometer Position

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

are collected in minutes.

RESULT AND DISCUSSION

Testing the relationship uses a single correlation design, so that testing the significance of the relationship is carried out separately. These include the relationship between sedentary behavior and visuospatial memory in early childhood and the relationship between sleep duration and visuospatial memory in early childhood. The number of samples involved as research sample subjects was 45 young children.

Table 1. Obtaining Descriptive Data for Research on Sedentary Behavior, Sleep Duration, and Visuospatial Memory Scores

	N=45	(%)	Min	Max	Mean	Std. Deviasi
Gender						
Boys	20	53				
Girls	22	47				
Sedentary Behaviour (minutes)			495	1117	669,71	141,29
Sleep Duration (minutes)			365	894	552, 24	90,84
Cognitive (Visuospatial Memory)			1	4	2,11	0,73
Under Age	12	27				
Normal	25	55				
Excellent	8	18				

Table 1 shows the results of descriptive research data analysis, the data obtained is in the form of minimum, maximum, average and standard deviation values for the duration of sedentary behavior, sleep and visuospatial memory scores for early childhood. The majority of young children studied spent time in sedentary behavior for an average of 669.71 minutes, meaning that sedentary behavior was carried out for an average of 11 hours. Meanwhile, the recommendation according to (WHO, 2019) is that the continuation of sedentary behavior at an early age should not exceed 2 hours. However, this recommendation is considered to be less detailed, because the 2 hour time limit is for one day or for each session of a number of activities carried out during one day. In this study, the sedentary time obtained for 669.71 minutes was the result of the total accumulation in a day, so that the length of time for sedentary

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

behavior carried out by the sample was still unclear to be classified as whether it was in a bad condition or not.

Then regarding the acquisition of sleep time, the majority of young children in the sample spent an average of 552.24 minutes at std. The deviation is 90.84, meaning that in hours the sample spends more than 9 hours sleeping in a day. With these results, the young children studied as a sample are not yet in the good category, but the majority of young children have slept for a sufficient duration in accordance with the recommended guidelines for early childhood children should sleep between 10-13 hours a day (Hirshkowitz et al., 2015; Walsh et al., 2018), this time is the total accumulated time for sleeping at night and also napping.

Mr Ant (Visual-Spatial Working Memory)

		Orange		Yellow		Green		Light Blue		Dark Blue	
Age (Y:M)	M (SD)	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
3:0-3:5	0.85 (0.76)	0.00	0.09	0.10	0.39	0.40	0.99	1.00	1.39	1.40	8.00
3:6-3:11	1.14 (0.86)	0.00	0.39	0.40	0.99	1.00	1.39	1.40	1.99	2.00	8.00
4:0-4:5	1.57 (0.89)	0.00	0.69	0.70	1.39	1.40	1.99	2.00	2.39	2.40	8.00
4:6-4:11	1.74 (0.87)	0.00	0.99	1.00	1.69	1.70	1.99	2.00	2.39	2.40	8.00
5:0-5:5	1.98 (0.82)	0.00	1.39	1.40	1.99	2.00	2.29	2.30	2.39	2.40	8.00
5:6-5:11	2.31 (0.80)	0.00	1.99	2.00	2.00	2.01	2.39	2.40	2.99	3.00	8.00

Figure 2. Mapping of Game Score Norms Mr.Ant

Figure 2 shows a descriptive analysis of the acquisition of cognitive ability scores, the acquisition of Mr. Ant's scores. The minimum score obtained was 1, the maximum score was 4, while the average score was 2.11 with a std deviation of 0.73. This means that the majority of visuospatial memory scores are in the green category, indicating that the majority of young children in the city of Bandung have fairly good visuospatial memory abilities with standard scores according to the level that early childhood visuospatial memory scores should be.

After the three variables have been carried out descriptive tests, then hypothesis testing is carried out by carrying out correlation tests with the aim of

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

identifying the correlations and interactions that occur. The data collected is normally distributed, so the correlation hypothesis test used uses the Pearson correlation test.

Table 2. Pearson Correlation Hypothesis Test

	Memori Visuospasial	
	Co. Correlation	*Sig.*
Sedentary behaviour	-.514	.047
Sleep Duration	.360	.028

Based on table 2, the results obtained a significance value of .047 and a correlation coefficient value of -.514, the coefficient value is negative. The closeness of the relationship that occurs is still categorized as moderate. Perhaps this occurs because there are other activities such as learning activities that are carried out at the same time as sedentary behavior (sitting, screen time) is carried out. The activities recorded in this study did not specify what types of activities were carried out in conjunction with sedentary behavior. The negative value itself means that the relationship between sedentary behavior and cognitive function tends to be inversely proportional. So it is analogous that if the level of sedentary behavior is low then the child's visuospatial memory capacity will be high and if the level of sedentary behavior is high then the child's cognitive function will be low. This can happen because sedentary behavior independently affects children's cognitive abilities (Walsh et al., 2018) and if the level of duration of sedentary behavior is high there will be a risk of decreasing cognitive function, and will even impact children's academic performance at school and also reduce fitness levels. and health (Carson, Lee, et al., 2017; Falck, Davis, & Liu-Ambrose, 2017). In this way, young children should be emphasized to participate in physically active activities and it is even better to participate in structured physical activity, namely 3-5 times a week with a minimum duration of 150 minutes/week. However, the reality that occurs in the field is different, even children aged 3 to 5

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

years are reported to often spend their days in sedentary behavior (Dowda et al., 2009)

The results obtained regarding the length of sedentary time in this study are coherent with several previous studies, including research conducted by (Zimmerman & Christakis, 2005) which revealed that too long time spent in sedentary behavior will have a detrimental impact on children's cognitive development. Even if it persists for more than 2 hours a day it will have a negative impact on cognitive function abilities (Byeon & Hong, 2015; Carson, Lee, et al., 2017). Then, similar to what was found in research conducted (Hamer & Stamatakis, 2014) that the impact of prolonged sedentary behavior at a young age, the impact will be experienced at a more mature age with an increased risk of cognitive function and worse health conditions. . This happens because sedentary behavior independently influences children's cognitive abilities (Walsh et al., 2018). So, the impact of sedentary behavior must be prevented, because sedentary behavior is one of the big problems in terms of health among the community (Suherman et al., 2020).

Efforts to prevent the negative impacts caused by sedentary behavior are by limiting the continuation of sedentary behavior to less than 2 hours a day and must be accompanied by routine and regular physical active living habits (doing physical activity) (WHO, 2019), because it limits its sustainability. However, it is still considered less than optimal, so it also needs to be accompanied by efforts to promote an active lifestyle. This effort is one strategy that is considered appropriate and effective in preventing the negative impacts on children's cognitive function. Getting used to a physically active lifestyle is also good for promoting a healthy lifestyle which will have a positive impact on children's cognitive function in the future (Chen et al., 2020; Lövdén et al., 2013). Considering that the early childhood period is an important developmental period for health behavior patterns that will later become habits (Sugiyama, Okely, Masters, & Moore, 2012). In fact, it is not only good for cognitive function, but

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

also for motor skills too. If the motor skills are classified as good, it will support a good level of physical and social growth and development in the child. This means that this statement proves that reducing the level of sedentary behavior and coupled with getting children accustomed to an active lifestyle has many positive impacts, especially in terms of children's physiological and anatomical growth and development. Therefore, at school and at home, children should be given a physical environment that stimulates and supports children to be active, because the physical environment is one of several factors that influence the child's activities or events. It is true that children aged 3 to 5 years should participate more in active activities, play freely and participate in structured physical activities. With efforts like these, behavior and activities will contribute well to the development of cognitive function in children (Walsh et al., 2018).

Based on data processing analysis in table 3, it shows that there is a significant relationship between sleep duration and cognitive function in early childhood. The significance value obtained is P>.028 with a correlation coefficient value of .360 which is positive. The positive value obtained means that the direction of the relationship is in the same direction or can be said to be directly proportional between the variables. By analogy, if sleep duration is high then cognitive function will be good and if sleep duration is low or less then cognitive function ability will also be low.

The results of this study are coherent with research conducted by (Killgore, 2010; Walsh et al., 2018) that sleep duration can independently influence cognitive function abilities. This can occur due to the vulnerability of the brain system, neurophysiological activity and main brain activity which functionally depends on the duration of sleep (Bathory & Tomopoulos, 2017). We all know that poor (less) sleep duration can result in reduced attention, speed of thinking and psychomotor alertness. There are other findings with a coherent discussion, namely both discussing the impact that can be caused by poor sleep duration, where poor sleep duration is related to a decrease in overall cognitive

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

performance, the exact calculation for each sleep duration is reduced by 1 hour from the total recommended duration, overall cognitive level will decrease by 0.67% (Ferrie et al., 2011; Lo, Loh, Zheng, Sim, & Chee, 2014). In fact, the quantity and quality of sleep that is done is one unit that has an impact on the performance of cognitive functions (Dewald, Meijer, Oort, Kerkhof, & Bögels, 2010). So the research statement can be directly concluded that good sleep, in terms of duration, will significantly impact cognitive abilities in the future.

Specifically in the early childhood group, sleep duration which influences the development of cognitive function, body composition, emotional regulation and growth is sleep duration which is said to be longer (Chaput, Colley, et al., 2017) because sleep has a central role in the maturation process. anatomical and physiological growth in the early years and several anatomical and physiological growth and development events in early childhood occur during sleep (WHO, 2004). This means that sleep that is more awake in quality and quantity has a good impact on early childhood. So it is certain that sleep duration is an objective predictor of cognitive performance (Kronholm et al., 2009). This finding can also be interpreted that sleep duration can reflect the actual realization of cognitive function and have an impact on the emergence of health symptoms. So that healthy sleep in quantity and quality is very necessary for the health and well-being of children and adults alike.

In this way, the results obtained from this study are coherent with previous research conducted by (Buman & Youngstedt, 2015; Killgore, 2010) and show support for the results which state that there is a significant relationship between sleep duration and cognitive function in early childhood. Therefore, it is important for young children to sleep with sufficient quantity/duration according to the guidelines recommended by the American NSF (National Sleep Foundation) (Hirshkowitz et al., 2015) and Canada's 24-Hour Movement Guidelines, namely the best duration. sleep for 10-13 hours a day (Chaput, Colley, et al., 2017; Ohayon et al., 2017).

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

CONCLUSION

Based on the results and discussion related to the research findings obtained, sedentary behavior and sleep duration each have a relationship with cognitive function abilities in 4 year old children. The relationship between sedentary behavior and cognitive function is inversely proportional, so that if the level of sedentary behavior is low then the child's cognitive function will be high, if the level of sedentary behavior is high then the child's cognitive function will be low. In contrast to sedentary behavior, the relationship between sleep duration and cognitive function is directly proportional, if sleep duration is high then cognitive function will be good and vice versa. Therefore, it is important for parents to be able to make monitoring efforts by limiting their children's sedentary behavior to no more than 2 hours a day, then adding to it by getting their children used to actively participating in physical movement and sleeping for sufficient duration. Efforts like this will make a good contribution to the cognitive growth and development of early childhood.

REFERENCES

Balitbangkes RI. (2018). Laporan Riskesdas 2018 Nasional.pdf. *Lembaga Penerbit Balitbangkes*, p. hal 156.

Bathory, E., & Tomopoulos, S. (2017). Sleep Regulation, Physiology and Development, Sleep Duration and Patterns, and Sleep Hygiene in Infants, Toddlers, and Preschool-Age Children. *Current Problems in Pediatric and Adolescent Health Care*, 1–13. https://doi.org/10.1016/j.cppeds.2016.12.001

Buman, M. P., & Youngstedt, S. D. (2015). Physical Activity, Sleep, and Biobehavioral Synergies for Health. In *Sleep and Affect: Assessment, Theory, and Clinical Implications*. https://doi.org/10.1016/B978-0-12-417188-6.00015-3

Byeon, H., & Hong, S. (2015). Relationship between television viewing and language delay in toddlers: Evidence from a Korea national cross-sectional survey. *PLoS ONE*, *10*(3), 1–12. https://doi.org/10.1371/journal.pone.0120663

Callender, L. K., Borghese, M. M., & Janssen, I. (2019). Which intensities , types , and patterns of movement behaviors are most strongly associated with cardiometabolic risk factors among children ? *Journal of Sport and Health*

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

Science. https://doi.org/10.1016/j.jshs.2019.06.006

Carson, V., Lee, E., Hewitt, L., Jennings, C., Hunter, S., Kuzik, N., … Tremblay, M. S. (2017). *Systematic review of the relationships between physical activity and health indicators in the early years (0-4 years)*. *17*(Suppl 5). https://doi.org/10.1186/s12889-017-4860-0

Carson, V., Tremblay, M. S., & Chastin, S. F. M. (2017). *Cross-sectional associations between sleep duration , sedentary time , physical activity , and adiposity indicators among Canadian preschool-aged children using compositional analyses*. *17*(Suppl 5). https://doi.org/10.1186/s12889-017-4852-0

Chaput, J., Colley, R. C., Aubert, S., Carson, V., Janssen, I., Roberts, K. C., & Tremblay, M. S. (2017). *Proportion of preschool-aged children meeting the Canadian 24-Hour Movement Guidelines and associations with adiposity : results from the Canadian Health Measures Survey*. *17*(Suppl 5). https://doi.org/10.1186/s12889-017-4854-y

Chaput, J., Gray, C. E., Poitras, V. J., Carson, V., Gruber, R., Birken, C. S., … Tremblay, M. S. (2017). *Systematic review of the relationships between sleep duration and health indicators in the early years (0 – 4 years)*. *17*(Suppl 5). https://doi.org/10.1186/s12889-017-4850-2

Chau, J. Y., Grunseit, A. C., Chey, T., Stamatakis, E., Brown, W. J., Matthews, E., … Ploeg, H. P. Van Der. (2013). *Daily Sitting Time and All-Cause Mortality : A Meta- Analysis*. *8*(11), 1–14. https://doi.org/10.1371/journal.pone.0080000

Chen, B., Bernard, J. Y., Padmapriya, N., Ning, Y., Cai, S., Lança, C., … Müller-Riemenschneider, F. (2020). Associations between early-life screen viewing and 24 hour movement behaviours: findings from a longitudinal birth cohort study. *The Lancet Child and Adolescent Health*, *4*(3), 201–209. https://doi.org/10.1016/S2352-4642(19)30424-9

Curcio, G., Ferrara, M., & De Gennaro, L. (2006). Sleep loss, learning capacity and academic performance. *Sleep Medicine Reviews*, *10*(5), 323–337. https://doi.org/10.1016/j.smrv.2005.11.001

Dewald, J. F., Meijer, A. M., Oort, F. J., Kerkhof, G. A., & Bögels, S. M. (2010). The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: A meta-analytic review. *Sleep Medicine Reviews*, *14*(3), 179–189. https://doi.org/10.1016/j.smrv.2009.10.004

Dowda, M., Brown, W. H., Mclver, K. L., Pfeiffer, K. A., O’Neill, J. R., Addy, C. L., & Pate, R. R. (2009). Policies and characteristics of the preschool

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

environment and physical activity of young children. *Pediatrics*, *123*(2). https://doi.org/10.1542/peds.2008-2498

Falck, R. S., Davis, J. C., & Liu-Ambrose, T. (2017). What is the association between sedentary behaviour and cognitive function? A systematic review. *British Journal of Sports Medicine*, *51*(10), 800–811. https://doi.org/10.1136/bjsports-2015-095551

Ferreira, M. V. N., Urteaga, T. rendo, De Moraes, A. C. F., Moreno, L. A., & Carvalho, H. B. (2019). Abdominal Obesity in Children: The Role of Physical Activity, Sedentary Behavior, and Sleep Time. *Nutrition in the Prevention and Treatment of Abdominal Obesity*, 81–94. https://doi.org/10.1016/b978-0-12-816093-0.00008-2

Ferrie, J. E., Shipley, M. J., Akbaraly, T. N., Marmot, M. G., Kivimäki, M., & Singh-Manoux, A. (2011). Change in sleep duration and cognitive function: Findings from the Whitehall II study. *Sleep*, *34*(5), 565–573. https://doi.org/10.1093/sleep/34.5.565

Hamer, M., & Stamatakis, E. (2014). Prospective study of sedentary behavior, risk of depression, and cognitive impairment. *Medicine and Science in Sports and Exercise*, *46*(4), 718–723. https://doi.org/10.1249/MSS.0000000000000156

Heni, H., & Mujahid, A. J. (2018). Pengaruh Penggunaan Smartphone terhadap Perkembangan Personal Sosial Anak Usia Pra-Sekolah. *Jurnal Keperawatan Silampari*, *2*(1), 330–342. https://doi.org/10.31539/jks.v2i1.341

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., … Adams Hillard, P. J. (2015). National sleep foundation's sleep time duration recommendations: Methodology and results summary. *Sleep Health*, *1*(1), 40–43. https://doi.org/10.1016/j.sleh.2014.12.010

Howard, S. J., & Melhuish, E. (2017). An Early Years Toolbox for Assessing Early Executive Function, Language, Self-Regulation, and Social Development: Validity, Reliability, and Preliminary Norms. *Journal of Psychoeducational Assessment*, *35*(3), 255–275. https://doi.org/10.1177/0734282916633009

Killgore, W. D. S. (2010). Effects of sleep deprivation on cognition. In *Progress in Brain Research* (Vol. 185). https://doi.org/10.1016/B978-0-444-53702-7.00007-5

Kronholm, E., Sallinen, M., Suutama, T., Sulkava, R., Era, P., & Partonen, T. (2009). Self-reported sleep duration and cognitive functioning in the general population. *Journal of Sleep Research*, *18*(4), 436–446. https://doi.org/10.1111/j.1365-2869.2009.00765.x

Lo, J. C., Loh, K. K., Zheng, H., Sim, S. K. Y., & Chee, M. W. L. (2014). Sleep

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

Duration and Age-Related Changes in Brain Structure and Cognitive Performance. *Sleep*, *37*(7), 821–821. https://doi.org/10.5665/sleep.3832

Lövdén, M., Xu, W., & Wang, H. X. (2013). Lifestyle change and the prevention of cognitive decline and dementia: What is the evidence? *Current Opinion in Psychiatry*, *26*(3), 239–243. https://doi.org/10.1097/YCO.0b013e32835f4135

Madigan, S., Browne, D., Racine, N., Mori, C., & Tough, S. (2019). Association between Screen Time and Children's Performance on a Developmental Screening Test. *JAMA Pediatrics*, *173*(3), 244–250. https://doi.org/10.1001/jamapediatrics.2018.5056

Mehta, B., Kamble, rathamesh H., Gadhvi, M., & Kaushal, A. (2017). Correlation of self-reported sleep duration with working memory of adolescents. *Journal of Family Medicine and Primary Care*, *6*(2), 169–170. https://doi.org/10.4103/jfmpc.jfmpc

Miller, A. L., Lumeng, J. C., & Lebourgeois, M. K. (2015). Sleep patterns and obesity in childhood. *Current Opinion in Endocrinology, Diabetes and Obesity*, *22*(1), 41–47. https://doi.org/10.1097/MED.0000000000000125

Ohayon, M., Wickwire, E. M., Hirshkowitz, M., Albert, S. M., Avidan, A., Daly, F. J., … Vitiello, M. V. (2017). National Sleep Foundation's sleep quality recommendations: first report. *Sleep Health*, *3*(1), 6–19. https://doi.org/10.1016/j.sleh.2016.11.006

Oliver-Landry, E. (2016). Sleep problems in children. *Australian Family Physician*, *45*(4), 166.

Park, J. H., Moon, J. H., Kim, H. J., Kong, M. H., & Oh, Y. H. (2020). Sedentary Lifestyle: Overview of Updated Evidence of Potential Health Risks. *Korean Journal of Family Medicine*, *41*(6), 365–373. https://doi.org/10.4082/KJFM.20.0165

Salmon, J., Tremblay, M. S., Marshall, S. J., & Hume, C. (2011). Health risks, correlates, and interventions to reduce sedentary behavior in young people. *American Journal of Preventive Medicine*, *41*(2), 197–206. https://doi.org/10.1016/j.amepre.2011.05.001

Staton, S. L., Smith, S. S., & Thorpe, K. J. (2015). "Do I really need a nap?": The role of sleep science in informing sleep practices in early childhood education and care settings. *Translational Issues in Psychological Science*, *1*(1), 32–44. https://doi.org/10.1037/tps0000011

Sugiyama, T., Okely, A. D., Masters, J. M., & Moore, G. T. (2012). Attributes of child care centers and outdoor play areas associated with preschoolers' physical activity and sedentary behavior. *Environment and Behavior*, *44*(3), 334–349. https://doi.org/10.1177/0013916510393276

HALAMAN OLAHRAGA NUSANTARA
JURNAL ILMU KEOLAHRAGAAN
Jendral A. Yani Street Lorong Gotong Royong 9/10 Ulu Palembang South Sumatera
email jurnal: jurnalhon@univpgri-palembang.ac.id
situs web: http://www.univpgri-palembang.ac.id

Suherman, A., Jajat, J., Nur Indri, R., Sultoni, K., Risma, R., & Agust, K. (2020). *Early Childhood Physical Activity and Sedentary Behavior in Indonesia : 21*(Icsshpe 2019), 426–428.

Walsh, J. J., Barnes, J. D., Cameron, J. D., Goldfield, G. S., Chaput, J. P., Gunnell, K. E., … Tremblay, M. S. (2018). Associations between 24 hour movement behaviours and global cognition in US children: a cross-sectional observational study. *The Lancet Child and Adolescent Health*, *2*(11), 783–791. https://doi.org/10.1016/S2352-4642(18)30278-5

WHO. (2019). WHO Guidelines on physical activity, sedentary behaviour. In *World Health Organization*. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/325147/WHO-NMH-PND-2019.4-eng.pdf?sequence=1&isAllowed=y%0Ahttp://www.who.int/iris/handle/10665/311664%0Ahttps://apps.who.int/iris/handle/10665/325147

Zimmerman, F. J., & Christakis, D. A. (2005). Children's Television Viewing and Cognitive Outcomes. *Archives of Pediatrics & Adolescent Medicine*, *159*(7), 619. https://doi.org/10.1001/archpedi.159.7.619