



Sedentary Lifestyle Phenomenon and Obesity Risk on Students at School and College during Transitions from Conventional School to Online School

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Article Info	Abstract
<p>Article history: Received 17 August 2022 Revised 24 October 2022 Accepted 27 October 2022 Available online 01 February 2023</p> <p>Keywords: Pandemic; Online School; Student; Sedentary Behaviour; Obesity</p> <p>Correspondence: dianaputriw99@gmail.com</p>	<p>Background: Online School was actively carried out during the COVID-19 pandemic to reduce social interaction, minimize outdoor activities, and decrease airborne virus transmission. This activity mainly uses virtual media. During activities, students are advised and ordered to stay inside their houses, which causes a reduction in physical activities. Said actions cause a significant change in their lifestyle and can increase the risk of obesity.</p> <p>Objective: To find out the phenomenon of obesity in conventional education school students, from elementary to high school, during the transition from face-to-face learning to long-distance learning</p> <p>Methods: Review several published scientific articles regarding the increased risk of obesity due to online school during the COVID-19 pandemic.</p> <p>Results: There is a relationship between online school and increased risk of obesity and sedentary behavior, stress, and diet. This is because online school makes decreased physical activity, increases screen time, and causes irregular sleep patterns and stress. Any student can experience this.</p> <p>Conclusion: Online learning during the COVID-19 pandemic has been proven to increase the risks of students becoming obese due to increased sedentary lifestyles. Hence a modification in their lifestyle and routine is highly needed.</p>
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INTRODUCTION

Pembelajaran Jarak Jauh in Indonesia, or long-distance learning, is a learning activity carried out as an emergency protocol ordered by Indonesia's Minister of Education and Culture issued through Ministerial Circular Letter Number 4 on March 24th, 2020. The only way for students in Indonesia to access their rights to education is by using long-distance learning, which reduces the transmission of COVID-19 between students. The use of online media especially will cause an increase in the time students spend in front of their gadgets, screens, or personal computers at home and decrease physical activity compared to face-to-face learning ¹.

A new lifestyle is called sedentary, which refers to a decrease in physical activity and an increase in low-effort physical activities such as sitting or lying down ². One potential concern is obesity because it may initiate other diseases such as cardiovascular disease, hypertension,

osteoarthritis, and metabolic diseases such as type 2 diabetes mellitus ³. Additionally, if you are obese and are infected with the COVID-19 virus, the probability of a bad outcome increases, so more adequate treatment is needed⁴.

With several existing studies, the researcher wants to discuss this problem due to the lack of research on Indonesia's population and is expected to build awareness of the effects of a sedentary lifestyle and obesity. The knowledge in this review is expected to be used as a basis for further research or reviews.

METHODS

This literature review using the PICO method based on clinical questions from the research question, which is how is the relationship between the phenomenon of increased sedentary activity and its risk for obesity in school students to college students during the initial transition of online school during the COVID-19 pandemic, it is established that:

PICO	Description
Population	Student, University student, Children, Adolescent
Intervension	Online school, Pandemic COVID-19
Comparators	Non pandemic COVID-19
Outcomes	Sedentary behavior, weight gaining, obesity

The search for articles that will be used as references uses databases from NCBI and Google Scholar. The keywords used are sedentary behavior, obesity, student, children, and adolescent. The limitation of articles used is based on the time of publication is ten years from 2011 to 2021, set during the COVID-19 pandemic. The articles being searched for are articles in English with full-text type. The

target population sought is students based on the age of children as categorized by WHO, which are defined as ranging from 5-19 years old, so they take groups of elementary school students to college students. If an article is found that presents data with a wide age range and is still within the age range of the subjects being sought, it will still be included in this review and adjusted accordingly.

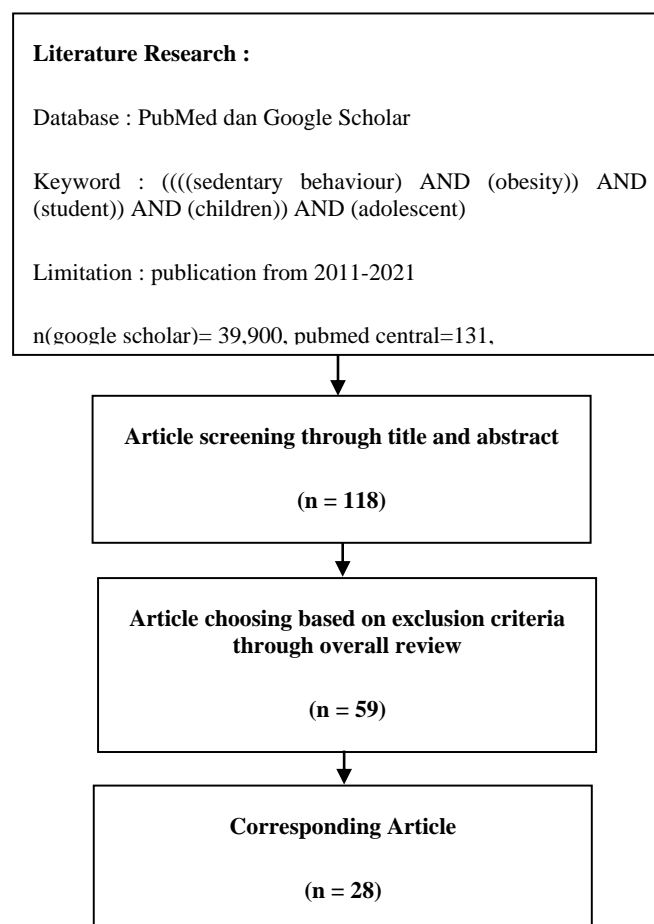


Figure 1. Flowchart amnuscript selection

RESULTS

Table 1 Data Extraction for included studies

Title	Author (year)	Article Type	Method	Important Conclusion
Sedentary Lifestyle: Overview of Updated Evidence of Potential Health Risks	Park, Jung Ha; Moon, Ji Hyun; Kim, Hyeon Ju; Kong, Mi Hee Oh, Yun Hwan (2020)	Review Article	-	A sedentary lifestyle may initiate other diseases such as diabetes mellitus, hypertension, dyslipidemia, obesity, and other metabolic diseases due to changes in metabolic regulation.
Childhood Obesity: A Review of Increased Risk for Physical and Psychological Co-morbidities	Elizabeth R. Pulgarón, PhD (2013)	Review Article	-	Obesity in children can lead them to several comorbid conditions, such as asthma, hypertension, and hyperglycemia. Obesity can also cause gastrointestinal problems such as GERD.
The impact of the coronavirus disease 2019	Tulchin-Francis, Kirsten	Research Article	Retrospective	<ul style="list-style-type: none"> There has been an increase in sedentary lifestyles, diet, and reduced physical activity in college students during the

(COVID-19) pandemic on university students' dietary intake, physical activity, and sedentary behaviour	Stevens, Wilshaw; Gu, Xiangli, et al. (2021)		cross-sectional	<p>pandemic, which caused the quality of health to decline.</p> <ul style="list-style-type: none"> • Increase sedentary activities from 8 hours per day before the pandemic to 11 hours during the pandemic.
The Impact of Covid-19 Pandemic on Students' Sedentary Behavior in Indonesia	Fitria, Syiva; Surya, Dedy. (2021)	Research Article	Retrospective cross-sectional	<p>Adolescents in Indonesia have shown a significant increase in sedentary behavior during the pandemic.</p>
The COVID-19 pandemic: an unprecedented tragedy in the battle against childhood obesity	Storz, Maximilian Andreas. (2020)	Review Article	-	<ul style="list-style-type: none"> • The COVID-19 pandemic has exacerbated the childhood obesity epidemic. • The pandemic creates an obesogenic environment that leads to significant weight gain and eating behavior.
Sociodemographic Predictors of Changes in Physical Activity, Screen Time, and Sleep among Toddlers and Preschoolers in Chile during the COVID-19 Pandemic	N. Aguilar-Farias, M. Toledo-Vargas, S. Miranda-Marquez, et al. (2021)	Research Article	Retrospective cross-sectional	<ul style="list-style-type: none"> • They are decreasing physical activity in all participants (5266 children). • Sociodemographic factors have an essential role in changing activity during a pandemic. • During the pandemic, children from low-income families did more physical activity than children from high-income families or families with higher education.
Physical inactivity and sedentary behaviors in the Bangladeshi population during the COVID-19 pandemic: An online cross-sectional survey	M. Rahman, M. Islam, M. Bishwas et al. (2020)	Research Article	Cross-sectional	<p>Students from upper-class families who live in urban areas have a high-risk factor for sedentary behavior.</p>
Hubungan Aktifitas Sedentari dengan Status Gizi pada Siswa SMP di Masa Pandemi COVID-19	Firmansyah, Achmad Reza; Nurhayati, Faridha. (2021)	Research Article	Cross-sectional	<ul style="list-style-type: none"> • Out of the collected data from 187 participants, it was shown that only 159 of them were categorized with high sedentary activity. • Sedentary behavior has no significant relationship with changes in nutritional status, with a percentage of 13%. • Obesity students do high-level sedentary activities.

Levels and changes of physical activity in adolescents during the COVID-19 Pandemic: Contextualizing urban vs. Rural living environment	Zenic, Natasa; Taiar, Redha; Glic, Barbara; Blazevic, Mateo; Maric, Dora; Pojskic, Haris; Sekulic, Damir. (2020)	Research Article	Prospective cross-sectional	Adolescents in urban areas have higher physical activity than adolescents in rural areas due to a better quality of life in urban areas. However, during this pandemic, the amount of physical activity is equally reduced.
Early effects of the COVID-19 pandemic on physical activity and sedentary behavior in children living in the U.S.	Dunton, Genevieve F.; Do, Bridgette; Wang, Shirlene D. (2020)	Research Article	Prospective cross-sectional	Girls and older children spend their free time during the pandemic engaging in sedentary behavior compared to boys, but overall, there was an increasing sedentary behavior.
Changes of Physical Activity and Ultra-Processed Food Consumption in Adolescents from Different Countries during Covid-19 Pandemic: An Observational Study	Ruíz-Roso, María Belén; De Carvalho Padilha, Patricia Matilla-Escalante; et al. (2020)	Research Article	Retrospective cross-sectional	Teenagers in developing countries such as Chile and Brazil are the teenagers with the most decreased physical activity. The decreased physical activity was related to gender, the mother's last education, and the country they lived in.
Food Insecurity and Pediatric Obesity: a Double Whammy in the Era of COVID-19	Tester, June M.; Rosas, Lisa G.; Leung, Cindy W. (2020)	Review Article	-	<ul style="list-style-type: none"> • The COVID-19 pandemic has caused children from low-income families to become more vulnerable to food security, triggering stress that can increase appetite. • During this pandemic, many families tend to save more food supplies to avoid shopping more often, but this is a temptation not to finish it fast.
Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome	Tremblay, Mark S.; Aubert, Salomé; Barnes, Joel D.; et al. (2017)	Research Article	Survey & Consensus study	Sedentary behavior is all activities that require energy 1.5 metabolic equivalents (METs) performed while lying or sitting and carried out in a conscious state.
Healthy movement behaviours in children and youth during the COVID-19	Mitra, Raktim; Moore, Sarah A.; Gillespie, Meredith; et al. (2020)	Research Article	Cross-sectional	<ul style="list-style-type: none"> • Children from high-income families engage in more outdoor physical activity than children from lower-income families

pandemic: Exploring the role of the neighbourhood environment				<ul style="list-style-type: none"> • Children and adolescents who live at home do more physical activity outdoors than in apartments.
Effect of COVID-19 lockdown on sleep behavior and screen exposure time : an observational study among Indian school children	Dutta, Koumi; Mukherjee, Ruchira; Sen, Devashish; Sahu, Subhashis. (2020)	Research Article	Cross-sectional	<ul style="list-style-type: none"> • There is no change in the percentage of screen exposure compared to before the lockdown. • The highest screen exposure time was during the lockdown than during the working day before the lockdown.
Impact of the COVID-19 Pandemic on Seasonal Variations in Childhood and Adolescent Growth: Experience of Pediatric Endocrine Clinics	Han, Jin-Ah Chung, Yae-Eun; Chung, In-Hyuk; et al. (2021)	Research Article	Cohort studies	<ul style="list-style-type: none"> • BMI has increased from before the pandemic (-0.05) to the pandemic (0.16). • The increase in BMI during the COVID-19 pandemic has an effect from certain seasons, primarily during school holidays, resulting in a decrease in physical activity, an increase in a sedentary life, and access to unhealthy food.
Stress and Obesity	Tomiyama, A Janet. (2019)	Review Article	-	<ul style="list-style-type: none"> • The ability to self-regulate in eating and physical activity is strongly associated with obesity. • Stress activates the HPA axis and stimulates cortisol to increase appetite and deposit fat.
Obesity: Pathophysiology and Management	Gadde, Kishore M.; Martin, Corby K.; Berthoud, Hans Rudolf; et. al. (2018)	Review Article	-	<ul style="list-style-type: none"> • Obesity occurs due to an imbalance between energy intake and expenditure. • There are environmental factors that help increase the risk of obesity.
The pathogenesis of obesity	Oussaada, Sabrina M.; van Galen, Katy A.; Cooman, Melody I.; et. al. (2018)	Review Article	-	<ul style="list-style-type: none"> • Obesity is caused by many factors, ranging from the instability of energy processing to hormonal and systemic metabolic regulation • The energy expenditure of obese people is higher than people with normal BMI.
Leptin, obesity, and leptin resistance: where are we 25 years later?	Izquierdo, Andrea G.; Crujeiras, Ana B.; Casanueva, Felipe F.; Carreira, Marcos C. (2019)	Review Article	-	<ul style="list-style-type: none"> • Leptin plays a role in body regulation to regulate body weight • If there is leptin resistance in the blood-brain barrier, it can cause obesity

Konsentrasi dan Motivasi Belajar Siswa Terhadap Pembelajaran Online Selama Masa Pandemi Covid-19	Winata, I Komang. (2021)	Research Article	Cross-sectional	<ul style="list-style-type: none"> • The average concentration level in the low category • The average level of student motivation is in the medium category.
Motivasi Belajar Siswa SMA pada Pembelajaran Daring di Masa Pandemi Covid-19	Cahyani, Adhetya; Listiana, Iin Diah; Larasati, Sari Puteri Deta. (2020)	Research Article	Cross-sectional	Learning motivation for students who take online or online learning during the Covid-19 virus pandemic has decreased with a significance value of 0.000.
Dampak Pembelajaran Dari Masa Pandemi Covid-19 terhadap Motivasi Belajar Siswa SMP di Kota Bukittinggi	Robandi, Dedi Mudjiran (2020)	Research Article	Cross-sectional	<ul style="list-style-type: none"> • Students learn motivation in online-based learning; 11% are in the very high category, 38% are in the moderate category, 27% are in the medium motivation category, and 24% are in the low motivation category. • Achievement of learning motivation results has not been maximized
Alcohol Consumption and Obesity: An Update	Traversy, Gregory; Chaput, Jean Philippe (2015)	Review Article	-	<ul style="list-style-type: none"> • Calories in alcohol are higher than carbohydrates and other sugar derivatives, with a value of 7 kcal/g. • Consuming alcohol can also contribute to weight gain by affecting the hormone leptin so that appetite increases and food consumption also increases.
Tingkat Stres pada Siswa-Siswi Sekolah Dasar dalam Menjalankan Proses Belajar di Rumah Selama Pandemi Covid-19	Palupi, Tri Nathalia (2020)	Research Article	Cross-sectional	<ul style="list-style-type: none"> • The stress level of primary school students in later years is higher than in the lower years. • The average score for the large class students is 31.79, and for the small class is 29.67.
Fenomena Stress dan Pembiasaan Belajar Daring Dimasa Pandemi Covid-19	Jatira, Yadi Neviyarni, S (2021)	Research Article	Studi kualitatif	<ul style="list-style-type: none"> • Higher-grade students (SMA/SMK/MA) feel stress while undergoing online school. • The online school makes students feel lazy and more bored in receiving knowledge because there are disturbances in learning.
Depresi, ansietas dan stres serta hubungannya dengan obesitas pada remaja	Masdar, Huriatul; Saputri, Pragita Ayu; Rosdiana, Dani; et.al. (2016)	Research Article	Cross-sectional	<ul style="list-style-type: none"> • There is a significant relationship between psychological aspects and nutritional status in adolescents, with a p-value of 0.003. • Stress and depression are psychological aspects that dominate the population

Hubungan stres dengan obesitas pada siswa-siswi kelas XII di SMAN 3 Batam tahun 2018

Istramilda (2019)

Research Article Cross-sectional

that affect nutritional status, with the results of 82.6% (depression) and 65.2% (stress)

The relationship between stress and obesity in large-grade students is significant, with a p-value of 0.022.

DISCUSSION

1. Definition and Risk Factors of a Sedentary Lifestyle

A sedentary lifestyle has been defined as any activity consciously carried out while lying down or sitting and is worth less than 1.5 Metabolic equivalents (METs) ⁵. One example of a sedentary lifestyle is playing video games, sitting watching television, online learning using devices such as gadgets or laptops, and

others that do not require extensive movement.

This lifestyle arguably has a detrimental effect on health because it may increase mortality risk and other diseases. The risk of diseases can occur, such as diabetes mellitus, hypertension, dyslipidemia, obesity, and cancer. In addition, it may also cause psychological health issues such as depression and may also cause disturbances in cognitive function ⁶.

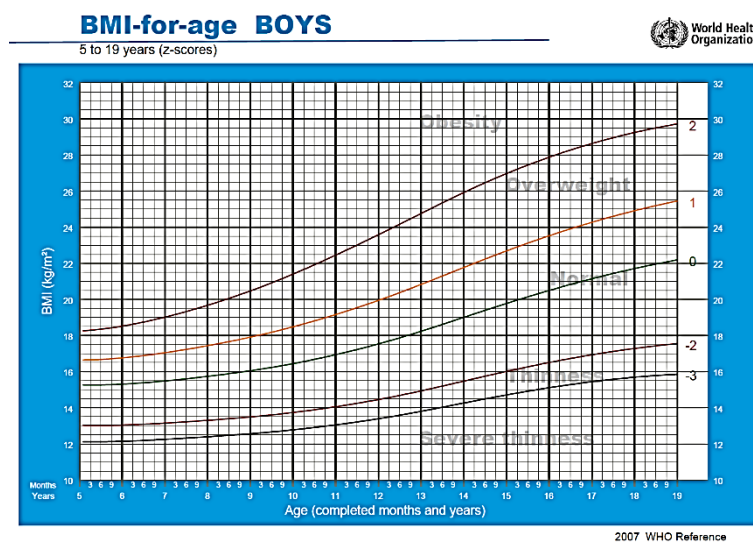


Figure 2. BMI for age on boys (WHO, 2021).

2. Obesity and Pathophysiology of Obesity

WHO describes obesity as an excessive or abnormal accumulation of fat in the body.

Obesity is identified by Body Mass Index (BMI), and WHO has classified obesity based on age ranging from children under five years,

children between the ages of 5-19 years, and adults. Children aged 5-19 years are said to be obese if the BMI calculation falls and passes the standard deviation (SD)+2⁷. Meanwhile, adults use the WHO-based BMI calculation with Asian race where the overweight is experienced if the BMI is above 23 to 24.9 and obese if the BMI is above 25⁸. To calculate BMI, the formula used is body weight in kilograms (kg) divided by height in centimeters (cm) squared⁸.

contributing factors, one of which is the instabilities between energy intake and energy expenditures. The energy that has been obtained through food that has been consumed or from processing fat will be used to maintain homeostasis, growth of body cells, and also to perform physical activities. If the energy expended does not exceed the energy obtained, it will be stored in the form of fat and may lead to obesity over time⁹.

The cause of obesity is not only caused by a single primary factor but caused by many

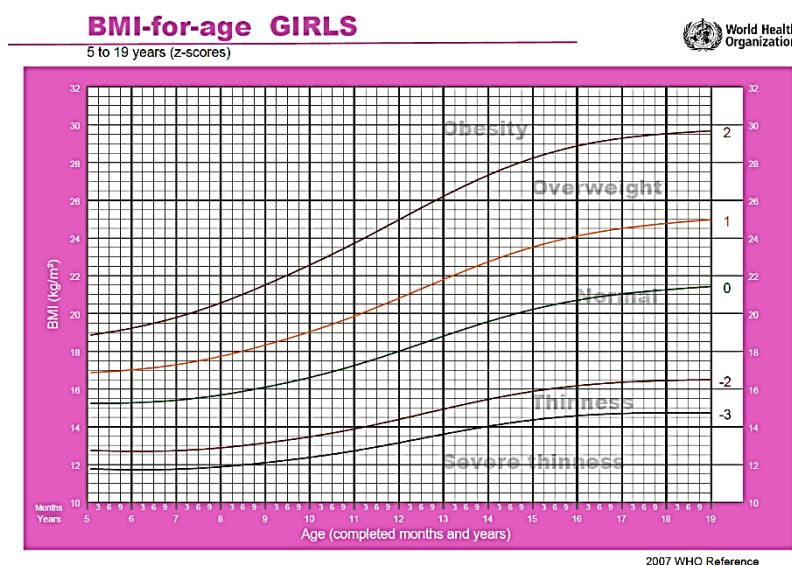


Figure 3. BMI for age on girls (WHO, 2021)

Table 2. IMT for Adults in Asia (WHO, 2000)

Classification	BMI (kg/m ²)	Risk of co-morbidities
Underweight	<18.5	Low (but oincreased risk of other clinical problem)
Normal weight	18.5 – 22.9	Average
Overweight	>=23	
At risk	23 – 24.9	Increased
Obese I	25 – 29.9	Moderate
Obese II	>=30	Severe

The hypothalamus is the center of information on whether the energy needed by the body is fulfilled or not with the help of hormones such as Leptin, ghrelin, and insulin. This hormone will be received by Agouti-Related Peptide (AGRP) and Proopiomelanocortin (POMC) neurons in the hypothalamus¹⁰. In comparison, Leptin is a hormone made by the body's adipose cells which later, when read by POMC neurons, means to dampen humans not to consume food anymore and increase energy burning. In obesity, where adipose cells are more numerous than in normal humans, leptin production also increases, but this Leptin will become resistant to the blood-brain barrier so that the amount in the brain reaches the hypothalamus is reduced. The hypothalamus will also assume that the body still needs a source of energy, so obese people usually feel hungry faster and consume more food¹¹.

There is a relationship between obesity and asthma, with many findings that obesity increases the prevalence of asthma, and when it occurs, both increase the risk of metabolic disease. Hypertension is also experienced in obese children and incredibly obese adolescents. They have twice the tendency to develop hypertension¹². Therefore, it is necessary to handle it from all parties starting from the government as well as teachers and guardians of students, to reduce the prevalence of obesity.

3. The Phenomenon of a Sedentary Lifestyle that Increasing Risk of Obesity

During the COVID-19 pandemic, students were imposed by the government to conduct online school by using laptops or other online devices. The online school creates an enabling environment for students to gain weight

because of sedentary behavior. This can exacerbate the risk of the childhood obesity epidemic in the future, and if obesity in children is not treated, it will persist until adulthood¹³.

3.1. Obesogenic factors Effect from Online School

Obesogenic factors are conditions that support an increase in the risk of obesity. During this pandemic, one of the most influential obesogenic habits is sedentary habits, increased screen viewing time, poor diet, and irregular sleep patterns. These obesogenic habits occur during long-distance learning, where the effect is decreased cardiorespiratory fitness levels¹³. One of the unique obesogenic factors is smoking, from a cohort study in Ireland showed that children whose mothers were exposed to cigarettes or smoked during pregnancy were one of the factors in increasing body weight and obesity in children aged 3 and 5 years compared to mothers who did not smoke. Thus, if the child is in the care of a smoking mother, it increases the prevalence of the child being overweight and obese¹⁴.

Judging from studies during this pandemic, due to online school, moderate and high physical activities such as walking or running outside the home are limited so that activities are carried out indoors, and the quantity of such is reduced. This is experienced by students of all kinds, from elementary to college students, both in Indonesia and other countries. As researched by¹⁵ and¹⁶, it is shown that Indonesian students' sedentary activity levels increased dramatically during online school. It was found that teenagers aged 18-23 years have an increasing level of sedentary activity during the lockdown by about 20.16%

of the time spent sitting still and not doing any physical activity¹⁵. Another research also admitted that the results showed that of the 187 samples of junior high school students, it was known that 159 samples carried out sedentary activities in the high category. Although there aren't any significant results from this study, it is still shown that there is an actual increase in sedentary lifestyles¹⁶. Furthermore, if the said lifestyle is prolonged, it will raise other kinds of drawbacks and risks. Henceforth, such issues need to be addressed to the public as an additional health awareness.

In regards to foreign research, many studies such as^{6,28} and other researchers regarding online school also concluded that the effect of online school on increased sedentary activity. Canadian college students reduced physical activity during the pandemic and were replaced by sedentary habits¹⁷. Children aged 5 to 13 years in America by their parents reported that most of their children engaged in increased sedentary activities during the early COVID-19 pandemic¹⁸.

The student's effect on online school results in unsatisfactory results because the knowledge received by students is less than optimal, and learning motivation is reduced. The average student motivation was in the moderate or sufficient category, and the level of concentration in learning was in the low category^{19, 20,21}. Therefore, if the pandemic and long-distance learning continue, students' health and knowledge will be even worse.

For college students who undergo long-distance learning during the COVID-19 pandemic, this affects decreasing physical activity and increasing sedentary habits and does not affect calorie and nutritional consumption.

However, the quality of food consumed, such as fruits, meat, vegetables, nuts, and seeds, decreased compared to before the pandemic, while alcohol consumption increased¹⁷. Consuming alcohol may also play a role in weight gain because the number of calories from alcohol itself is higher than carbohydrates or other sugar derivatives. Not only that, but alcohol also affects the satiety-hunger regulating hormone, namely the hormone leptin, so that appetite increases and eating patterns change²². The diet during the pandemic, especially in the United States, has also changed regarding food security. Children who come from low-income families during the pandemic do not get lunch to fulfill their nutrition due to the closed school canteen, while families, in general, prepare for the lockdown by storing food so that there is no shortage, but the choice of stored food is their favorite food so that children are also tempted to consume it faster²³.

3.2. Sociodemographic Factors of Sedentary Behavior due to pandemic

A country also undeniably consists of layers of different economic statuses. Some come from families with high, middle, or low economic status. From these various economic class statuses, the habits and behavior of each family are also different, especially during this pandemic. From several countries surveyed, such as Brazil, Chile, Colombia, Spain, and Italy, Brazil, followed by Chile, became the country with the highest prevalence of adolescents whose routines were stagnant or did not do many physical activities during the isolation²⁴. In Croatia, children in urban areas had a higher level of physical activity than those in rural areas. However, there was a

decrease in physical activity among adolescents in urban rather than rural areas due to social distancing implemented in cities.

Moreover, adolescents in urban and rural areas experience declining physical activities²⁵. In Bangladesh and India, students also experienced a significant decrease in physical activity compared to other age groups due to online activities such as attending school. Especially if you live in an urban area and as a student from a high-income family, there are additional risk factors for developing obesogenic sedentary habits during the COVID-19 pandemic²⁶. Not only from the family background but also differences in children's behavior in physical activities. Children who have space to play at home tend to have less significant reductions in physical activity, sleep quality and less increase in screen viewing time compared to children who live in apartments²⁷.

Differences in places of residence will also have a different kinds of activities. A study in Canada carried out grouping, namely cluster 1, which had an increase in outdoor activity, and cluster 2, which experienced a decrease in outdoor activity. The results are that the majority of children and adolescents in Canada, as much as 56%, show the effects of the COVID-19 pandemic, which shows decreased outdoor activities accompanied by increased screen viewing time and other sedentary actions. One factor influencing cluster 1 is age. Children are more towards the cluster with increasing physical activity than teenagers, especially children and adolescents who live in a house rather than in an apartment. In addition, living in a dense area and having access to a park of less than 1 km increases the chance of being in cluster 1 (increased physical activity). In terms

of family income, families with high incomes can also be categorized in the increased physical activity cluster²⁸.

Indonesia itself appears to have increased sedentary habits during the lockdown among teenagers. Around 20.16% of the time was spent in sedentary activities compared to before the pandemic. Gender did not affect the difference in time spent in sedentary activities¹⁵. Indonesian researchers also conducted their first study to see the differences between residence and obesity rates in 33 provinces throughout Indonesia. This study was conducted before the pandemic, but the results show a correlation between differences in residence and the prevalence of obesity based on the location of residence. As a result, there are differences between urban and rural areas. Approximately a 17% chance of obesity in children and adolescents who live in urban areas rather than rural areas, with a value of 13.5%. Factors that influence one of them are eating patterns and sedentary behavior. Children living in urban areas are more likely to engage in sedentary behavior than those in rural areas²⁹.

Even children who experience endocrine problems during this pandemic have gained weight. This cohort study was conducted by³⁰, and data were collected on BMI 4 times during January 2019 on D1, July 2019 on D2, January 2020 on D3, and July 2020 on D4. This found that girls and boys who underwent therapy showed in figure 4 an increasing BMI during the onset of COVID-19 cases (D3) until the six months pandemic lasted (D4). From this study, it can be concluded that normal children and children with a history of disease both experienced weight gain due to the pandemic.

From the studies obtained, sedentary behavior is considered to be the biggest contributor to obesity, where there is no significant difference in different places of residence. This is because COVID-19 has caused all countries to conduct quarantine so that activities outside the home are not allowed, and trigger increased sedentary activities.

3.3. Student's Stress Factors from Online School

Online school also drives students to experience stress. Students felt stressed in a study with a population of elementary school (elementary) and high school (high school) children by 31 and 32. High school students admit to feeling bored and lazy because of disturbances in learning, while in early elementary school children, the stress level is lower than in higher-grade students. If this stress condition continues, it might increase the prevalence of overweight and obesity. In the research conducted by³³ and³⁴ regarding the correlation between stress and obesity, it was

also found that there was a significant relationship. The results obtained by Masdar are that stress and depression in high school students increase the prevalence of obesity by about 0.219 times. Isramilda also found that of the high school students being studied, the result shows a correlation between stress and obesity, so it was necessary to deal with stress on students who are practicing online school to keep these obesogenic factors away.

4. Strengths and limitations of a literature review writing

The advantages of this literature review are more explanations for an online schools for Indonesian students, their effects on obesogenic factors, and their correlation to obesity prevalence are explained. However, this review is not free from shortcomings, starting from the lack of research on how these obesogenic factors can influence the process of overweight and obesity. No studies have used the Cohort method with the Indonesian student population to support this review.

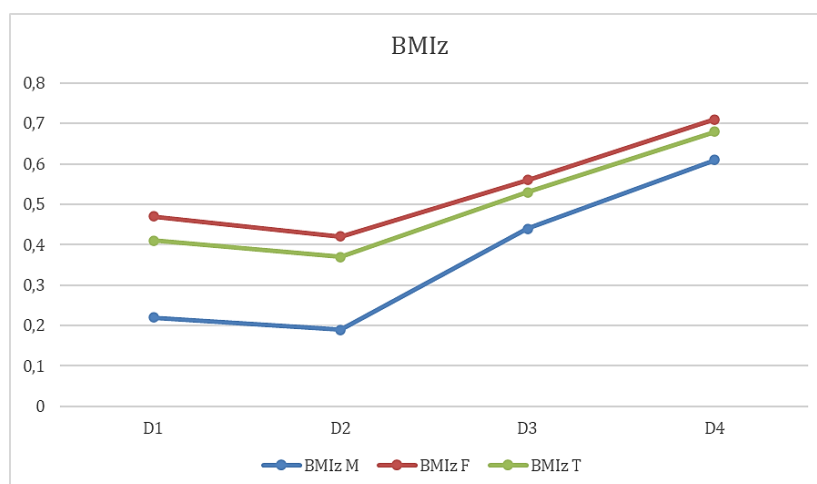


Figure 4. Z-score BMI (BMIz) comparison from 4 times visits (D1-D4),³⁰.

5. Recommendations for the further literature review writing

Hopefully, this review can be used as a basis for conducting further research to see whether it is true that these intrinsic and extrinsic factors influence the occurrence of obesity in the future or not. Further research is also needed using the cohort method with a comparison of conventional school time to hybrid learning, namely a combination of online learning with face-to-face learning, to assess whether there are changes in activity patterns and the risk of obesity in the future.

CONCLUSION

A sedentary lifestyle is all activities carried out in a lying or sitting position, one example of which is watching television for a long time. This lifestyle has an adverse effect where the risk of diseases such as obesity, diabetes, dyslipidemia, and others increases mortality. The phenomenon during the COVID-19

pandemic is the increase in sedentary lifestyles for school students to college students. This is an obesogenic factor that reduces physical activity and increases sedentary activity. In addition, obesogenic factors such as poor diet, sociodemographics, and stress also occur during online school.

Sociodemographic as in the environment of the students living in urban and rural areas, there is a decrease in physical activity. This was due to the lockdown that was being carried out. Not only in Indonesia but this decline also occurred in many countries. Especially in students who live in urban areas and come from high-income families, there is an increase in a sedentary lifestyle compared to other groups. Its effect on students and college students is a decline in motivation and rising stress levels, thereby reducing the ability to learn. Therefore, it is necessary to deal with all parties, from the government to parents and guardians, to help reduce this.

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