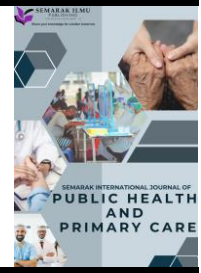




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# Obesity, Eating Habits, and Physical Activity before and during Covid-19 Pandemic among University Lecturers

Khoo Tze Sean<sup>1</sup>, Nur Aqliliriana Zainuddin<sup>1,\*</sup>, Chew Wai Hoong<sup>1</sup>

<sup>1</sup> M.Kandiah Faculty of Medicine & Health Sciences, Universiti Tunku Abdul Rahman, Bdr. Sg.Long, 43000 Kajang, Selangor, Malaysia

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### ABSTRACT

The COVID-19 pandemic has caused significant changes to the lives of individuals around the world. Malaysia has implemented restrictions as response to the pandemic and the effects are felt by all parties, including lecturers. This study aims to investigate the impact of the lockdown on the prevalence of obesity, body weight, physical activity and eating habits of university lecturers in Malaysia. A self-reported questionnaire was distributed to lecturers of different universities in Malaysia. The questionnaire involves 2 main sections. The first section records the participants' physical activity level before and during the pandemic while the second section records the changes in eating habits. 323 eligible responses were analyzed, 13.9% of participants were obese and 27.6 were overweight before the pandemic. Significant weight change was recorded as the mean weight increased by  $0.57 \pm 0.56$  kg during the pandemic. Physical activity level decreased from  $1.67 \pm 0.17$  to  $1.60 \pm 0.17$  and changes in eating habits were also observed. Weight change was significantly associated with physical activity, total food intake, sweetened products and confectionery intake, salty snacks, fast food and sweet drinks intake. Prevalence of obesity increased slightly but changes were not significant. The prevalence of obesity is worrying among university lecturers in Malaysia. Interventions should be implemented to improve the current situation. Significant weight gain and PAL decrease were recorded during the COVID-19 pandemic. Weight gain was associated with the decrease in physical activity and the increased consumption of unhealthy foods.

## 1. Introduction

Obesity is a condition where an excessive amount of fat is accumulated in a person's body. Based on the World Health Organisation, a body mass index (BMI) of over 25 is classified as overweight while a BMI of over 30 is considered obese. Obesity increases the risk of cardiac failure as it impacts cardiovascular function through several mechanisms [1]. This includes metabolic factors,

\* Corresponding author.

E-mail address: [riana290191@gmail.com](mailto:riana290191@gmail.com)

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inflammation, oxidative stress, endothelial dysfunction, and sympathetic activation HH. Data showed that the risk of cardiac failure doubled when class 1 obesity was increased to class 3 obesity [2]. In Southeast Asia, Malaysia has the highest prevalence of obesity among adults. In the 2019 National Health and Morbidity Survey, the prevalence of obesity among Malaysian adults was 19.7%, a huge surge from 4.4% in 2011 [3]. Furthermore, according to a Ministry of Health study, the prevalence of overweight and obese among Malaysian adults rose to 54.2% in 2020 from 50.1% in 2019.

On March 11, 2020, the novel coronavirus (COVID-19) outbreak was declared a global pandemic by the World Health Organization (WHO) [4]. As of late June 2022, there have been more than 536 million confirmed cases and over 6.3 million deaths worldwide. To slow down the spread of the virus, Malaysia has imposed many restrictions, including movement control orders and also lockdowns. This has led to many lifestyle changes among citizens, for example, outdoor activities have dramatically decreased, and working from home has become the norm. Furthermore, an Australian study showed a significant increase in eating disorders in the general population which includes binge eating [5]. These factors will likely contribute to the increase in weight gain among people across the country, including university lecturers.

Based on current studies, Malaysian populations seem to be adhering to similar patterns of change in physical activity. According to Salway *et al.*, [6], during the Movement Control Order, physical activity reduced by an average of 6.7 hours/week when compared to 2018. The prevalence of inactive adults also increased to 34%, a 14% increase from 2018 [6]. Furthermore, a study targeting the B40 population also indicated the same pattern. Subjects responded that they became physically inactive with more time spent in sedentary activities such as sitting in front of screens. They also reported that their time spent on exercise decreased significantly [7].

In a study done by Alhousseini & Alqahtani [8], 85.6% of respondents reported eating home cooked-meals as compared to only 35.6% before the COVID-19 outbreak. A Canadian and Italian study also matched this pattern of findings as subjects reported an increase in homemade meals consumption during lockdown [9,10]. Subjects from the Italian study also reported increased snacking during the pandemic [10]. Besides, Scarmozzino & Visioli [11] reported that a significant portion of their subjects reported an increased consumption of comfort food such as desserts and salty snacks

While obesity is proven to be prevalent in all sorts of different demographics, not many studies have been done on university lecturers. Additionally, although studies show that people with higher education have a lower risk of being obese, the prevalence of obesity is still high in such populations. Furthermore, the current trend shows that the COVID-19 pandemic has led to significant weight gain in many populations, it is unclear whether university lecturers display such patterns. Therefore, this study aims to bridge this gap as such data would be useful in future relevant studies. This study aims to determine the correlation between the prevalence of obesity among Malaysian university lecturers before and during the COVID-19 pandemic. Additionally, it seeks to explore the correlation between the level of physical activity among these lecturers during the same periods. Furthermore, the research investigates the correlation between their eating habits before and during the COVID-19 pandemic.

## 2. Methodology

This study is a cross-sectional study, which is most relevant when it comes to assessing the prevalence of diseases or traits [12]. With limited resources and time, this study design provides an advantage as it is quick, easy, and inexpensive to conduct [13]. After sample size calculation, total number of participants needed for this study is 382.

The inclusion criteria for this study include lecturers who are currently employed at a Malaysian university. Limiting the study to lecturers from Malaysian universities ensures ease of questionnaire distribution and follow-up. For the exclusion criteria, individuals with physical disabilities or those who are paralyzed are excluded from the study. This exclusion is based on the fact that such conditions can result in altered body compositions, which may lead to an underestimation of body fat, as noted by Wingo *et al.*, [14].

### 2.1 Instrument

This study uses a self-administered questionnaire as the primary data collection instrument. The questionnaire is divided into three major sections:

- i. Part 1 gathers demographic information, including age, gender, ethnicity, height, pre-COVID-19 weight, and current weight.
- ii. Part 2 consists of four questions designed to assess the respondents' level of physical activity. These questions are adapted from the Johansson and Westerterp questionnaire, which measures changes in physical activity before and during the COVID-19 pandemic [15]. This questionnaire has been validated using the double-labeled water method. To facilitate ease of response, Part 2 employs a 5-point Likert scale.
- iii. Part 3 comprises five questions aimed at evaluating the respondents' eating habits. This section is based on a questionnaire from a Polish study with similar objectives [16]. No modifications have been made to Part 3, and permission to use this questionnaire will be sought from the original researchers via email.

Questions in part 2 were taken from a Johansson and Westerterp questionnaire [15]. The questionnaire aims to measure the change in activity before and during the COVID-19 pandemic, and it has been validated with the double-labeled water method [15]. Questions in part 2 are based on the 5-point Likert scale to ease the answering process. The part 3 questionnaire is taken from a Polish study which had similar aims to this study and is used to assess the respondents' change in eating habits [16]. No modifications were made in part 3. An email was sent to the researchers to request permission for the use of their questionnaire.

The questionnaire was assessed by experts to ensure its face validity. The lecturers will evaluate the questionnaire through a validation form and a pilot study will be done on 12 university lecturers [17-19]. A pilot study is crucial as it identifies the flaws and potential downfalls in the research instruments and protocols before implementing them in the actual study [20]. In addition, experts are required to verify the questionnaire's face and validity to ensure that the questionnaire's items are related to the objectives and to identify areas of improvement [21].

To test for the questionnaire's reliability, an internal consistency test (done through Cronbach's alpha coefficient) and a stability test (done through Spearman-Brown coefficient) will be carried out. This process aims to ensure that the data collected by the questionnaire are accurate and consistent, which are important criteria of a high-quality assessment instrument [22].

### 3. Results

Table 1 presents the demographic data of the participants. This includes the age groups, gender, and ethnicity of the participants. A total of 360 responses were collected through the distribution of the online questionnaire via platforms such as WhatsApp, Instagram, and Microsoft Teams. After

screening through the data, only 323 of them were eligible for this study. Several participants were not university lecturers while some did not complete the questionnaire. This study achieved 76.9% of the intended number of eligible participants (420).

Table 1  
 Demographic data

Demographic data	Frequency (%)
<b>N</b>	323 (100)
<b>Age Groups</b>	
23-39	176 (54.5)
40-59	138 (42.7)
60-70	9 (2.8)
<b>Gender</b>	
Male	114 (35.3)
Female	209 (64.7)
<b>Race/Ethnicity</b>	
Malay	103 (31.9)
Chinese	164 (82.7)
Indian	42 (95.7)
Others	14 (4.3)

Table 2 shows the results for the weight and physical activity level changes of the participants. Before the pandemic, the mean weight of the participants was  $66.17 \pm 16.99$  kg. During the pandemic, this value increased to  $66.74 \pm 17.55$  kg which shows an average increase of  $0.57 \pm 0.56$  kg. There was no change in the median weight. Furthermore, the participant's physical activity level decreased from  $1.67 \pm 0.17$  to  $1.60 \pm 0.17$ , a difference of  $0.07 \pm 0$ . The median PAL changed from 1.70 to 1.60. After running a Wilcoxon Test, weight changes and PAL changes were statistically significant ( $p < 0.05$ ).

Table 2  
 Changes in weight and physical activity level during the pandemic

Phase	Weight (kg)	PAL
	Mean $\pm$ SD	Mean $\pm$ SD
	Median	Median
	Min-Max	Min-Max
Before Pandemic	$66.17 \pm 16.99$ 63.0 38-155	$1.67 \pm 0.17$ 1.70 1.40-2.30
During Pandemic	$66.74 \pm 17.55$ 63.0 40-150	$1.60 \pm 0.17$ 1.60 1.40-2.30
Significance*	$p=0.044$	$p<0.001$

Table 3 shows the changes in eating habits of the participants during the pandemic. For total food consumption, 4.3% (n=14) of individuals declared a significant decrease while 16.1% (n=52) declared a slight decrease. 40.6% (n=131) declared no change, 32.8% (n=106) reported a slight increase, and 6.2% (n=20) declared a significant increase in total food consumption. For sweetened and confectionary products, 22.6% (n=73) reported a decrease in consumption whereas 9.9% (n=32) and 12.7% (n=41) declared a significant decrease and slight decrease respectively. 47.1% (n=152) reported no change in consumption, 26% (n=84) reported a slight increase in consumption and 4.3% (n=14)

reported a significant increase in consumption. A decrease in fast food, salty snacks, and sweet drinks consumption was reported by 21.1% (n=68) where 9.6% (n=31) and 11.5% (n=37) reported a significant decrease and slight decrease respectively. 44.6% (n=144) reported no consumption change while 34.4% (n=111) reported increased consumption where 30.7% (n=99) declared a slight increase and 3.7% (n=12) reported a significant increase. For alcohol consumption, 81.7% (n=264) reported no change while only 3.6% (n=35) reported a decrease and only 7.5% (n=24) reported an increase. For the final category which is delivery meals and take away meals. More than half of the participants reported and increase in frequency where 36.2% (n=117) reported a slight increase 23.8% (n=77) reported a significant increase. 22.6% (n=73) of participants reported no change, 9.3% (n=30) reported a slight decrease and 8% (n=26) reported a significant decrease.

Table 3  
 Changes in eating habits during the pandemic (General)

Food Categories	Frequency (%)				
	Overall	Sweetened & Confectionary Products	Salty snacks, fast food and sweet drinks	Alcohol	Delivery of meals and take-away meals
N	323 (100)	323 (100)	323 (100)	323 (100)	323 (100)
Eating Habits Change					
Significantly decreased	14 (4.3)	32 (9.9)	31 (9.6)	26 (8)	26 (8)
Slightly decrease	52 (16.1)	41 (12.7)	37 (11.5)	9 (2.8)	30 (9.3)
Did not change	131 (40.6)	152 (47.1)	144 (44.6)	264 (81.7)	73 (22.6)
Slightly increased	106 (32.8)	84 (26.0)	99 (30.7)	18 (5.6)	117 (36.2)
Significantly increased	20 (6.2)	14 (4.3)	12 (3.7)	6 (1.9)	77 (23.8)

#### 4. Discussions

There are currently no studies on the prevalence of obesity among Malaysian university lecturers. This study analyzed responses from 323 Malaysian university lecturers. The data showed that 27.6% of participants were overweight and 13.9% were obese before the pandemic. These results are similar to findings by Cheong *et al.*, [23], who reported 16.1% obesity among staff at a Malaysian public university, and Rampal *et al.*, [24], who found 31.1% overweight and 11.8% obese among staff at University Putra Malaysia.

During the pandemic, the number of overweight participants dropped to 24.8% while the prevalence of obesity increased to 15.2%. The increase in the prevalence of obesity is within expectations, as many studies done on different populations have shown similar trends [25,26]. While the decrease in overweight participants might seem like an anomaly, there are a few possible explanations. As this study was conducted after the peak of the pandemic, it is plausible that participants lost the weight that they gained. In a study focusing on the behaviors following the lockdown and reopening, physical activity increased significantly as participants walked and moved around more [27]. Another explanation might be that some of the weight loss experienced by some participants is not from fat loss, but a loss in muscle mass due to lower physical activity levels. Westerterp [28] found that muscle mass starts to reduce by reducing physical activity levels in a few days. Jespersen *et al.*, [29] report that muscle mass can start to lose as quickly as 10 days after detraining.

Before the pandemic, the mean physical activity level of the participants before the pandemic was  $1.67 \pm 0.17$ . During the pandemic, this value decreased by 0.07 and dropped to  $1.60 \pm 0.17$ . This finding has been consistent with other similar studies around the world. Lopez-Bueno *et al.*, [30] reported that participants reduced their weekly physical activity by approximately 20 percent. In an Australian study, the researchers found that during the pandemic, 30% less participants achieved sufficient levels of activity when compared with the previous two years [31]. Furthermore, Puccinelli *et al.*, [32] also found that physical activity level among Brazilians were higher prior to the pandemic. This phenomenon is within expectations as many restrictions were imposed to stop the spread of the COVID-19 virus. Due to the restrictions, the lifestyles of many people were drastically altered as the majority of people were forced to stay in their homes.

Another reason less physical activity level is due to remote working, or working from home, has significantly reduced physical activity levels. A US survey during the COVID-19 pandemic found that 35.2% of people who worked outside the home switched to remote work [33]. Those in professional jobs were more likely to make this switch. Malaysia implemented similar measures, requiring non-essential work, including education, to be conducted online. This shift has resulted in more people spending extended periods sitting, as noted by Bailey *et al.*, [34], who reported an increase in prolonged sitting from 29% to 41% during the pandemic. Sadarangani *et al.*, [35] found that those who were active before the pandemic experienced the greatest increase in sitting time. Similarly, a Japanese study found that working from home led to more sitting time and a direct link between remote work days and increased sitting time [36].

Another finding in this study shows a positive relationship between changes in total food consumption and weight change. This is consistent with other studies. For instance, a cross-sectional study found that 65% of Polish women who gained weight during the pandemic increased their food intake [37]. Conversely, Al-Musharaf *et al.*, [38] reported that 57% of women who lost weight during quarantine reduced their food intake. However, weight gain still requires a calorie surplus. If the increased food intake consists mainly of satiety-inducing foods like vegetables and fruits, weight loss may occur. A cohort study also found that weight change was inversely related to the intake of vegetables, whole grains, fruits, nuts, and yogurt.

Increased consumption of sweetened and confectionery products is linked to weight gain. Similar studies support this. For example, German students during the COVID-19 pandemic showed that higher intake of sweets and cakes was a major predictor of weight gain [39]. Mazza *et al.*, [40] also found that people who gained weight during lockdown significantly increased their consumption of sugary items like chocolate and ice cream. Weight gain is also positively associated with increased consumption of salty snacks, fast food, and sugary drinks. One study found that weight gain during the pandemic was linked to higher intake of these items. Eating fried and junk food three or more times a week was associated with a higher risk of weight gain [41]. Snacks, fast food, and sugary drinks are calorie-dense and high in sugar and fat compared to healthier options like fruits and vegetables. An average fast-food meal contains around 1400 kcal, and frequent consumption has been linked to higher total energy intake [42].

The current study has several limitations. First, as a cross-sectional study, it cannot determine cause-and-effect relationships. The reliance on participant memory in the questionnaire introduces the risk of recall bias, potentially affecting the accuracy of the results. Additionally, the use of convenience sampling may lead to sampling bias, as not all individuals had an equal chance to participate. Recruiting lecturers through email yielded a low response rate (around 0.02%), resulting in fewer participants than planned. Lastly, since most participants are Malaysian, the findings may not be applicable to lecturers in other regions. Future studies should consider using a prospective design for more conclusive results. To reduce recall bias, researchers should conduct actual

measurements rather than relying on self-reported data. Physical interviews are preferred over online questionnaires to ensure participants fully understand the questions, thus improving accuracy. Expanding the participant pool to include lecturers from other countries would enhance comparability and strengthen conclusions. Additionally, conducting studies over a longer period could address the limitations encountered in this research and improve overall quality.

## 5. Conclusions

In conclusion, the prevalence of obesity is quite high among Malaysian university lecturers even before the COVID-19 pandemic. During the pandemic, there was a slight increase in number of obese participants, but the changes were not statistically significant. However, results showed that during the pandemic, there was significant weight gain among the participants. A significant decrease in physical activity level was also recorded. Weight was positively related with the consumption of total food, sweetened and confectionary products, salty snacks, fast food and sweet drinks. No significant association was found between weight and alcohol intake or delivery/take away meal consumption. With the available information, individuals are advised to perform enough exercise and adhere to a healthier diet to prevent weight gain and to lower the risk of obesity. Although the mean weight during the pandemic was significantly higher, quite a number of participants maintained their weight or even lost weight. Further studies should be conducted to fully understand this phenomenon. Also, cohort studies and randomized controlled trials are highly recommended as they provide stronger evidence to determine causability between variables. Lastly, future studies should also be conducted on a wider scale that involves participants from other countries to enhance the applicability of research findings.

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## References

- [1] Aryee, Ebenezer K., Bige Ozkan, and Chiadi E. Ndumele. "Heart failure and obesity: the latest pandemic." *Progress in Cardiovascular Diseases* 78 (2023): 43-48. <https://doi.org/10.1016/j.pcad.2023.05.003>
- [2] Kenchaiah, Satish, Jane C. Evans, Daniel Levy, Peter WF Wilson, Emelia J. Benjamin, Martin G. Larson, William B. Kannel, and Ramachandran S. Vasan. "Obesity and the risk of heart failure." *New England Journal of Medicine* 347, no. 5 (2002): 305-313. <https://doi.org/10.1056/NEJMoa020245>
- [3] Mohd-Sidik, Sherina, Rampal Lekhraj, and Chai Nien Foo. "Prevalence, associated factors and psychological determinants of obesity among adults in Selangor, Malaysia." *International journal of environmental research and public health* 18, no. 3 (2021): 868. <https://doi.org/10.3390/ijerph18030868>
- [4] Cucinotta, Domenico, and Maurizio Vanelli. "WHO declares COVID-19 a pandemic." *Acta bio medica: Atenei parmensis* 91, no. 1 (2020): 157.
- [5] Phillipou, Andrea, Denny Meyer, Erica Neill, Eric J. Tan, Wei Lin Toh, Tamsyn E. Van Rheenen, and Susan L. Rossell. "Eating and exercise behaviors in eating disorders and the general population during the COVID-19 pandemic in Australia: Initial results from the COLLATE project." *International Journal of eating disorders* 53, no. 7 (2020): 1158-1165. <https://doi.org/10.1002/eat.23317>
- [6] Salway, Ruth, Tin Tin Su, Roshidi Ismail, Miranda Elaine Glynis Armstrong, Charlie Foster, and Laura Johnson. "The impact of COVID-19 movement restrictions on physical activity in a low-income semi-rural population in Malaysia: A longitudinal study." *Journal of global health* 11 (2021). <https://doi.org/10.7189/jogh.11.05029>
- [7] Lim, Shiang Cheng, Ishu Kataria, Carrie Ngongo, Venessa Sambai Usek, Shashank Rajkumar Kudtarkar, Arunah Chandran, and Feisul Idzwan Mustapha. "Exploring the impact of COVID-19 movement control orders on eating habits and physical activity in low-resource urban settings in Malaysia." *Global health promotion* 29, no. 4 (2022): 18-26. <https://doi.org/10.1177/17579759221091197>

- [8] Alhousseini, Noara, and Abdulrahman Alqahtani. "COVID-19 pandemic's impact on eating habits in Saudi Arabia." *Journal of public health research* 9, no. 3 (2020): jphr-2020. <https://doi.org/10.4081/jphr.2020.1868>
- [9] Di Renzo, Laura, Paola Gualtieri, Francesca Pivari, Laura Soldati, Alda Attinà, Giulia Cinelli, Claudia Leggeri et al. "Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey." *Journal of translational medicine* 18 (2020): 1-15. <https://doi.org/10.1186/s12967-020-02399-5>
- [10] Carroll, Nicholas, Adam Sadowski, Amar Laila, Valerie Hruska, Madeline Nixon, David WL Ma, Jess Haines, and Guelph Family Health Study. "The impact of COVID-19 on health behavior, stress, financial and food security among middle to high income Canadian families with young children." *Nutrients* 12, no. 8 (2020): 2352. <https://doi.org/10.3390/nu12082352>
- [11] Scarmozzino, Federico, and Francesco Visioli. "Covid-19 and the subsequent lockdown modified dietary habits of almost half the population in an Italian sample." *Foods* 9, no. 5 (2020): 675. <https://doi.org/10.3390/foods9050675>
- [12] Kesmodel, Ulrik S. "Cross-sectional studies—what are they good for?." *Acta obstetrica et gynecologica Scandinavica* 97, no. 4 (2018): 388-393. <https://doi.org/10.1111/aogs.13331>
- [13] Grujičić, Sandra, and Aleksandra Nikolić. "STUDIJE PRESEKA: PREDNOSTI I NEDOSTACI." *Zdravstvena zaštita* 50, no. 4 (2021). <https://doi.org/10.5937/zdravzast50-35574>
- [14] Wingo, Brooks C., Tapan Mehta, Peng Qu, Larry C. Vogel, and James H. Rimmer. "Exploratory study examining clinical measures of adiposity risk for predicting obesity in adolescents with physical disabilities." *American Journal of Physical Medicine & Rehabilitation* 94, no. 8 (2015): 585-594. <https://doi.org/10.1097/PHM.0000000000000323>
- [15] Johansson, Gunnar, and K. R. Westerterp. "Assessment of the physical activity level with two questions: validation with doubly labeled water." *International journal of obesity* 32, no. 6 (2008): 1031-1033. <https://doi.org/10.1038/ijo.2008.42>
- [16] Dobrowolski, Hubert, and Dariusz Włodarek. "Body mass, physical activity and eating habits changes during the first COVID-19 pandemic lockdown in Poland." *International Journal of Environmental Research and Public Health* 18, no. 11 (2021): 5682. <https://doi.org/10.3390/ijerph18115682>
- [17] Belle, G. van. (2008). *Statistical Rules of Thumb*, 2nd Edition. Wiley.
- [18] Julious, Steven A. "Sample size of 12 per group rule of thumb for a pilot study." *Pharmaceutical Statistics: The Journal of Applied Statistics in the Pharmaceutical Industry* 4, no. 4 (2005): 287-291. <https://doi.org/10.1002/pst.185>
- [19] Wilmoth, Gregory H. "Handbook in research and evaluation, Stephen Isaac and William B. Michael San Diego, CA: EDITS Pubs., 1981." *Group & Organization Studies* 7, no. 1 (1982): 124-126. <https://doi.org/10.1177/105960118200700111>
- [20] Hassan, Zailinawati Abu, Peter Schattner, and Danielle Mazza. "Doing a pilot study: why is it essential?." *Malaysian family physician: the official journal of the Academy of Family Physicians of Malaysia* 1, no. 2-3 (2006): 70.
- [21] Nevo, B. A. R. U. C. H. (1985). Face validity revisited. *Journal of Educational Measurement*, 22(4), 287–293. <https://doi.org/10.1111/j.1745-3984.1985.tb01065.x>
- [22] Mohajan, Haradhan Kumar. "Two criteria for good measurements in research: Validity and reliability." *Annals of Spiru Haret University. Economic Series* 17, no. 4 (2017): 59-82. <https://doi.org/10.26458/1746>
- [23] Cheong, Siew Man, Mirnalini Kandiah, Karuthan Chinna, Yoke Mun Chan, and Hazizi Abu Saad. "Prevalence of obesity and factors associated with it in a worksite setting in Malaysia." *Journal of community health* 35 (2010): 698-705. <https://doi.org/10.1007/s10900-010-9274-1>
- [24] Rampal, L., P. Saeedi, S. Aminizadeh Bezenjani, M. S. Salmiah, and O. Norlijah. "Obesity and associated health related factors among university staff in Serdang, Malaysia." *Malaysian Journal of Medicine and Health Sciences* 8, no. 2 (2012): 23-32.
- [25] Yang, Shujuan, Bing Guo, Linjun Ao, Chao Yang, Lei Zhang, Junmin Zhou, and Peng Jia. "Obesity and activity patterns before and during COVID-19 lockdown among youths in China." *Clinical obesity* 10, no. 6 (2020): e12416. <https://doi.org/10.1111/cob.12416>
- [26] Robinson, Eric, Emma Boyland, Anna Chisholm, Joanne Harrold, Niamh G. Maloney, Lucile Marty, Bethan R. Mead, Rob Noonan, and Charlotte A. Hardman. "Obesity, eating behavior and physical activity during COVID-19 lockdown: A study of UK adults." *Appetite* 156 (2021): 104853. <https://doi.org/10.1016/j.appet.2020.104853>
- [27] Massar, Stijn AA, Alyssa SC Ng, Chun Siong Soon, Ju Lynn Ong, Xin Yu Chua, Nicholas IYN Chee, Tih Shih Lee, and Michael WL Chee. "Reopening after lockdown: the influence of working-from-home and digital device use on sleep, physical activity, and wellbeing following COVID-19 lockdown and reopening." *Sleep* 45, no. 1 (2022): zsab250. <https://doi.org/10.1093/sleep/zsab250>
- [28] Westerterp, Klaas R. "Physical activity and body-weight regulation." *The American journal of clinical nutrition* 110, no. 4 (2019): 791-792. <https://doi.org/10.1093/ajcn/nqz132>



- [29] Jespersen, J. G., A. Nedergaard, Lars Louis Andersen, P. Schjerling, and J. L. Andersen. "Myostatin expression during human muscle hypertrophy and subsequent atrophy: increased myostatin with detraining." *Scandinavian journal of medicine & science in sports* 21, no. 2 (2011): 215-223. <https://doi.org/10.1111/j.1600-0838.2009.01044.x>
- [30] López-Bueno, Rubén, Guillermo F. López-Sánchez, José A. Casajús, Joaquín Calatayud, Alejandro Gil-Salmerón, Igor Grabovac, Mark A. Tully, and Lee Smith. "Health-related behaviors among school-aged children and adolescents during the Spanish Covid-19 confinement." *Frontiers in pediatrics* 8 (2020): 573. <https://doi.org/10.3389/fped.2020.00573>
- [31] Gallo, Linda A., Tania F. Gallo, Sophia L. Young, Karen M. Moritz, and Lisa K. Akison. "The impact of isolation measures due to COVID-19 on energy intake and physical activity levels in Australian university students." *Nutrients* 12, no. 6 (2020): 1865. <https://doi.org/10.3390/nu12061865>
- [32] Puccinelli, Paulo José, Taline Santos da Costa, Aldo Seffrin, Claudio Andre Barbosa de Lira, Rodrigo Luiz Vancini, Pantelis T. Nikolaidis, Beat Knechtle, Thomas Rosemann, Lee Hill, and Marilia Santos Andrade. "Reduced level of physical activity during COVID-19 pandemic is associated with depression and anxiety levels: an internet-based survey." *BMC public health* 21 (2021): 1-11. <https://doi.org/10.1186/s12889-021-10470-z>
- [33] Brynjolfsson, Erik, John J. Horton, Adam Ozimek, Daniel Rock, Garima Sharma, and Hong-Yi TuYe. *COVID-19 and remote work: An early look at US data*. No. w27344. National Bureau of Economic Research, 2020. <https://doi.org/10.3386/w27344>
- [34] Bailey, Daniel P., Amy V. Wells, Terun Desai, Keith Sullivan, and Lindsay Kass. "Physical activity and sitting time changes in response to the COVID-19 lockdown in England." *PloS one* 17, no. 7 (2022): e0271482. <https://doi.org/10.1371/journal.pone.0271482>
- [35] Sadarangani, Kabir P., Gabriela F. De Roia, Pablo Lobo, Robinson Chavez, Jacob Meyer, Carlos Cristi-Montero, David Martinez-Gomez et al. "Changes in sitting time, screen exposure and physical activity during COVID-19 lockdown in South American adults: A cross-sectional study." *International Journal of Environmental Research and Public Health* 18, no. 10 (2021): 5239. <https://doi.org/10.3390/ijerph18105239>
- [36] Javad Koohsari, M., T. Nakaya, A. Shibata, K. Ishii, and K. Oka. "Working from Home After the COVID-19 Pandemic: Do Company Employees Sit More and Move Less? Sustainability 2021, 13, 939." (2021). <https://doi.org/10.3390/su13020939>
- [37] Drywień, Małgorzata Ewa, Jadwiga Hamulka, Monika A. Zielinska-Pukos, Marta Jeruszka-Bielak, and Magdalena Górnicka. "The COVID-19 pandemic lockdowns and changes in body weight among Polish women. A cross-sectional online survey PLifeCOVID-19 study." *Sustainability* 12, no. 18 (2020): 7768. <https://doi.org/10.3390/su12187768>
- [38] Al-Musharaf, Sara, Ghadeer Aljuraiban, Rania Bogis, Ruyuf Alnafisah, Madhawi Aldhwayan, and Abd Tahrani. "Lifestyle changes associated with COVID-19 quarantine among young Saudi women: A prospective study." *PloS one* 16, no. 4 (2021): e0250625. <https://doi.org/10.1371/journal.pone.0250625>
- [39] Palmer, K., A. Bscheiden, and N. Stroebele-Benschop. "Changes in lifestyle, diet, and body weight during the first COVID 19 'lockdown' in a student sample." *Appetite* 167 (2021): 105638. <https://doi.org/10.1016/j.appet.2021.105638>
- [40] Mazza, Elisa, Yvelise Ferro, Roberta Pujia, Samantha Maurotti, Tiziana Montalcini, and Arturo Pujia. "Homemade food, alcohol, and body weight: Change in eating habits in young individuals at the time of COVID-19 Lockdown." *Journal of Education and Health Promotion* 10 (2021). [https://doi.org/10.4103/jehp.jehp\\_250\\_21](https://doi.org/10.4103/jehp.jehp_250_21)
- [41] Reyes-Olavarría, Daniela, Pedro Ángel Latorre-Román, Iris Paola Guzmán-Guzmán, Daniel Jerez-Mayorga, Felipe Caamaño-Navarrete, and Pedro Delgado-Floody. "Positive and negative changes in food habits, physical activity patterns, and weight status during COVID-19 confinement: associated factors in the Chilean population." *International Journal of Environmental Research and Public Health* 17, no. 15 (2020): 5431. <https://doi.org/10.3390/ijerph17155431>
- [42] Bowman, Shanthi A., Steven L. Gortmaker, Cara B. Ebbeling, Mark A. Pereira, and David S. Ludwig. "Effects of fast-food consumption on energy intake and diet quality among children in a national household survey." *Pediatrics* 113, no. 1 (2004): 112-118. <https://doi.org/10.1542/peds.113.1.112>