

Development of Information System-Based Policy for COVID-19 Affected Students in the Semi-Arid Area of Indonesia

Apris A. Adu¹, Sarci M. Toy², R. Pasifikus Christa Wijaya³, Indra Yohanes Kiling³

¹Associate Professor and Dean, Department of Public Health, ²Assistant Professor, Department of Public Health,

³Assistant Professor, Department of Psychology, Faculty of Public Health, Nusa Cendana University, Indonesia

Abstract

This study aimed to provide an overview of the diet of students during the COVID-19 pandemic, socioeconomic status, the physical activities undertook the practiced COVID-19 prevention behavior, and student health. The sample size obtained was 253 participants, who were new students for the 2020/2021 academic year. Structural equation modeling was used for statistical analysis. Students could access nutritious food, but it was not followed by regular daily exercise. Students were also found to have good COVID-19 prevention behavior, for example using masks, washing hands, and coughing and sneezing etiquette, but only 41% of students had sufficient rest or sleep. Students have a good level of health, despite lacking physical activities. COVID-19 preventive behavior and socioeconomic status indirectly had an impact on student health. The right policies are necessary to improve student health.

Keywords: COVID-19, socioeconomic, student health, diet, exercise, structural equation modeling

Introduction

The first positive case of COVID-19 in Indonesia was found on Monday, March 2, 2020, which was transmitted through human-to-human. On 11 June 2020, the Government of Indonesia announced 35,295 confirmed cases of COVID-19, 2000 cases of death, and 12,636 cases of recovery from 424 districts/cities in all 34 provinces¹. The impact of COVID-19 has caused a public health emergency, thousands of deaths, a sluggish economy, increased unemployment, and quarantines around the world².

In response to the handling of the COVID-19 pandemic, Indonesia adopted a policy of restricting

access to anticipate an even greater risk of transmission by implementing Large-Scale Social Restrictions and prohibiting the implementation of mass activities. The types of mass activities referred to include educational and/or work activities, religious activities, weddings, and other social activities. There are many challenges faced in the application of online lecturing systems, both from within students and from the environment. Not all students have the ability to adapt quickly as many students are not familiar with the use of e-learning. Also, the limited availability of 4G and 3G broadband, low economic background, and other factors are challenges that can hinder the implementation of online learning policies.

The unique challenge in Semi-Arid Area of Indonesia, especially in East Nusa Tenggara is that students are scattered in various islands, which is one of the archipelago provinces of Indonesia with insufficient support for access to information. Improvement continues to be made for the development of better lectures. This system can also be developed as an information center

Corresponding author:

Apris A. Adu

Associate Professor and Dean of Faculty of Public Health, Nusa Cendana University, Adi Sucipto Street, Kupang, East Nusa Tenggara, Indonesia 85001

E-mail: apris.adu@staf.undana.ac.id

Additional Information:

for students related to health. Students need to get the latest information about COVID-19 and the university has to monitor the health development of students. The purpose of this study was to provide an overview of the student diet during the COVID-19 pandemic, the physical activities undertaken, the practiced COVID-19 prevention behavior, and the student's health status. We believe that this research is important because the condition of students during this pandemic can be a source of information in planning and implementing University policies related to students especially in low income areas.

Method

Sample and Data collection

This type of research is quantitative with a Cross-Sectional Study design³. Power Analysis was chosen to determine the minimum sample size needed to obtain adequate statistical power to develop the model⁴, conducted by using *G*Power 3.1.9.4* software⁵. The sampling technique used a quota sampling⁶. The inclusion criteria were new students for the 2020/2021 academic year, coming from the arid regions of the East Nusa Tenggara archipelago and undergoing lectures entirely online. The data collection method used was an online survey that accessed through an e-learning system based on a *Modular Object-Oriented Dynamic Learning Environment (Moodle)*⁷, was carried out for 3 months from July to October 2020 and obtained 253 participants.

Variables

Student Health

Physical Health Questionnaire measuring somatic symptoms that have a potential link between psychological disorders and physical illnesses⁸, closely related to their mental health state⁹⁻¹¹. The construct validity was tested using Confirmatory Factor Analysis (CFA), using *Jeffreys's Amazing Statistics Program (JASP 0.14)*^{12,13}. After testing, 11 items were obtained (see Table 1). Modified PHQ has a good internal consistency (Cronbach's $\alpha = 0.832$). Cut-off point¹⁴ of model analysis shows that Physical Health Questionnaire (modified) had a Relative Noncentrality Index (RNI) of 0.951 and Comparative Fit Index (CFI) of

0.95, Standardized Root Mean Square Residual (SRMR) of 0.048, The Root Mean Square Error of Approximation (RMSEA) of 0.063.

COVID-19 Preventive Behavior

COVID-19 Preventive Behavior is measured using the COVID-19 Preventive Behavior Scale¹⁵, based on health behaviors recommended by the World Health Organization¹⁶ and the Government of Indonesia in the COVID-19 pandemic. The scale consists of 6 items, responses using a semantic differential ranging from 1 (never) to 5 (always). To be categorized as having adequate preventive behavior, the respondent must get a score of >3 (a score of 3 or less is considered inadequate) on a minimum of 5 items out of 6 items. When any researchers choose to use the total score, high scores indicate that participants report a high frequency of preventive behavior.

Validity testing uses EFA and CFA. One factor solution extracted, with all items loaded adequately (>0.30 , $p < 0.05$; see Table 1). EFA, CFA and scale reliability analysis using JASP 0.14^{12,13}. Reliability Cronbach's $\alpha = 0.754$, the scale has a good fit; Chi-squared Test $p = 0.092$, SRMR = 0.036, RMSEA = 0.052, GFI = 0.98, RNI = 0.98, IFI = 0.981, and TLI = 0.967.

Socioeconomic Status

Socioeconomic status was measured using 3 questions: How much is your family's monthly income, what was your father's last education level, what was your mother's last education level. Responses of income are 1 ($< 1.000.000$ IDR); 2 (1.000.000 - 2.000.000 IDR); 3 (2.000.000 - 3.000.000 IDR); 4 (3.000.000 - 4.000.000 IDR); 5 (4.000.000 - 5.000.000 IDR); 6 ($> 5.000.000$ IDR). Response of education level are 1 (Not completing elementary school); 2 (Elementary School); 3 (Middle School); 4 (High School); 5 (Undergraduate); 6 (Master Degree); 7 (PhD).

Daily Exercise

Self-evaluation of daily physical exercise: do you exercise for at least 30 minutes regularly. Responses are 1 (never) to 5 (always).

Sleep Duration

Self-evaluation of daily sleep adequacy: how many

hours of sleep/rest do you have in a day. Responses are 1 (Less than 8 hours a day); 2 (8 hours or more a day)

Nutritious Diet

Self-evaluation regarding the adequacy of nutrients in daily food consumption: how often do you eat a balanced nutritious diet. Responses are 1 (never) to 5 (always).

Model Development

It is hypothesized that the COVID-19 preventive behavior, socioeconomic status, daily exercise, sleep duration, and nutritious diet have a direct and indirect effect on the student health conditions. Based on these hypotheses, Model 1 is developed in Amos^{17,18}.

Maximum likelihood and bootstrap estimates were used to adjust for the lack of multivariate normality. Model 1 shows fairly good fit statistics (see Figure 1). We use the modification indices to provide suggestions for further model modifications¹⁷. After Model 2 was developed, both models are included in a single analysis¹⁷. We found that Model 1 significantly worse than Model 2 ($p < 0.01$)¹⁷, it was decided to use model 2 to test the research hypothesis as the final model.

Result

Descriptive Statistics

The family income of 38.7% of the participants is less than 69 USD, below the poverty limit in East Nusa Tenggara (see Table 2). Participants tend to have a good level of health; however, headaches are the most common complaint (Mean = 14.1; SD = 4.36). Only 41% of participants had sufficient time to rest or sleep. Participants tend to be able to access nutritious food (often 29.2% and always 26.9%), but unfortunately, it is not followed by regular daily exercise (never 19.0%, rarely 23.7%, sometimes 29.6%). A total of 180 participants (71.15%) had an adequate level of COVID-19 prevention behavior, while 73 participants (28.85%) were still less aware of doing it.

Modeling Results

Conducting COVID-19 preventive behavior does not directly improve student health ($\beta = -0.095$, lower = -0.256, upper = 0.136, SE = 0.101, $p = 0.503$). Higher

socioeconomic background does not directly predict lower health problems ($\beta = -0.079$, lower = -0.246, upper = 0.091, SE = 0.088, $p = 0.372$). Coming from a more prosperous family does not directly guarantee that students will be having lesser health problems. COVID-19 preventive behavior is positively related to rest and sleep duration ($\beta = 0.146$, lower = 0.01, upper = 0.258, SE = 0.064, $p = 0.04$). Doing social distancing, as well as stay at home provide greater opportunities for students to be able to rest longer.

Awareness of maintaining health encourages students to maintain their diet and nutritional intake. It was found that COVID-19 prevention behavior is positively related to a nutritional diet ($\beta = 0.484$, lower = 0.338, upper = 0.613, SE = 0.07, $p = 0.001$). One of the reasons that are often mentioned by students is to maintain the body's immune system. This reason also encourages students to be active in the daily exercises, explaining the positive relationship between COVID-19 preventive behavior and daily exercise ($\beta = 0.3$, lower = 0.126, upper = 0.445, SE = 0.082, $p = 0.001$).

The higher the level of COVID-19 preventive behavior, the more active students will be in exercising with the aim of keeping their bodies in fit condition. Meanwhile, socioeconomic status was positively related to sleep duration ($\beta = 0.185$, lower = 0.045, upper = 0.316, SE = 0.068, $p = 0.009$) and Nutritious Diet ($\beta = 0.21$, lower = 0.09, upper = 0.329, SE = 0.062, $p = 0.001$), but not related to daily exercises ($\beta = -0.002$, lower = -0.15, upper = 0.151, SE = 0.077, $p = 0.956$).

It was found that all mediating variables have a positive relationship with student health: sleep duration ($\beta = 0.158$, lower = 0.027, upper = 0.28, SE = 0.066, $p = 0.022$), nutritious diet ($\beta = 0.337$, lower = 0.18, upper = 0.49, SE = 0.081, $p = 0.001$) and daily exercise ($\beta = 0.159$, lower = 0.015, upper = 0.301, SE = 0.074, $p = 0.031$) contribute to improving student health.

Direct Effects

The result of direct effects indicate that daily exercise is directly depends on COVID-19 preventive behavior only ($\beta = 0.3$, $p = 0.001$). Sleep duration is directly depends on COVID-19 preventive behavior ($\beta = 0.146$, $p = 0.04$), and socioeconomic factors ($\beta = 0.185$, $p = 0.009$). Nutritious diet is directly depends

on socioeconomic factors ($\beta = 0.21$, $p = 0.001$) and COVID-19 preventive behavior ($\beta = 0.484$, $p = 0.001$).

Student Health is directly depends on daily exercise ($\beta = 0.159$, $p = 0.031$), sleep duration ($\beta = 0.158$, $p = 0.022$) and nutritious diet ($\beta = 0.337$, $p = 0.001$). Socioeconomic factors ($\beta = -0.079$, $p = 0.372$) and COVID-19 preventive behavior ($\beta = -0.069$, $p = 0.503$) do not have a direct effect on student health. The null hypothesis that there is no direct effect of COVID-19 preventive behavior and socioeconomic factors on student health cannot be rejected.

Total Effects

The result of total effect indicates that daily exercise depends, directly or indirectly, on COVID-19 preventive behavior ($\beta = 0.3$, $p = 0.001$). Relatively high scores of COVID-19 preventive behavior are associated with high daily exercise scores. Sleep duration is depends, directly or indirectly, on COVID-19 preventive behavior ($\beta = 0.146$, $p = 0.04$), and socioeconomic factors ($\beta = 0.185$, $p = 0.009$). High scores of COVID-19 preventive behavior and socioeconomic factors are associated with high sleep duration scores. Nutritious diet is depends, directly or indirectly, on socioeconomic factors ($\beta = 0.21$, $p = 0.001$) and COVID-19 preventive behavior ($\beta = 0.484$, $p = 0.001$). High scores of COVID-19 preventive behavior and high socioeconomic factors scores are associated with high nutritious diet scores.

Student Health is depends, directly or indirectly, on daily exercise ($\beta = 0.159$, $p = 0.031$), sleep duration ($\beta = 0.158$, $p = 0.022$) and nutritious diet ($\beta = 0.337$, $p = 0.001$). High scores on the daily exercise, sleep duration, and nutritious diet are associated with high scores on student health. Meanwhile, socioeconomic factors ($\beta = 0.02$, $p = 0.826$) and COVID-19 preventive behavior ($\beta = 0.164$, $p = 0.069$) do not have a total effect on student health.

Indirect Effect

It was found that the socioeconomic status ($\beta = 0.1$, $p = 0.003$) and COVID-19 preventive behavior ($\beta = 0.234$, $p = 0.001$) had a significantly positive indirect effect on student health, thus the null hypothesis that has no indirect effect on COVID-19 preventive behavior and socioeconomic factors on student health can be rejected. Several paths can explain these indirect effects.

There are 3 paths that can explain the indirect effect of COVID-19 preventive behavior on student health ($\beta = 0.234$, $p = 0.001$). COVID-19 preventive behavior effects daily exercise (direct $\beta = 0.3$, $p = 0.001$) and in turn has a positive effect on student health (direct $\beta = 0.159$, $p = 0.031$) (see Figure 1 for model path). Second, COVID-19 preventive behavior effects sleep duration (direct $\beta = 0.146$, $p = 0.04$), then the latter has an effect on student health (direct $\beta = 0.158$, $p = 0.022$). Third, COVID-19 preventive behavior effects nutritious diet (direct $\beta = 0.484$, $p = 0.001$), then effects the student health (direct $\beta = 0.337$, $p = 0.001$). Among these paths, the nutritious diet path is the most important for explaining student health, followed by daily exercise and sleep duration.

On the other hand, there are 2 paths that can explain the indirect effect of socioeconomic status ($\beta = 0.1$, $p = 0.003$) on student health. First, socioeconomic status effects nutritious diet (direct $\beta = 0.21$, $p = 0.001$), then effects the student health (direct $\beta = 0.337$, $p = 0.001$). Second, socioeconomic status effects sleep duration (direct $\beta = 0.185$, $p = 0.009$), then the latter has an effect on student health (direct $\beta = 0.158$, $p = 0.022$).

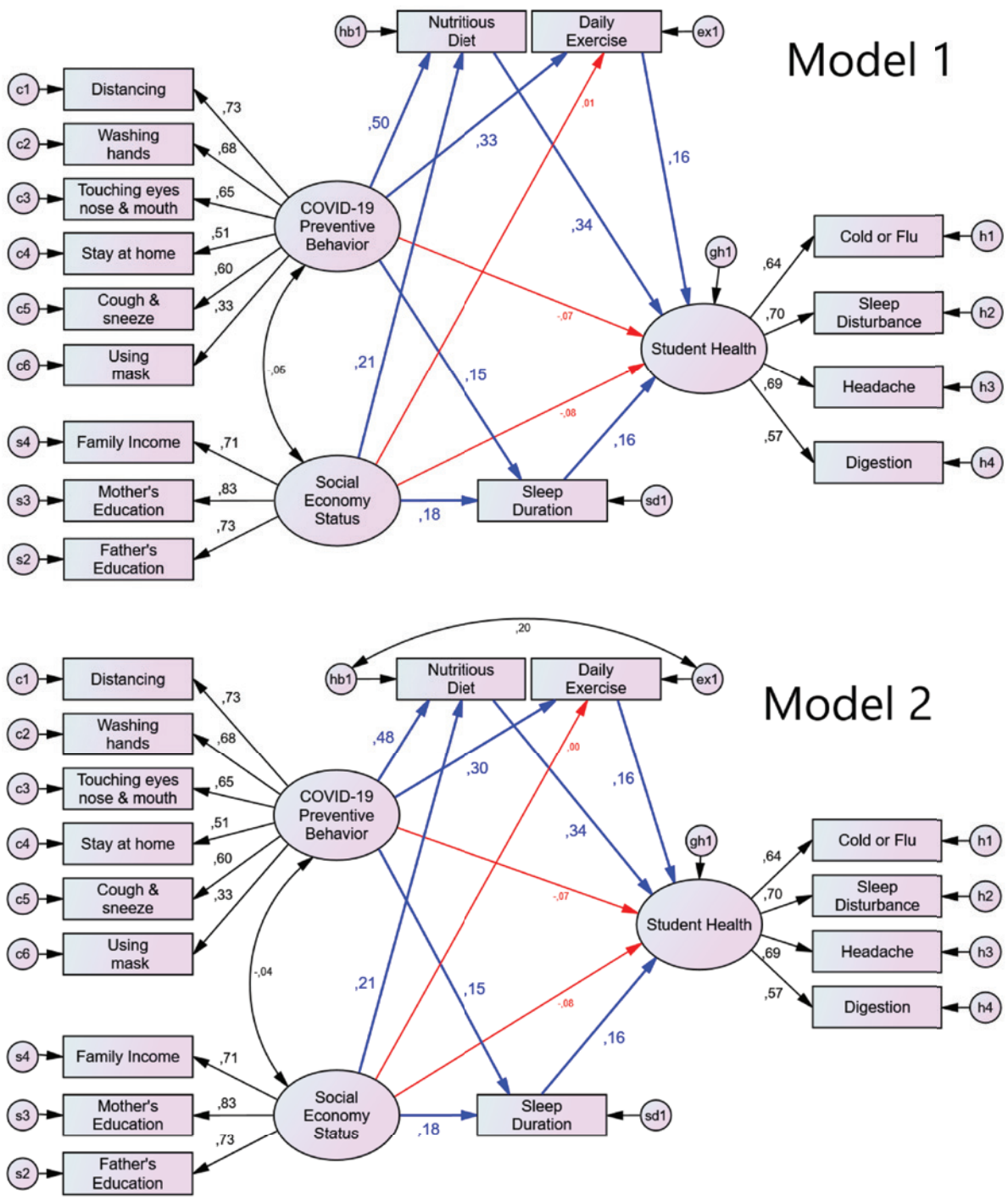


Fig. 1 Standardized path coefficients of the hypothesized model 1 and model 2. Blue solid arrows mean significant regression weight while red solid arrows indicate insignificant regression weight. *Model 1*: CMIN/DF = 1.258, p = 0.045, TLI = 0.965, CFI = 0.973, RMSEA = 0.32; *Model 2*: CMIN/DF = 1.178, p = 0.115, TLI = 0.976, CFI = 0.981, RMSEA = 0.22

Source: Amos Output¹⁸

Table 1. Items and Factor loadings of Variables' Scales

Variable	Factor	Items	R2	Loading	p
Physical Health	Flu/Cold	Have you had any health problems (feeling unwell) since the beginning of college up to now?	0.454	0.762	< .001**
		In the past two months, how many times have you had mild flu (you feel uncomfortable but don't make it necessary to rest at home)?	0.342	0.490	< .001**
	Sleep Disturbance	How often do you have trouble sleeping at night?	0.317	1.024	< .001**
		How often do you wake up from sleep at night?	0.384	0.954	< .001**
		How often do you have nightmares or disturbing dreams?	0.402	0.835	< .001**
	Headaches	How often do you get headaches?	0.505	1.075	< .001**
		How often do you get headaches when there is a lot of pressure on things to get done?	0.738	1.541	< .001**
		How often do you get headaches because you are frustrated that something is not working properly or when you are upset with someone?	0.613	1.375	< .001**
	Digestion/ Gastrointestinal	How often do you experience stomach upset (indigestion)?	0.529	1.023	< .001**
		How often do you feel nauseous?	0.330	0.557	< .001**
		How often do you experience constipation or diarrhea?	0.392	0.678	< .001**
	COVID-19 Preventive Behavior	Prevention	Avoid touching eyes, nose and mouth	0.423	0.753
Wash your hands with soap and running water or alcohol (hand sanitizer) regularly			0.463	0.609	< .001**
Maintain a distance of at least 1 meter (3 feet) between you and those around you			0.577	0.799	< .001**
Stay away from outdoor crowds or stay at home			0.245	0.519	< .001**
Properly use a cloth mask when leaving the house			0.105	0.168	< .001**
Cover your mouth and nose with the inside of your bent elbow or tissue when you cough or sneeze			0.332	0.550	< .001**

**<0.01 Two Tailed Significance (bias-corrected)

Table 2. Descriptive Statistics			
Variables		n	%
COVID-19 Preventive Behavior	Adequate	180	71.2%
	Lack	73	28.8%
Father's Education	< Elementary school	9	3.6%
	Elementary School	44	17.4%
	Middle School	21	8.3%
	High School	106	41.9%
	Undergraduate	65	25.7%
	Master Degree	7	2.8%
	PhD	1	0.4%
Mother's Education	< Elementary school	8	3.2%
	Elementary School	50	19.8%
	Middle School	39	15.4%
	High School	96	37.9%
	Undergraduate	56	22.1%
	Master Degree	3	1.2%
	PhD	1	0.4%
Family Income per Month	< 69 USD	98	38.7%
	70 – 139 USD	49	19.4%
	140 – 209 USD	36	14.2%
	210 – 279 USD	37	14.6%
	280 – 349 USD	22	8.7%
	> 350 USD	11	4.3%
Status of residence	Boarding House	98	38.7%
	Living with Relatives	46	18.2%
	Living with Parents	109	43.1%
Daily Exercise	Never	48	19.0%
	Rarely	60	23.7%
	Sometimes	75	29.6%
	Often	35	13.8%
	Always	35	13.8%
Sleep Duration	Less than 8 hours	149	58.9%
	8 hours or more	104	41.1%
Nutritious Diet	Never	4	1.6%
	Rarely	23	9.1%
	Sometimes	84	33.2%
	Often	74	29.2%
	Always	68	26.9%
		Mean	SD
COVID-19 Preventive Behavior	Avoid touching eyes nose mouth	3.37	1.16
	Washing hands	4.24	0.90
	Social Distance	3.84	1.05
	Stay home/avoid crowds	3.86	1.05
	Use mask	4.82	0.52
	Cough/sneeze etiquette	4.31	0.96
Student Health	No Flu/Cold	12.6	1.65
	No Sleep Disturbance	15.4	3.57
	No Headache	14.1	4.36
	No Digestion Problems	17.3	2.72

Discussion

We found that COVID-19 prevention behaviors are accepted as important and are closely related to other health behaviors. This closeness means that an increase in COVID-19 prevention behavior will also be followed by an increase in other health behaviors, especially eating nutritious food, exercising, maintaining diet, and sleeping patterns. Performing these behaviors will improve the health level, especially for students. Eating nutritious food is a very important factor for students to maintain their body health. On the other hand, besides COVID-19 preventive behavior, socioeconomic status also affects a nutritious diet. To counteract the negative impact of the low socio-economic status of the family, it is necessary to develop several policies by educational institutions to maintain the quality of student health.

Universities in low-income areas can endorse the use of climatologically available balanced-nutrition sources. East Nusa Tenggara is an archipelago and is a semi-arid climate with vegetation that tends to be dominated by savanna and steppe. The dominant agricultural products are rice, maize, and beans. This can be seen from the type of food consumed, such as corn, peanuts, moringa, papaya leaves, or pumpkin shoots. Judging from the mixture of food ingredients, it is quite diverse and almost complete in nutrition, because the energy source is found in corn, protein sources come from nuts, and vitamins and minerals come from vegetables. This type of food is usually consumed by farming communities or from the middle to lower economic groups, who rely on farming in the garden. Although it is fairly simple, it contains almost complete nutrients.

Educational institutions need to issue a special policy regarding COVID-19 on campus, thus facilitating the educational process to comply with health protocols during the COVID-19 pandemic. Dissemination of health information using various media (including forums and classes in e-learning) needs to be encouraged.

The quality of sleep/rest for students needs to be considered well, especially when adapting to the online lecture system. College assignments should not be used as compensation for distance learning. Class management using Asynchronous Learning has to be encouraged to adapt with time schedules, furthermore it will enable students that living on remote areas

to access learning material offline, thus, the effect of low socioeconomic status on the quality of rest can be reduced by providing opportunities for students directly to rest well and lowering the academic burden.

Conclusion

COVID-19 preventive behavior and socioeconomic status indirectly affect the health of students. Students tend to be able to access nutritious food, but it is not followed by regular daily exercise. Participants have adequate COVID-19 prevention behavior, for example using the mask, washing hands, and cough/sneeze etiquette but only half of participants had sufficient time to rest or sleep. Overall, students have a good level of health.

Conflict of Interest: There are no Conflicts of Interest.

Source of Funding: The study was self-funded project.

Ethical Clearance: This study was carried out after obtaining ethical approval from the Institutional Ethics Committee on the Nusa Cendana University in April 2020.

References

1. WHO Indonesia. *Coronavirus Disease Situation Report World Health Organization*. World Health Organization; 2020. https://www.who.int/docs/default-source/searo/indonesia/covid19/ikhtisar-kegiatan-2---11062020.pdf?sfvrsn=654d8232_2
2. Aragona M, Barbato A, Cavani A, Costanzo G, Mirisola C. Negative impacts of COVID-19 lockdown on mental health service access and follow-up adherence for immigrants and individuals in socio-economic difficulties. *Public Health*. 2020;186:52-56. doi:10.1016/j.puhe.2020.06.055
3. Setia MS. Methodology Series Module 3: Cross-sectional Studies. *Indian J Dermatol*. 2016;61(3):261-264. doi:10.4103/0019-5154.182410
4. Hair Jr JF, Hult GTM, Ringle C, Sarstedt M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Sage publications; 2016.
5. Faul F, Erdfelder E, Lang AG, Buchner A.

- G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*. 2007;39(2):175-191. doi:10.3758/BF03193146
6. Dodge Y, Commenges D. *The Oxford Dictionary of Statistical Terms*. Oxford University Press on Demand; 2006.
 7. Dougiamas M, Taylor P. Moodle: Using learning communities to create an open source course management system. In: *EdMedia+ Innovate Learning*. Association for the Advancement of Computing in Education (AACE); 2003:171-178.
 8. Schat ACH, Kelloway EK, Desmarais S. The Physical Health Questionnaire (PHQ): Construct validation of a self-report scale of somatic symptoms. *J Occup Health Psychol*. 2005;10(4):363-381. doi:10.1037/1076-8998.10.4.363
 9. Xiong J, Lipsitz O, Nasri F, et al. Impact of COVID-19 pandemic on mental health in the general population: A systematic review. *J Affect Disord*. 2020;277(June):55-64. doi:10.1016/j.jad.2020.08.001
 10. Graupensperger S, Benson AJ, Kilmer JR, Evans MB. Social (Un)distancing: Teammate Interactions, Athletic Identity, and Mental Health of Student-Athletes During the COVID-19 Pandemic. *J Adolesc Heal*. 2020;67(5):662-670. doi:10.1016/j.jadohealth.2020.08.001
 11. Sahu P. Closure of Universities Due to Coronavirus Disease 2019 (COVID-19): Impact on Education and Mental Health of Students and Academic Staff. *Cureus*. 2020;2019(4):4-9. doi:10.7759/cureus.7541
 12. Love J, Selker R, Marsman M, et al. JASP: Graphical statistical software for common statistical designs. *J Stat Softw*. 2019;88(2):1-17.
 13. JASP Team. JASP (Version 0.14). Published online 2020. <https://jasp-stats.org/>
 14. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equ Model*. 1999;6(1):1-55. doi:10.1080/10705519909540118
 15. Wijaya RPC, Benu JMY. Development and Validation of COVID-19 Preventive Behavior Scale in Indonesia. *Manuscr Prep*.
 16. WHO. Advice for the public. Published 2020. Accessed November 5, 2020. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>
 17. Arbuckle JL. *IBM SPSS Amos 23.0 User's Guide*. Amos Development Corporation, SPSS Inc.; 2014. http://amosdevelopment.com/download/User_Guide_23.pdf
 18. Arbuckle JL. Amos. Published online 2014.