

Predictors of interdependent happiness among health science students during the COVID-19 pandemic

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ABSTRACT

There are limited studies on the impact of the COVID-19 pandemic on the mental health of Filipino health science students, mainly those correlating a unique culturally related construct, such as interdependent happiness (IDH), to physiologic, health, and psychosocial factors. Cross-sectional data were collected to investigate the factors predicting the IDH of students at a private university during the COVID-19 pandemic. A seven-part online survey was completed by 180 respondents using convenience sampling. There was no evidence of multicollinearity issues in any of the independent variables. The findings revealed that 100% of respondents had poor sleep quality, a morning chronotype, and better eating habits. The majority (81%) had low levels of physical activity, low levels of social support (60%), and average levels of IDH (36.1%). Bivariate analyses revealed that sleep quality and chronotype were negatively associated with IDH. Dietary habits and social support were found to have a moderately positive relationship with IDH. Physical activity was not found to be significantly related to IDH. Regression analysis revealed three variables significantly associated with IDH: sleep quality, dietary habits, and social support. When age, gender, college, year level, family income, body mass index, and grade point average were all considered, there were no significant differences in the IDH of health science

students. This study shows that sleep quality, dietary habits, and social support all predict IDH and should be considered when managing the psychological impact of COVID-19 or any future pandemics among students.

INTRODUCTION

There is currently growing interest in happiness research. Previous studies investigated and measured happiness through the lens of Western-derived constructs, in which individual achievement and self-esteem are the primary factors associated with happiness (Hitokoto 2014). In the East Asian context, happiness is associated with a collectivist setting, where one's happiness is relationship-oriented (Hitokoto and Uchida 2018). It is realized when one forgoes the pursuit of individualistic happiness in favor of sharing harmonious interdependent connections with significant others, while expressing oneself in a discrete and unassuming fashion, to conform to group standards and avoid conflicts (Anderson 2018). Several empirical studies have investigated the relationship between happiness and contributing factors, such as sleep quality (Shubha and Rashmi 2016), diurnal preference (Gulec et al. 2013), physical activity (Zhang and Chen 2019), dietary habits (Veenhoven 2019), and social support (Moeini et al. 2018), suggesting that these health and psychosocial factors have an impact on an individual's happiness. These studies, however, were conducted before the COVID-19 pandemic and used tools that did not measure interdependent happiness (IDH).

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KEYWORDS

Sleep quality, dietary habits, social support, interdependent happiness, COVID-19

The COVID-19 pandemic took a heavy toll on public health, more importantly on the mental health of younger individuals. The disruptions brought about by strict shelter-in-place measures have heightened pre-existing stress levels among students (Grubic et al. 2020) in large part due to academic delays, school closures, changes in daily routine, and the economic effects of limited social connections (Liu et al. 2019; Cao et al. 2020; Lyons et al. 2020). Limited data on the effects of the pandemic on health science students have been published. Hence, we sought to determine the reference socio-demographic, anthropometric, and academic profile of health science students, the effect of interdependent social relationships to their happiness, and the factors that influence their IDH in times of global health crises. Specifically, we aimed to: (1) Describe how the respondents perceive their quality of sleep (QoS), chronotype (CT), physical activity (PA), dietary habits (DH), social support (SS), and IDH; (2) Determine if a relationship exists between the above factors and IDH; (3) Identify which factors significantly predict IDH; and (4) Determine if a significant difference in the IDH is present among the respondents when age, sex, college, year level, body mass index (BMI), combined family income (CFI), and grade point average (GPA) are considered.

MATERIALS AND METHODS

This cross-sectional study was conducted online among Medicine and Dentistry students at a private university in the Southern Tagalog Region (Region IV-A) in Silang, Cavite. All first-year to fourth-year (level 1 to level 4) students enrolled during the second semester of school year 2019-2020 and whose classes were affected by the COVID-19 lockdown were included in the survey. Irregular students were excluded from our analysis. There was strict compliance with the Data Privacy Act of 2012 (Republic Act 10173). The study was approved by the Adventist University of the Philippines Ethics Review Board (2020-ERB-AUP-064). A convenience sample of 225 students was determined using a 5% margin of error with a 95% confidence level and a population of 540 health science students. The online survey ran from July to August 2020.

The researchers constructed an online survey questionnaire using an online survey software (SurveyMonkey, USA). It consisted of seven parts that were mostly derived from validated questionnaires: respondents' profile, Shortened Pittsburg Quality of Sleep Index (sPQSI) (Famodu et al. 2018), reduced Morningness-Eveningness Questionnaire (rMEQ) (Adan and Almirall 1991), International Physical Activity Questionnaire - Short Form (IPAQ-SF) (van Poppel et al. 2010), Dietary Habits and Nutrition Knowledge Questionnaire (DHNKQ) (Roh et al. 2006), Social Support Questionnaire (SSQ) (Mergal et al. 2019) and the Interdependent Happiness Scale (IHS) developed (Hitokoto and Uchida 2015). Except for the respondents' profile, pilot testing of the survey instrument showed Cronbach's alpha for sPQSI, rMEQ, SSQ, and IHS at 0.81, 0.74, 0.91, and 0.90, while the test-retest reliability for DHNKQ and IPAQ-SF were 0.95 and 0.76, respectively.

We summarized respondents' age, family income, GPA, BMI, quality of sleep, chronotype, physical activity, dietary habits, social support, and interdependent happiness using mean and standard deviation. Sex, college, and year level used frequency and proportion. The Pearson product-moment correlation examined the relationship between independent and dependent variables. Simple and multiple linear regression tests examined the effects of demographic, anthropometric, and academic factors like age, gender, family income, GPA, BMI, and year level on study model relationships as effect modifiers. Data were encoded, processed, analyzed, and presented using SPSS 26,

GraphPad Prism 8, and Excel 2013. Statistical tests for pilot testing and the survey employed a 0.05 level of significance.

RESULTS AND DISCUSSION

The analytical sample included only 180 (37%) out of the 491 respondents who expressed consent and participated in the online survey. Excluded responses were either incomplete or inappropriate or were classified as outliers by the questionnaire guidelines (e.g., IPAQ tool). Table 1 shows that most of the respondents were under 27 years old, with an average age of 22.7 (standard deviation, SD = 2.97), 74% were females; 61% of the participants were from the College of Dentistry, while 28% were second-year students and a mean BMI of 22.64 (SD = 4.68). In terms of income, 44% reported a monthly household income of PhP 31,000 to 80,000. The analytic sample had a "very good" grade point average (GPA) of 3.12 (SD = 0.42) based on the approved university grading system (Table 1). Table 2 shows that all the participants had poor QoS, a morning CT, and a 'better' DH, while the majority had low PA (81%) and below-average (41%) SS. Finally, 36% of respondents scored their IDH as 'average.'

Table 1: Respondents' profiles

Variable	Categories	Frequency	Percentage
Age	18-22	95	52.8
	23-27	72	40.0
	28-32	12	6.7
	33-37	1	0.6
Sex	Male	47	26
	Female	133	74
College	Medicine	71	39
	Dentistry	109	61
Year level	First	48	27
	Second	50	28
	Third	38	21
	Fourth	44	24
BMI	<18.5 (Underweight)	99	55
	18.5-22.9 (Normal)	66	37
	23-24.9 (Overweight)	12	7
	30-40 (Obese 1)	3	1
FI	<15,000	7	4
	15-30k	33	18
	31-80k	79	44
	81-120k	28	16
	121-160k	16	9
	>160,000	17	9
GPA	3.76 - 4.00 (Excellent)	11	6
	3.51 - 3.75 (Very Outstanding)	29	16
	3.26 - 3.50 (Outstanding)	20	11
	3.01 - 3.25 (Very Good)	49	27
	2.76 - 3.00 (Good)	37	21
	2.51 - 2.75 (Very Satisfactory)	15	8
	2.26 - 2.50 (Satisfactory)	18	10
	2.01 - 2.25 (Passing)	1	1

BMI, body mass index; CFI, combined family income; GPA, grade point average

Table 2: Physiologic and health factors, sources of support, and interdependent happiness of respondents

Variable	Category	Frequency	Percentage
Physiologic factors			
Quality of Sleep	Poor Sleep Quality	180	100
Chronotype	Definitely Morning Type	170	94
	Moderately Morning Type	10	6
Health factors			
Dietary Habits	Better Eating Habits	180	100
Physical Activity	Low	146	81
	Moderate	34	19
Social Support	Very Low	36	20
	Below Average	73	41
	Average	51	28
	Above Average	16	9
	Very High	4	2
Interdependent Happiness	Very Low	9	5
	Below Average	25	14
	Average	65	36
	Above Average	53	29
	Very High	28	16

The analysis of sPQSI components, as shown in Table 3, determined that the sleep latency, sleep efficiency, and daytime dysfunction components of the sPQSI contributed to the poor sleep quality of the respondents.

Table 3: Analysis of sPQSI components

Component	Mean	SD
Sleep latency	2.32	1.76
Sleep duration	0.91	0.89
Sleep efficiency	3.00	0.00
Sleep disturbances	0.99	0.61
Daytime dysfunction	1.44	0.91
Global PQSI score	8.66	2.89

PQSI, Pittsburg Quality of Sleep Index; sPQSI, Shortened Pittsburg Quality of Sleep Index

The above results confirm that health science students had poor QoS (Luciano et al. 2021), similar to the general population (Blume et al. 2020). Furthermore, poor sleep latency, sleep efficiency, and daytime dysfunction are consistent studies evaluating sleep quality among college students before and during the pandemic (Benham 2021; Marelli et al. 2021). Possible factors contributing to these observations included increased screen time resulting in prolonged exposure to blue light, which suppressed melatonin release and promoted alertness in the evening (Shechter et al. 2018), and stress-related to self-perceived worries for the health and safety of significant

others (Majumdar et al. 2020). The low PA mirrored the results of previous studies conducted on university students (Rogowska et al. 2020) and below-average SS was comparable to a study done on front-line nurses (Labrague and De Los Santos 2020). In addition to the heavy academic demands, the extraordinary disruptions brought about by the strict quarantine measures and travel restrictions imposed to mitigate pathogenic spread may have occurred so abruptly that students were left adjusting to changes in their daily routine, physical activities, family, and work conditions affecting their overall QoS and PA. Although most of the students were allowed to go home to their families during the suspension of in-person classes, it was surprising to note that only a small number reported receiving a high level of SS, considering that family members are known to be primary sources of SS. A possible explanation for this might be that actual perceived and received support from family members is lacking. Although they may be physically present in the home, family members themselves may be individually engaged in other activities such as online work or online classes, making students feel neglected. Uchida et al. (2019) found that face-to-face interaction is an essential component of social support (Uchida et al. 2019). Based on Erik Erickson's Stages of Psychosocial Development, the respondents fall under the stage of Intimacy vs. Isolation (Orenstein and Lewis 2024), where individuals develop intimate connections or long-term partnerships. The reduction in the usual frequency and quality of face-to-face interaction provided by their classmates, friends, and significant others occurred as the students were physically cut off from them since they no longer stayed in the same premises of the university, contributing to below-average to very low social support among the respondents.

In terms of DH, this study showed that all participants had better eating habits during the pandemic. While most studies show that students partake in less healthy diets during the outbreak (Gonidakis 2022), Filipino students tend to eat healthier.

A possible explanation for this could be that health science students have applied knowledge regarding good nutrition as a means to prevent COVID-19 infection. Also, due to quarantine restrictions, access to fast food may have been limited, allowing families to shift to making healthier home-cooked meals. Although this result corroborates the earlier findings of Di Renzo et al. (2020) and Rodríguez-Pérez et al. (2020) regarding a shift to a healthier diet at the height of the COVID-19 pandemic, in a large-scale study done utilizing Italian and Spanish samples, respectively, this study provides for the first time, data on dietary habits in a subset of the Filipino population during the COVID-19 pandemic (Di Renzo et al. 2020; Rodríguez-Pérez et al. 2020).

Studies looking at Argentinian and German samples observe a shift to evening CT during the COVID-19 lockdown (Leone et al. 2020; Staller and Randler 2021). In contrast, we found that most students had a definite morning CT. We hypothesize that the discrepancy between the study findings and literature resulted from more robust social zeitgebers among the study participants similar to the study by Korczak et al., (2008) (Korczak et al. 2008). Although universities implemented a "flexible learning" teaching strategy utilizing online teaching, more often than not, most learning sessions still transpired in the morning. Therefore, students who went home to live with their parents or relatives were obliged to wake up early in the morning to make personal preparations and help with the household chores before joining online activities.

Another possibility is the influence of age on chronotype as it exhibits developmental changes. Early adolescent chronotype tends to become late, around 12 years of age (Díaz-Morales and Randler 2008). On the other hand, at around 20 years old, the

chronotype shifts towards morningness (Roenneberg et al. 2004). The morning preference observed among the respondents might be a reflection of the emerging chronotype for their age since none of the participants were younger than 20 years of age.

Lastly, the 'average' to 'very high' levels of IDH among the respondents suggest that negative emotions, such as depression, anxiety, and stress individually experienced by students, could shift to more positive emotions when consideration is given to the individual's association and interdependent social relationships. The result supports the findings of other studies showing that good interpersonal relationships improved mental health during the COVID-19 lockdown (Pieh et al. 2020).

Relationship between physiologic factors, health factors, and social support to interdependent happiness

Pearson correlation scatterplots in Figure 1 show that poor QoS designated as a high score ($p < 0.001$) and high rMEQ scores ($p < 0.001$) have an inverse (negative) relationship with IDH (level of association: QoS – medium, CT – small). Meanwhile, increasing levels of DH ($p < 0.001$) and SS ($p < 0.001$) positively correlate with the level of IDH (level of association: DH – medium, SS – medium). However, a change in PA, whether increased or decreased, does not affect the IDH of the respondents or vice versa ($p = 0.376$).

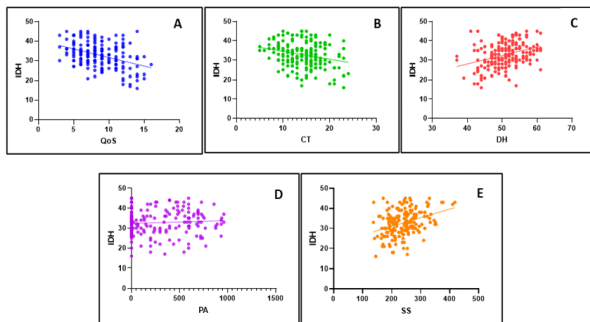


Figure 1: Scatterplots for the relationship of each physiologic factor, health factor and social support to interdependent happiness. Scatterplot colors correspond to A. Quality of sleep, QoS, and Interdependent happiness, IDH, (blue), B. Chronotype, CT, and IDH (green), C. Dietary habits, DH, and IDH, D. Physical activity, PA, and IDH (purple) and E. Social support, SS, and IDH (orange).

The relationship between the independent variables QoS, DH and SS, and IDH in the study, supports the findings of previous studies that as the QoS worsened (indicated by higher sPQSI scores), the level of IDH decreased (Ness and Saksvik-Lehouillier 2018; Kitazawa et al. 2019), and as DH improved and SS increased, the higher the levels of IDH is observed (Moeini et al. 2018; Holder 2019; Veenhoven 2019). The decrease in IDH observed as QoS decline may be related to poor QoS influencing brain regions involved in emotions (Lai 2018). This influence may occur by suppressing positive emotions while magnifying negative emotions via altering dopamine and serotonin levels (Jones et al. 2019). On the other hand, the positive influence of good DH on IDH, although poorly understood, might be related to the intake of certain food elements that modulate brain chemistry (Mujcic and A 2016). In their paper, Radavelli-Bagatini et al., (2022) cited that fruits and vegetables contain bioactive compounds, including minerals (zinc, magnesium), vitamins (B and C), and fiber, which appear to regulate brain neurochemicals (e.g., serotonin, dopamine, endorphins, and norepinephrine) that are associated with positive emotions (Radavelli-Bagatini et al. 2022). Meanwhile, adequate SS influences IDH by helping relieve emotional stress. It ensures that one has adequate necessities to help an individual throughout the pandemic (Kanekar and Sharma 2020).

The finding of an inverse association between CT scores and IDH, though small, is inconsistent with the literature indicating that morning preference is related to greater subjective well-being (Randler 2008) and better mood compared to other chronotypes (Díaz-Morales and Randler 2008). This discrepancy may be related to COVID-19-induced quarantine measures decreasing the student's exposure to natural light while increasing light pollution via exposure to indoor electrical lighting and blue light from electronic screen media use. All of which may alter daytime and nighttime melatonin and cortisol levels. Studies have suggested that the abnormal levels of these hormones are linked to depressive symptomatology and mood changes and may serve as subtle indicators of chronodisruption (Harb et al. 2015).

The finding on PA not significantly associated with IDH echoes a recent cross-sectional study among a small sample of first-year medical students in Cyprus (Fisher et al. 2019). While these findings conflict with the consistently significant positive relationship between PA and IDH (Zhang and Chen 2019), several factors may come into play such as the non-establishment of a sequential relationship between variables through repeated PA and IDH measures. Repeated measures might determine whether PA patterns are changing, showing significant association when the effect of PA on IDH occurred with an extended period of evaluation.

One could not discount the possibility of a relatively small sample size and participant demographics, e.g., health science students, affecting the variability of the sample, leading to difficulty in detecting an association. However, there is still much evidence to suggest that being physically active is beneficial to both the physical and psychological aspects of health.

Predictors of interdependent happiness

Table 4 shows that a positive change in the scores of QoS ($p < 0.001$) and CT ($p < 0.001$) tend to decrease the level of IDH. On the other hand, high DH and SS scores, but not PA ($p = 0.376$), tend to correspond positively with IDH ($p < 0.001$). These factors, therefore, are predictors of the level of IDH of the respondents.

Multiple linear regression test in Table 5 shows that QoS ($p < 0.001$), DH ($p = 0.003$), and SS ($p < 0.001$) significantly predicted IDH, however, CT ($p = 0.317$) and PA ($p = 0.211$) did not, after adjusting for the other predictors. The values of the variance inflation factor (VIF) in Table 5 reveal no evidence of multicollinearity issues among all independent variables, making the results of the multiple linear regression valid.

Table 4: Simple linear regression analysis summary for predicting interdependent happiness of respondents

Predictor	Coefficient R ²	B coefficient
Quality of Sleep	0.160	-0.882*
Chronotype	0.063	-0.408*
Dietary Habits	0.118	0.440*
Physical Activity	-0.001	0.001
Social Support	0.120	0.043*

*Level of significance at 0.05

Table 5: Variance inflation factor (VIF) and regression coefficients for each predictor in the model with interdependent happiness as the outcome variable

Predictor	Variance Inflation Factor (VIF)	B coefficient
Quality of Sleep	1.123	-0.650*
Chronotype	1.273	-0.111
Dietary Habits	1.230	0.266*
Physical Activity	1.087	0.002
Sources of Support	1.058	0.030*

Adjusted R²=28.9%; VIF interpretation: No multicollinearity problem (0-4), moderate multicollinearity problem (5-10), serious multicollinearity problem (>10); *level of significance at 0.05

Additionally, the stepwise regression analysis in Table 6 demonstrates that the value of adjusted R² increases upon adding more independent variables to the model, showing that these factors are substantial in predicting respondents' level of IDH.

Table 6: Stepwise regression analysis summary for predicting interdependent happiness of respondents

Predictor	B-coefficient				
	Step 1	Step 2	Step 3	Step 4	Step 5
Quality of Sleep	-0.882	-0.797	-0.816	0.149	-0.650
Chronotype	-	-0.285	-0.261	0.115	-0.111
Dietary Habits	-	-	0.001	0.090	0.266
Physical Activity	-	-	-	0.001	0.002
Sources of Support	-	-	-	-	0.030
No. of variable(s)	1	2	3	4	5
Adjusted R ² (%)	16.4	18.7	18.6	23.2	28.9

Table 7: Regression coefficients of interaction terms for the effects of moderating variables in the interdependent happiness of respondents

Moderating variable	B coefficient (Interaction terms)				
	Quality of Sleep	Chronotype	Dietary habits	Physical activity	Social support
Age	0.004	-0.037	0.008	0.000	0.000
Sex	-0.386	-0.149	0.274	-0.005	0.024
FI	0.124	0.081	-0.089	0.001	-0.010
GPA	-0.510	0.099	0.231	-0.003	0.005
BMI	-0.034	0.039	-0.015	0.000	0.001
College	-0.393	0.060	0.277	-0.001	0.014
Year level	0.138	0.103	0.077	0.001	0.007

BMI, body mass index; FI, family income; GPA, grade point average; level of significance at 0.05

Furthermore, a universal influence of age and sex may explain the absence of a moderating effect between dietary habits, social support, and IDH (Veenhoven 2019). The finding that age and sex did not alter the relationship between physical activity and IDH was not surprising since the study found that IDH was not significantly associated with physical activity.

The results of this study need interpretation in the context of the following limitations. First, concerns about generalizability are apparent as this work only examined a sample of students in a university. Second, the timing of data collection from July to

August 2020 may have affected the responses since the government started easing lockdown restrictions and allowed more mobility in some parts of the country. Thirdly, the web-based survey may have affected respondent survey completion leading to a low response rate overall in areas where internet connectivity was unstable or weak. Finally, because of the cross-sectional design of this research, causality was not established.

There are currently limited studies with predictive analyses specific to IDH utilizing physiologic and health factors and social support. The above findings attest to the reports in the current literature, which found that physiologic factors such as QoS (Mushtaq et al. 2014; Stoica 2015; Kitazawa et al. 2019) and CT (Miller et al. 2015), and health factors like DH (Mujcic and A 2016) and SS (Moeini et al. 2018) predict happiness. Moreover, our findings suggest that subjective physiologic measures like self-reported questionnaires on QoS and CT may predict variables such as IDH.

Effects of moderating variables in the interdependent happiness of respondents

The relationship between CT and IDH no longer being statistically significant after adjusting for the other variables could suggest a mediating variable. For instance, Howell and colleagues found a similar non-significant effect between morning preference and mindfulness after controlling for QoS (Howell et al. 2008). Likewise, PA did not predict IDH significantly. This finding may suggest that subjective PA measures alone may not predict IDH.

Another novelty of this study is the result of the interaction analysis on linear regression. Table 7 shows that age, sex, CFI, GPA, BMI, and year level do not moderate the relationship between physiological, health factors, and source of support to the IDH of the respondents ($p>0.05$). The matter of age and sex not moderating the relationship between QoS, CT, and IDH may result from a relatively young non-clinical study sample with comparable societal obligations and access to educational structures. João and colleagues found that the relationship between these variables becomes more evident when compared across age groups (João et al. 2018).

Future studies could examine a larger, more representative study population to understand the implications of the results better. IDH is culturally unique among Asian communities; it would be

interesting to replicate this study among other student populations, whether locally or abroad.

Another area of interest would be to investigate the relationship between quality of sleep, physical activity, and IDH through additional methods of observation besides self-report such as the use of wrist actigraphy and polysomnography for sleep, accelerometry for physical activity, and measurement of biomarkers such as neurotransmitter levels for IDH. Using both subjective and objective measures would complement and strengthen future studies.

CONCLUSION AND RECOMMENDATIONS

Happiness in a crisis like the COVID-19 pandemic is possible and is predicted by sleep quality, dietary habits, and social support. By investigating the factors influencing the IDH of health science students during the COVID-19 pandemic, this study contributed to the growing body of knowledge on the mental health of an important sector of society. Using the results of this study as a take-off point, stakeholders should make a concerted effort to develop policies or design intervention programs to promote and raise the levels of IDH among students to mitigate the psychological impact associated with the current pandemic or any future pandemics.

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The authors have self-funded this study and declare no conflict of interest.

CONTRIBUTIONS OF INDIVIDUAL AUTHORS

The authors confirm contribution to the manuscript as follows: study conception and design: Demuel Dee L. Berto, D. Darwin A. Dasig, Leticia T. Ibanez; data collection: Demuel Dee L. Berto; analysis and interpretation of results: Demuel Dee L. Berto, Marlon L. Bayot; draft manuscript preparation: Demuel Dee L. Berto, Marlon L. Bayot. All authors have reviewed the results and approved the final version of the manuscript.

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