

Depressive symptoms as key predictor of health-related quality of life in post-COVID-19 Undergraduate Students: A multivariate analysis with EQ-5D-5L and EQ VAS

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ABSTRACT

In the post COVID-19 era, Health-Related Quality of Life (HRQoL), a multidimensional construct reflecting individuals' physical, psychological, and social well-being, has become an important public health issue. The EuroQol 5 Dimensions 5 Levels (EQ-5D-5L) and the EuroQol Visual Analogue Scale (EQ-VAS) are widely recognised tools for assessing HRQoL. This study aimed to evaluate HRQoL using the EQ-5D-5L and EQ-VAS and to identify predictive factors associated with HRQoL among post-COVID-19 undergraduate students. A cross-sectional survey was conducted between May and July 2023 among 451 undergraduate students. Data were analysed using descriptive statistics, the Mann-Whitney U test, the Kruskal-Wallis test, Spearman's correlation and stepwise multiple linear regression, with the significance level set at 0.05. The mean utility score derived from the EQ-5D-5L was 0.96 (SD = 0.07), and the mean EQ-VAS score was 82.9 (SD = 14.5). Most participants reported no problems across the EQ-5D-5L domains, except for pain/discomfort (23.3%) and anxiety/depression (28.8%). Significant differences in HRQoL scores were observed based on gender, age, GPA, medical history, depressive symptoms, monthly expenses and health-related behaviours ($p < 0.05$). Regression analysis revealed that depressive symptoms (PHQ-9) and medical history were negatively associated with both EQ-5D-5L and EQ-VAS scores, while GPA was a positive predictor of the utility score. Age and year of study were also associated with variations in EQ-VAS scores. These findings underscore the need for mental health and academic support interventions aimed at improving HRQoL among post-COVID-19 student populations. Universities should consider providing targeted support, particularly for students in higher-risk academic years.

Keywords:

Depression, EQ-5D-5L, EQ VAS, Health-Related Quality of Life, Post-COVID-19, Undergraduate Students

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INTRODUCTION

The COVID-19 pandemic has significantly impacted global physical and mental health, particularly among university students – a population undergoing academic, social and personal transitions.¹ Although many individuals have recovered from the acute phase of infection, a considerable number continue to experience long-term consequences, commonly referred to as ‘post-COVID-19 condition’ or ‘long COVID.’ These lingering effects may include fatigue, shortness of breath, chest discomfort, cognitive impairments (e.g., difficulty concentrating or memory loss) and psychological symptoms such as anxiety and depression.² In young adults, these symptoms can persist for weeks or even months after the initial illness, affecting academic performance, social interactions and overall quality of life. Additionally, the rapid shift to online learning disrupted traditional education, while new lifestyle adjustments – such as social distancing and heightened self-care – contributed to increased stress and uncertainty. These changes, coupled with widespread media coverage, have exacerbated anxiety and psychological distress, particularly among student populations.³

Health-Related Quality of Life (HRQoL), which reflects physical, mental and social well-being, is an essential measure for understanding student health. The EQ-5D-5L and the EQ-VAS are widely validated tools for assessing HRQoL.⁴⁻⁹ Applying these instruments to undergraduate students who have recovered from COVID-19 provides valuable insights for health planning in academic settings.

Previous research highlights a strong link between mental health, COVID-19 and HRQoL in university students. For example, a study from Peru reported that depressive symptoms significantly affected

mental health and daily functioning,¹⁰ while post-COVID-19 students in India exhibited reduced HRQoL in the domains of pain, stress and mobility.¹¹ A systematic review found varying rates of depression prevalence during the pandemic, ranging from 21.2% among Mexican high school students to 57.9% among Indonesian university students. Depression was strongly associated with lower HRQoL and increased social isolation.¹² Additionally, in the Italian population, normative values for the EQ-5D-5L have been developed, indicating that gender, age, and socioeconomic status are significant predictors of HRQoL.⁴ Previous studies have demonstrated that knowledge, attitudes, and preventive behaviors related to COVID-19 are associated with mental health and overall well-being among university students. For instance, Khumsaen found that individuals with higher levels of COVID-19 knowledge and preventive behaviors exhibited better health outcomes.¹³ Likewise, Karuniawati et al. reported that students’ attitudes toward COVID-19 were significantly associated with their psychological status and quality of life.¹⁴ These findings support the inclusion of COVID-19-related knowledge, attitudes, and preventive behaviors as predictive variables in the present study.

In Thailand, studies have shown that undergraduate students generally report moderate levels of HRQoL.¹⁵ Differences in HRQoL have been observed across gender¹⁵ and academic year.¹⁶ During the pandemic, approximately 80% of students reported moderate to high levels of HRQoL, with social and environmental factors playing significant roles.¹⁷ Tanviboonwong et al. further identified the university environment, social relationships, curriculum and monthly expenses as key predictors of HRQoL, collectively explaining 72.4% of the variance.¹⁸

Given these findings, understanding HRQoL among undergraduate students during the post-COVID-19 period—regardless of their infection history—is vital, as compromised HRQoL can negatively affect their long-term physical and mental health, academic performance and future opportunities. This study aims to assess HRQoL using the EQ-5D-5L and EQ-VAS, and to identify the factors that influence it. The findings will inform the development of targeted health promotion and mental health strategies within university settings.

METHODS

Study design and population

This research was conducted as a cross-sectional study at the University of Phayao in Phayao Province. The study population comprised 15,753 undergraduate students, from first to fourth year, who were actively enrolled at the time of data collection.¹⁹ Data were collected between May and July 2023.

Sample size and sampling procedure

The sample size was calculated using Daniel's formula,²⁰ based on a reported prevalence of good quality of life (57.9%) among Indonesian university students.¹⁴ Although a previous study involving Thai undergraduates was referenced, it did not provide specific prevalence data suitable for sample size calculation. The Indonesian study was selected due to its use of a similar measurement tool (EQ-5D-5L), a comparable university context, and a recent publication date, making the prevalence figure relevant and applicable to this study's objectives. The minimum required sample size was 366. To account for non-response and enhance reliability, an additional 10% was added, resulting in a final sample size of 451 students.

A multi-stage sampling method was employed. First, university faculties were

categorised into three clusters: (1) Science and Technology, (2) Health Sciences and (3) Humanities and Social Sciences. One faculty was randomly selected from each cluster through drawing lots. Within each selected faculty, students from Years 1 to 4 were proportionally sampled to achieve the required overall sample size.

Inclusion Criteria: Participants were undergraduate students enrolled in the regular bi-semester program at the University of Phayao, Phayao Province, during Semester 1 of the 2022 academic year. Eligible participants were aged 18 years or older and provided written informed consent to participate in the study.

Exclusion Criteria: Students were excluded if they had any diagnosed psychiatric disorders (e.g., major depressive disorder, anxiety disorders), severe physical illnesses or experienced issues during data collection that prevented them from completing the questionnaire.

Measurement instruments

Data were collected using a structured, validated, self-administered questionnaire, developed based on a literature review and adapted from previous studies. The questionnaire comprised six sections:

(1) *General Characteristics* – This section included items on gender, age, year of study, GPA, BMI, monthly expenses and medical history. Medical history, in this context, specifically refers to pre-existing chronic health conditions (e.g., allergic rhinitis, asthma) and a history of COVID-19 infection.

(2) *COVID-19 Knowledge* – This section was developed based on the study conducted by Khumsaen N.¹³ and consisted of 10 true/false items. Each correct answer was awarded 1 point, resulting in total scores ranging from 0 to 10. Knowledge levels were categorised according to Bloom's criteria²¹ as low (0–5), moderate (6–7) and high (8–10).

(3) Attitudes Toward COVID-19 –

This section consisted of 13 items measured on a 4-point Likert scale (strongly agree = 4, agree = 3, disagree = 2, strongly disagree = 1). Total scores ranged from 13 to 52 and were categorised, based on Bloom's criteria²¹, into three levels: low (13–30), moderate (31–41) and high (42–52). This section demonstrated acceptable internal consistency (Cronbach's alpha = 0.776).

(4) COVID-19 Preventive Behaviours – This section included 10 items rated on a 4-point Likert scale (0 = never to 3 = always), with total scores ranging from 0 to 30. Scores were categorised as low, moderate or high based on Bloom's criteria.²¹ Internal consistency was high, with a Cronbach's alpha of 0.842.

(5) EQ-5D-5L and EQ-VAS – The EQ-5D-5L assesses health status across five key dimensions: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension includes five severity levels, ranging from no problems to extreme problems. By combining all levels across the five dimensions, the instrument can describe up to 3,125 unique health states.⁵ The EQ-VAS measures self-perceived health on a vertical visual analogue scale ranging from 0 (worst imaginable health) to 100 (best imaginable health). Utility values, ranging from -1 to 1, were calculated according to the EQ-5D-5L valuation protocol.⁶

(6) PHQ-9 – A 9-item standardised tool used to screen for depression, validated for use in Thailand.²² Each item is rated on a 4-point scale (0–3), yielding a total score ranging from 0 to 27. Scores are interpreted as follows: < 7 = no or minimal depression, 7–12 = mild, 13–18 = moderate and ≥ 19 = severe depression. The tool demonstrated high reliability in the pilot test, with a Cronbach's alpha coefficient of 0.892.

Data collection

Following IRB approval, prior to participation, all students received a written informed consent form explaining the purpose of the study, the voluntary nature of participation, and assurance that their decision to participate or not would have no impact on their academic grades or standing. Although data collection was conducted during class time, students were informed that they could freely choose to participate without any pressure or obligation. Participants were informed about the study objectives and provided written consent. Data collection was conducted during class hours with instructors' permission, using hard-copy, self-administered questionnaires that were distributed and completed on-site in the classroom. Confidentiality and the voluntary nature of participation were emphasised. All 451 completed questionnaires were checked for completeness and included in the analysis.

Data analysis

The data were analysed using IBM SPSS Statistics for Windows, version 29, employing both descriptive and inferential statistical methods. Inferential analyses included comparisons of mean ranks using the Mann-Whitney U test for two-group comparisons, the Kruskal-Wallis test for comparisons involving more than two groups, and bivariate analysis using Spearman's correlation, with the significance level set at 0.05. Before conducting the analysis, assumptions for multiple linear regression were tested. These included checking the independence of errors, converting categorical independent variables into dummy variables, and assessing multicollinearity through tolerance and Variance Inflation Factor (VIF) values. Tolerance values were high (close to 1), and all VIF values were below 10,²³ indicating no multicollinearity.

concerns. All assumptions were satisfied. Stepwise multiple linear regression analyses of utility scores and EQ-VAS scores identified statistically significant associated factors at the 0.05 significance level.

RESULTS

A total of 451 undergraduate students participated in the study. The majority were female (90.5%), with a mean age of 19.87 years ($SD = 1.193$); most participants were aged 20 years or older (71.4%). Participants were relatively

evenly distributed across academic years, with a slightly higher proportion in the first and third years. The mean GPA was 2.97 ($SD = 0.418$), and over half (52.1%) had a GPA below 3.00. The average BMI was 21.96 kg/m^2 ($SD = 4.478$), with the majority falling within the normal BMI range (40.6%). Monthly expenses averaged 5,646.78 Baht ($SD = 2,747.47$), with most students spending between 3,001 and 5,000 Baht (42.1%). Regarding health history, 10.6% reported a pre-existing condition, and 35.7% had previously contracted COVID-19 (Table 1).

Table 1. General characteristics of the samples (n=451)

Characteristics	Number	%
Gender		
Male	43	9.5
Female	408	90.5
Age ($\bar{x}$ =19.87, SD =1.193, Min=18 years, Max=24 years)		
18–19 Years	129	28.6
≥ 20 Years	322	71.4
Current year of study		
First year	123	27.3
Second year	109	24.1
Third year	115	25.5
Fourth year	104	23.1
Grade Point Average: GPA ($\bar{x}$ =2.97, SD =0.418, Min=1.83, Max=4.00)		
< 3.00	235	52.1
≥ 3.00	216	47.9
Body Mass Index: BMI (kg/m^2) ($\bar{x}$ =21.96, SD =4.478, Min=13.67, Max=37.58)		
Underweight	115	25.5
Normal	183	40.6
Overweight	57	12.6
Obese	65	14.4
Severely Obese	31	6.9
Monthly expenses ($\bar{x}$ =5,646.78, SD =2,747.469, Min=800 Baht, Max=21,000 Baht)		
< 3,000 Baht	83	18.4
3,001–5,000 Baht	190	42.1
$\geq 5,001$ Baht	178	39.5
Medical History		
Yes	48	10.6
No	403	89.4
History of COVID-19 Infection		
Yes	161	35.7
No	290	64.3

Both male and female undergraduate students reported relatively

low proportions of health problems across all EQ-5D-5L dimensions. The fewest

problems were observed in mobility, self-care, and usual activity, with fewer than 12% of respondents in any academic year reporting issues in these dimensions. In contrast, higher proportions of problems were found in the pain/discomfort and anxiety/depression dimensions, particularly among first- and fourth-year students. Female students tended to report more problems in these two dimensions compared to males. Regarding overall HRQoL, the mean EQ-5D-5L index score

was 0.96 (SD = 0.07) with a median of 1.00 (IQR = 0.04), indicating that most students perceived their general health status as very good. The mean EQ-VAS score was 82.90 (SD = 14.54) with a median of 85.00 (IQR = 20.00), suggesting a high level of self-perceived health status. Male students reported a slightly higher mean EQ-VAS score (86.60) than female students (82.41), reflecting marginally better perceived health status among males (Table 2).

Table 2. Descriptive of HRQoL using the EQ-5D-5L and EQ VAS classified by gender and current year of study. (n=451)

Current year of study	EQ-5D-5L descriptive with score (reporting problems %)									
	Mobility		Self-care		Usual activity		Pain/discomfort		Anxiety/depression	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	11.1	4.8	11.1	1.9	11.1	1.9	16.7	14.3	11.1	32.4
2	0.0	12.3	0.0	0.0	0.0	5.7	33.3	25.5	33.3	26.4
3	0.0	11.7	0.0	1.0	0.0	9.7	8.3	29.1	25.0	29.1
4	0.0	10.6	0.0	2.1	0.0	8.5	10.0	30.9	10.0	33.0
HRQoL	Male				Female				Total	
	Mean(SD)		Median(IQR)		Mean(SD)		Median(IQR)		Mean(SD)	Median(IQR)
Utility score	0.98(0.07)		1.00(0.00)		0.96(0.07)		1.00(0.04)		0.96(0.07)	1.00(0.04)
EQ-VAS score	86.60(12.57)		90.00(20.00)		82.41(14.67)		85.00(20.00)		82.90(14.54)	85.00(20.00)

Table 3 presents the HRQoL analysis based on EQ-5D-5L utility and EQ-VAS scores across various demographic and health-related factors. Significant differences ($p < 0.05$) were observed for gender, age, GPA, medical history, depressive symptoms (PHQ-9), monthly expenses and health-related behaviours. Female students and those aged ≥ 20 years had lower EQ-VAS scores. Students with a GPA ≥ 3.00 reported higher EQ-VAS scores. Participants with

underlying medical conditions or elevated PHQ-9 scores exhibited lower utility and EQ-VAS scores. While utility scores did not significantly differ by year of study, EQ-VAS scores were slightly lower among higher-year students, with first-year students reporting the highest median scores. Positive health-related behaviours were associated with higher EQ-VAS scores. No significant associations were found for BMI, history of COVID-19, knowledge level or attitude.

Table 3. Analysis of the EQ-5D-5L and EQ VAS by factors (n=451)

Factors	n	EQ-5D-5L (utility score)				EQ-VAS score			
		Median	IQR	Range	p-value ^a	Median	IQR	Range	p-value ^b
Gender									
Male	43	1.00	0.00	0.29	0.007**	90.00	20.0	50.0	0.013*

Factors	n	EQ-5D-5L (utility score)				EQ-VAS score			
		Median	IQR	Range	p-value ^a	Median	IQR	Range	p-value ^b
Female	408	1.00	0.04	0.48		85.00	20.0	80.0	
Age									
18–19 Years	129	1.00	0.03	0.29	0.042*	90.00	20.0	75.0	<0.001**
≥ 20 Years	322	1.00	0.07	0.48		80.00	15.0	80.0	
Current year of study									
First year	123	1.00	0.03	0.29	0.143	90.00	20.0	75.0	<0.001**
Second year	109	1.00	0.06	0.41		80.00	20.0	80.0	
Third year	115	1.00	0.07	0.48		80.00	15.0	68.0	
Fourth year	104	1.00	0.07	0.43		85.00	10.0	80.0	
GPA									
< 3.00	235	1.00	0.07	0.43	0.095	80.00	15.0	80.0	0.006**
≥ 3.00	216	1.00	0.04	0.48		90.00	20.0	80.0	
BMI									
Underweight	115	1.00	0.04	0.41	0.767	85.00	15.0	80.0	0.253
Normal	183	1.00	0.04	0.48		85.00	15.0	80.0	
Overweight	57	1.00	0.06	0.37		80.00	20.0	55.0	
Obese	65	1.00	0.04	0.43		85.00	20.0	50.0	
Severely Obese	31	1.00	0.08	0.24		90.00	20.0	50.0	
Monthly expenses									
< 3,000	83	1.00	0.07	0.41	0.804	90.00	20.0	80.0	0.033*
3,001–5,000	190	1.00	0.04	0.48		85.00	15.0	75.0	
≥ 5,001	178	1.00	0.04	0.30		84.50	15.0	80.0	
Medical History									
Yes	48	0.96	0.12	0.48	<0.001**	82.50	20.0	80.0	0.197
No	403	1.00	0.04	0.43		85.00	20.0	80.0	
History of COVID-19 Infection									
Yes	290	1.00	0.04	0.43	0.525	85.00	20.0	80.0	0.995
No	161	1.00	0.04	0.48		85.00	14.0	80.0	
PHQ-9									
None	184	1.00	0.03	0.34	<0.001**	90.00	15.0	80.0	<0.001**
Mild	187	1.00	0.05	0.43		80.00	15.0	74.0	
Moderate	59	0.96	0.12	0.48		80.00	15.0	63.0	
Moderately Severe	16	0.91	0.12	0.32		80.00	15.0	66.0	
Severe	5	0.84	0.10	0.13		50.00	50.0	60.0	
COVID-19 knowledge									
Low	7	1.00	0.04	0.07	0.723	98.00	20.0	30.0	0.229
Moderate	35	1.00	0.04	0.37		80.00	20.0	40.0	
High	409	1.00	0.04	0.48		85.00	20.0	80.0	
Attitudes toward COVID-19									
Low	8	1.00	0.00	0.07	0.195	90.00	18.0	40.0	0.941
Moderate	190	1.00	0.04	0.48		85.00	20.0	75.0	
High	253	1.00	0.04	0.32		85.00	20.0	80.0	
COVID-19 preventive behaviors									
Low	7	1.00	0.14	0.29	0.518	90.00	30.0	40.0	0.002**
Moderate	99	1.00	0.07	0.43		80.00	20.0	50.0	
High	345	1.00	0.04	0.48		89.00	15.0	80.0	

^a Mann-Whitney Test (two group), ^b Kruskal-Wallis Test (more than two)

* Significant at the 0.05 level, ** Significant at the 0.01 level

Table 4 presents Spearman's correlation between the EQ-5D-5L utility scores and the independent variables (n = 451). A significant negative correlation was observed between the utility score and

PHQ-9 ($r = -0.367$, $p < 0.01$), indicating that higher levels of depressive symptoms are associated with lower HRQoL. Age was also negatively correlated with the utility score ($r = -0.109$, $p < 0.05$), while monthly

expenses showed a negative but non-significant correlation ($r = -0.105$, $p > 0.05$). GPA was positively correlated with the utility score ($r = 0.118$, $p < 0.05$), suggesting that better academic performance is associated with higher HRQoL. No significant correlations were

found between the utility score and BMI, knowledge, attitude or behaviour. However, behaviour showed a significant negative correlation with PHQ-9 ($r = -0.146$, $p < 0.01$), implying a potential indirect effect of behaviour on health status through mental health.

Table 4. Bivariate analysis using Spearman's correlation to assess the relationship between independent variables and utility score of the samples (n=451)

Variables	1	2	3	4	5	6	7	8	9
1 Age	1.000								
2 BMI	-0.015	1.000							
3 GPA	-0.326**	-0.045	1.000						
4 Monthly expenses	0.112*	0.060	0.023	1.000					
5 PHQ-9	0.046	-0.019	-0.035	0.029	1.000				
6 Knowledge	0.051	-0.013	-0.010	0.003	0.028	1.000			
7 Attitude	0.109*	0.021	-0.082	0.116*	0.045	0.091	1.000		
8 Behavior	0.101*	-0.042	-0.085	-0.005	-0.146**	0.016	0.057	1.000	
9 Utility score	-0.109*	-0.051	0.118*	-0.105	-0.367**	-0.036	0.030	0.084	1.000

* significant at the 0.05 level, ** significant at the 0.01 level

Table 5 presents Spearman's correlation coefficients between EQ-VAS scores and selected variables among university students (n = 451). EQ-VAS scores were significantly negatively correlated with age ($r = -0.233$, $p < 0.01$) and PHQ-9 scores ($r = -0.331$, $p < 0.01$), indicating that younger students and those with fewer depressive symptoms reported better self-rated health. GPA ($r = 0.128$, $p <$

0.01) and health behaviour scores ($r = 0.123$, $p < 0.01$) were positively correlated with EQ-VAS scores, suggesting that better academic performance and healthier behaviours are associated with higher perceived health. Monthly expenses showed a weak but significant negative correlation with EQ-VAS ($r = -0.112$, $p < 0.05$). No significant correlations were observed for attitude or knowledge.

Table 5. Bivariate analysis using Spearman's correlation to assess the relationship between independent variables and EQ-VAS score of the samples (n=451)

Variables	1	2	3	4	5	6	7	8	9
1 Age	1.000								
2 BMI	-0.015	1.000							
3 GPA	-0.326**	-0.045	1.000						
4 Monthly expenses	0.112*	0.060	0.023	1.000					
5 PHQ-9	0.046	-0.019	-0.035	0.029	1.000				
6 Knowledge	0.051	-0.013	-0.010	0.003	0.028	1.000			
7 Attitude	0.109*	0.021	-0.082	0.116*	0.045	0.091	1.000		
8 Behavior	0.101*	-0.042	-0.085	-0.005	-0.146**	0.016	0.057	1.000	
9 EQ-VAS score	-0.233**	-0.008	0.128**	-0.112*	-0.331**	-0.022	0.019	0.123**	1.000

* significant at the 0.05 level, ** significant at the 0.01 level

Stepwise multiple linear regression was employed to identify significant

predictors of self-reported health (EQ-5D-5L and EQ-VAS) among 451 participants.

The results indicated that depressive symptoms (PHQ-9) were negatively associated with both EQ-5D-5L and EQ-VAS scores, suggesting that greater depression severity corresponded with poorer perceived health. A history of medical conditions also predicted lower health scores. GPA was positively associated with EQ-5D-5L, implying that

better academic performance was linked to higher perceived health. Age showed a negative association with EQ-VAS, indicating that older students tended to report lower self-rated health. Notably, being a fourth-year student was positively associated with EQ-VAS scores, suggesting that senior students perceived their health more favourably (Table 6)

Table 6 Stepwise Multiple Linear Regression analysis showing factors predicted with the EQ-5D-5L and EQ VAS of the samples (n=451)

Variables	EQ-5D-5L		Beta	p-value	Tolerance	VIF
	B	SE				
X ₁ PHQ-9	-0.006	0.001	-0.362	<0.001**	0.987	1.013
X ₂ Medical History	-0.030	0.010	-0.130	0.003**	0.988	1.012
X ₃ GPA	0.016	0.007	0.094	0.030*	0.996	1.004
Constant = 0.954, R ² =0.169						
Variables	EQ VAS		Beta	p-value	Tolerance	VIF
	B	SE				
X ₁ PHQ-9	-1.137	0.151	-0.327	<0.001**	0.999	1.001
X ₂ Age	-2.744	0.580	-0.225	<0.001**	0.834	1.199
X ₃ 4th year of study	3.620	1.641	0.105	0.028*	0.835	1.198
Constant = 143.524, R ² =0.155						

* significant at the 0.05 level

** significant at the 0.01 level

DISCUSSION

The study found that, after the COVID-19 pandemic, most undergraduate students exhibited a high level of HRQoL, with a mean EQ-5D-5L index score of 0.96 (SD = 0.07) and a mean EQ-VAS score of 82.9 (SD = 14.5). These findings suggest that the majority of participants perceived their overall health positively, particularly in the dimensions of mobility and self-care, where most students reported no problems. However, mild to moderate issues were still observed in the areas of pain/discomfort and anxiety/depression. These results are consistent with international studies reporting similarly high HRQoL levels. For example, studies from Italy reported mean EQ-5D-5L and EQ-VAS scores of 0.93 and 81.8,⁴ respectively; China reported scores of 0.94 and 84.09⁷; and among Chinese university students, the scores were 0.95 and 85.6.⁸ Thai university students assessed

by the SF-12 tool also showed relatively good HRQoL (81.6 ± 14.9).²⁴ Conversely, some countries – such as India and Peru – reported lower HRQoL among students, particularly in association with depressive symptoms.³⁻⁴ Data from Germany also highlighted mental health concerns, with a low Mental Component Score (MCS) of 36.3.²⁵ Although overall HRQoL was favourable, a notable proportion of students experienced mild to moderate anxiety and depression, reflecting the psychological and emotional burden imposed by the COVID-19 pandemic. Contributing factors included prolonged social isolation, fear of infection, academic uncertainty and limited access to support systems.²⁶⁻²⁷ These findings are consistent with prior research demonstrating declines in student mental health during the COVID-19 crisis.²⁸ Therefore, despite generally favourable HRQoL scores, prioritising mental health promotion remains essential to address

anxiety and depression and to improve long-term quality of life.

Scores from the EQ-5D-5L and EQ-VAS were consistent in assessing HRQoL among students, with higher EQ-5D-5L scores corresponding to higher EQ-VAS scores. This consistency aligns with findings from studies conducted in Ethiopia, Italy and China, which reported moderate to strong correlations between the two instruments.^{7,9,29} Although the tools differ in format, they offer complementary perspectives: the EQ-5D-5L assesses five specific health domains, while the EQ-VAS provides a holistic self-rating of overall health. Thus, using both instruments together is appropriate for a comprehensive assessment of post-COVID-19 HRQoL in university students.

Female students reported more problems in the anxiety/depression and pain/discomfort dimensions than male students, indicating lower psychological quality of life. This finding is consistent with multiple studies showing that females tend to have significantly a lower HRQoL scores, particularly in psychological domains, possibly due to greater stress sensitivity and increased social-emotional burdens.^{4,9,28,30-33} However, some studies have found no significant gender differences, which may be attributed to differences in study populations or methodologies.^{8,11,29} In the present study, the majority of participants were female (90%), which closely reflects the gender distribution of the university's undergraduate population, where approximately 84% of students are female. Although the proportion in the sample is slightly higher, the data collection process involved random selection within classrooms and voluntary participation. Therefore, this minor discrepancy is unlikely to indicate selection bias and instead reflects the general characteristics of the student population. The

predominance of female respondents may thus be considered representative, and findings related to gender differences in HRQoL should be interpreted within this demographic context.

Senior students tended to report more problems with anxiety/depression and pain/discomfort compared to junior students, supporting evidence that mental health issues and physical discomfort increase with age or academic progression.^{4,7,28,30-31} However, some studies suggest that first-year students may experience greater mental health challenges, indicating that the impact on HRQoL may vary across academic stages depending on psychosocial adjustment.²⁵

Mental health status – particularly depression and anxiety – poor academic performance, and unhealthy behaviours were key factors associated with reduced HRQoL. Numerous studies have linked impaired mental health to all dimensions of HRQoL.^{7,31-32} Poor mental health is also correlated with academic difficulties, reduced motivation, and an increased risk of dropout.³⁴⁻³⁵ Furthermore, stress, financial hardship, dissatisfaction with one's field of study, and everyday coping challenges negatively impact HRQoL.^{3,10,16,25} Studies conducted in Thailand similarly indicate that effective mental health management is associated with a higher quality of life.

Several factors influenced HRQoL post-COVID-19, as measured by the EQ-5D-5L and EQ-VAS, including mental health, medical history, academic performance, age and year of study. Among these, mental health emerged as the most significant predictor, aligning with prior research linking depression, anxiety, stress and emotional difficulties to lower HRQoL scores.^{9,24,28} Xu et al. identified anxiety and depression as primary predictors of HRQoL among primary care patients,⁹ while Marufi et al. confirmed their significant

influence.²⁴ Other studies have emphasised the influence of stress, social isolation and emotional challenges.²⁸ Among students, HRQoL is affected by mental health, stress and academic year,¹⁶ with additional contributions from behavioural factors, discrimination and stress levels.²⁵

Medical history – including comorbidities and post-COVID complications – was significantly associated with lower HRQoL, consistent with findings from India and other regions.^{11,29} In this study, students reported comorbidities such as asthma, allergic rhinitis, obesity and mental health conditions (e.g., anxiety, depression), all of which are associated with poorer physical and psychological health. Some students who had recovered from COVID-19 also reported lingering symptoms such as fatigue and cognitive difficulties, which may have further contributed to reduced HRQoL. Academic performance was also associated with HRQoL, with factors like stress and lack of motivation negatively impacting students' quality of life.^{34–35} Younger age and lower academic year were linked to better HRQoL, aligning with previous findings that male gender, younger age and normal BMI are associated with higher HRQoL scores.³⁰ In Thailand, the academic year has similarly been shown to influence HRQoL during the pandemic.¹⁶

Other potential factors – such as gender, income, health behaviours, sleep, perceived discrimination, family support and marital status – have been identified in previous studies but did not emerge as prominent in the present study.^{4,25,29,31} In summary, the HRQoL of undergraduate students is shaped by multiple factors, particularly mental health, chronic illness and academic variables. These findings underscore the importance of promoting mental well-being, monitoring students with chronic conditions and offering academic support systems – such as flexible deadlines, counselling services and study

skills workshops – to help mitigate long-term adverse effects on quality of life.

CONCLUSION

The results indicate that mental health (as measured by PHQ-9), medical history, GPA, age and academic year are significant predictors of self-reported health, as assessed using both the EQ-5D-5L and EQ-VAS. These findings highlight the importance of addressing mental health and accounting for demographic and academic factors when evaluating individuals' perceptions of their health status.

LIMITATIONS AND RECOMMENDATION

This cross-sectional study limits causal inference, and the use of self-reported data may introduce bias. The sample was drawn from a single university, which limits the generalisability of the findings. Although random classroom selection and voluntary participation were employed, potential selection bias cannot be entirely ruled out. Future research should adopt longitudinal designs, incorporate more diverse samples and utilise objective health data. Universities should implement targeted mental health and academic support programs to improve HRQoL among at-risk students.

AUTHORS' CONTRIBUTIONS

NP: Conceptualization, Supervision, Formal analysis, Writing - Original Draft and Writing - Review & Editing

MM.: Formal analysis, Writing - Review & Editing and Supervision.

ETHICAL CONSIDERATION

The study was conducted in accordance with the Declaration of

Helsinki. Ethical approval was obtained from the Human Research Ethics Committee of the University of Phayao (Reference No. UP-HEC 1.2/056/65) on 21 September 2022.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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REFERENCES

1. Lee J, Solomon M, Stead T, Kwon B, Ganti L. Impact of COVID-19 on the mental health of US college students. *BMC Psychol*. 2021;9(1):95. doi: <https://doi.org/10.1186/s40359-021-00598-3>
2. Han Q, Zheng B, Daines L, Sheikh A. Long-Term Sequelae of COVID-19: A Systematic Review and Meta-Analysis of One-Year Follow-Up Studies on Post-COVID Symptoms. *Pathogens*. 2022;11(2):269. doi: [10.3390/pathogens11020269](https://doi.org/10.3390/pathogens11020269)
3. Wilson OWA, Holland KE, Elliott LD, Duffey M, Bopp M. The Impact of the COVID-19 Pandemic on US College Students' Physical Activity and Mental Health. *J Phys Act Health*. 2021;18(3):272-8. doi: [10.1123/jpah.2020-0325](https://doi.org/10.1123/jpah.2020-0325).
4. Mereaglia M, Malandrini F, Finch AP, Ciani O, Jommi C. EQ-5D-5L population norms for Italy. *Appl Health Econ Health Policy*. 2023;21(2):289-303. doi: <https://doi.org/10.1007/s40258-022-00772-7>
5. Devlin N, Roudijk B, Ludwig K. Value sets for EQ-5D-5L: a compendium, comparative review & user guide. 2022.
6. Pattanaphesaj J. Health-related quality of life measure (EQ-5D-5L): measurement property testing and its preference-based score in Thai population [Doctoral dissertation]: Mahidol University; 2014.
7. Bai G, Zhang J, Chen Y, Cao L, Yang Y, Jiang C. Health-related quality of life assessed by EQ-5D-5L and its determinants among Chinese adults. *Front Public Health*. 2024;12:1383781. doi: <https://doi.org/10.3389/fpubh.2024.1383781>
8. Zhou HJ, Zhang A, Wei J, Wu J, Luo N, Wang P. Psychometric performance of EQ-5D-5L and SF-6DV2 in measuring health status of populations in Chinese university staff and students. *BMC Public Health*. 2023;23(1):2314. doi: <https://doi.org/10.1186/s12889-023-17208-z>
9. Xu RH, Sun R, Tian L, Cheung AW-L, Wong EL. Health-related quality of life in primary care patients: a comparison between EQ-5D-5L utility score and EQ-visual analogue scale. *Health Qual Life outcomes*. 2024;22(1):2. doi: <https://doi.org/10.1186/s12955-023-02215-w>
10. Figueroa-Quñones J, Cjuno J, Machay-Pak D, Ipanaque-Zapata M. Quality of life and depressive symptoms among Peruvian university students during the COVID-19 pandemic. *Front Psychol*.

- 2022;13:781561. doi: <https://doi.org/10.3389/fpsyg.2022.781561>
11. Ibiroga D, Dinesh A, Jose A, Bisheko MJ. Quality of Life assessment among post-COVID-19 undergraduates of a tertiary institution in India. *Amrita J Med*. 2023;19(2):79-84. doi: 10.4103/AMJM.AMJM_12_23
 12. Fernandes MdSV, Mendonça CR, da Silva TMV, Noll PReS, de Abreu LC, Noll M. Relationship between depression and quality of life among students: a systematic review and meta-analysis. *Sci Rep*. 2023;13(1):6715. doi: <https://doi.org/10.1038/s41598-023-33584-3>
 13. Khumsaen N. Knowledge, Attitudes, and Preventive Behaviors of COVID-19 among People Living in Amphoe Uthong, Suphanburi Province. *Journal of Prachomklao College of Nursing, Phetchaburi Province*. 2021;4(1):33-48.
 14. Karuniawati H, Sari N, Hossain MS, Ismail WI, Haq AHB, Yulianti T, et al. Assessment of mental health and quality of life status of undergraduate students in Indonesia during COVID-19 outbreak: A cross-sectional study. *Int J Environ Res Public Health*. 2022;19(19):12011. doi: <https://doi.org/10.3390/ijerph191912011>
 15. Photiwat K and Silphiphat K. Factors Related to the Quality of Life of Undergraduate Students in Thailand. *Rajapark J*. 2023;17(55):266-82.
 16. Melarplont S and Meebunmak Y. Happiness and Quality of Life to COVID-19 Epidemic among Nursing Students, Boromarajonani College of Nursing Ratchaburi. *Journal of Boromarajonani College of Nursing, Suphanburi*. 2022;5(1):67-78.
 17. Kingsawad K and Duangchinda A. Quality of Life of Undergraduate Students during the Epidemic of Coronavirus Disease 2019 (COVID-19). *J Health Sci*. 2023;32(3):393-9.
 18. Tanviboonwong P, Sungthong P, Charoenchaipinan N. Factors affecting on the quality of life of undergraduate students in Srinakharinwirot university Ongkharak. *Journal of faculty of physical education*. 2022;25(1):15-24.
 19. Education Service System, University of Phayao. Report on Current Student Enrollment Statistics [Internet]. [cited 2022 May 9]. Available from: <https://reg.up.ac.th/content/all/information>
 20. Daniel WW, Cross CL. *Biostatistics: A foundation for analysis in the health sciences*. 10th Edition, John Wiley & Sons, Hoboken; 2013.
 21. Bloom BS. *Taxonomy of educational objectives: The classification of educational goals*. New York: David McKay Company; 1971.
 22. Lotrakul M, Sumrithe S, Saipanish R. Reliability and validity of the Thai version of the PHQ-9. *BMC Psychiatry*. 2008;8:46.
 23. O'brien RM. A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity*. 2007;41:673-90. doi: <https://doi.org/10.1007/s11135-006-9018-6>
 24. Marufi N, Malekzadeh R, Naderi F, Garmabi M, Sharifnezhad A, Darrudi F, et al. Association of depression and anxiety with health-related quality of life in beginning Medical Sciences Student. *Sci Rep*. 2024;14(1):24515. doi: <https://doi.org/10.1038/s41598-024-76503-w>
 25. Wagner K, Reinhardt Z, Negash S, Weber L, Wienke A, Mikolajczyk R, et al. University students' health-related quality of life and its determinants. Results from a cross-sectional survey during the COVID-19 pandemic. *PloS one*. 2025;20(1):e0310378. doi: <https://doi.org/10.1371/journal.pone.0310378>
 26. Son C, Hegde S, Smith A, Wang X, Sasangohar F. Effects of COVID-19 on college students' mental health in the United States: Interview survey study. *J Med Internet Res*. 2020;22(9):e21279. doi: 10.2196/21279

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27. Xie X, Xue Q, Zhou Y, Zhu K, Liu Q, Zhang J, et al. Mental health status among children in home confinement during the coronavirus disease 2019 outbreak in Hubei Province, China. *JAMA pediatrics*. 2020;174(9):898-900. doi:10.1001/jamapediatrics.2020.1619
28. Adams KL, Saunders KE, Keown-Stoneman CDG, Duffy AC. Mental health trajectories in undergraduate students over the first year of university: a longitudinal cohort study. *BMJ open*. 2021;11(12):e047393. doi: 10.1136/bmjopen-2020-047393
29. Asrie AB, Dereje M, Getachew A, Genetu B. Assessment of Health-Related Quality of Life and Its Associated Factors Among Cardiovascular Disease Patients at a Teaching Hospital in Northwest Ethiopia: A Cross-Sectional Study. *BioMed Res Int*. 2025;2025:1159456. doi: <https://doi.org/10.1155/bmri/1159456>
30. Palacios-Cartagena RP, Adsuar JC, Hernández-Mocholí MÁ, Carlos-Vivas J, Barrios-Fernández S, Garcia-Gordillo MA, et al. Health-related quality of life norm data of the Peruvian adolescents: results using the eq-5d-y. *Int J Environ Res Public Health*. 2021;18(16):8735. doi: <https://doi.org/10.3390/ijerph18168735>
31. Tan GXD, Soh XC, Hartanto A, Goh AYH, Majeed NM. Prevalence of anxiety in college and university students: An umbrella review. *J Affect Disord Rep*. 2023;14:100658. doi: <https://doi.org/10.1016/j.jadr.2023.100658>
32. Li H-M, Zhong B-L. Quality of life among college students and its associated factors: a narrative review. *AME Med J*. 2022;7. doi: 10.21037/amj-22-96
33. Ifroh RH, Gai X, Rabiautsani MA, Han X. The social support, healthy lifestyle, subjective well-being, and health-related quality of life among university students. *J Educ Health Promot*. 2024;13(1):427. doi: 10.4103/jehp.jehp_1988_23
34. Baalmann T. Health-Related Quality of Life, Success Probability and Students' Dropout Intentions: Evidence from a German Longitudinal Study. *Res High Educ*. 2024;65:153-80. doi: <https://doi.org/10.1007/s11162-023-09738-7>
35. Torkani F, Ahmadi S-H, Binazir A, Fath MM, Shafigh N, Asadiparvar-Masouleh H, et al. The relationship between health-related quality of life and academic success in nursing students: the mediating role of academic burnout and academic motivation. *BMC Med Educ*. 2025;25:42. doi: <https://doi.org/10.1186/s12909-025-06661-6>
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