BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019918
Article Type:	Research
Date Submitted by the Author:	05-Oct-2017
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Primary Subject Heading:	Mental health
Secondary Subject Heading:	Public health, Epidemiology, Sociology, Health services research
Keywords:	Cross-sectional survey, Depressive symptoms, MENTAL HEALTH, Social and behavioral factors, University students, Cambodia

Social and behavioral factors associated with depressive symptoms among university students in Cambodia: A cross-sectional study

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ABSTRACT

Objective To explore social and behavioral factors associated with depressive symptoms among university students in Cambodia.

Design Cross-sectional study.

Settings Two public universities, one in the capital city of Phnom Penh and another in Battambang provincial town.

Participants This study included 1,359 students randomly selected from all departments in the two universities using a multi-stage cluster sampling method for a self-administered questionnaire survey in 2015.

Primary outcome measure Depressive symptoms measured by using the Center for Epidemiologic Studies Depression scale (CES-D).

Results The proportion of students with depressive symptoms and severe depressive symptoms were 50.6% and 19.6%, respectively. Students with depressive symptoms were significantly more likely to report poor academic performance (AOR=7.31, 95% CI=2.24-23.86), having thought of ending life (AOR=1.60, 95% CI=1.01-2.56), higher consumption of unhealthy food (AOR=1.72, 95% CI=1.08-2.76), severe problem with sleeping (AOR=2.81, 95% CI=1.31-6.06), a negative perception about their body shape (AOR=0.54, 95% CI=0.29-0.99) and their general health status (AOR=2.99, 95% CI= 1.28-7.00), and limited physical activeness (AOR=0.30, 95% CI=0.16-0.58). Students with depressive symptoms were also significantly more likely to encounter physical violence (AOR=1.39, 95% CI=1.04-1.86) and psychological abuse (AOR=1.82, 95% CI=1.37-2.42), and lack of general and medical care (AOR=0.51, 95% CI=0.30-0.86) by their family when they were growing up.

Conclusions The key factors associated with depressive symptoms were family-related and individual behaviors and attitudes. Thus, efforts should be invested in comprehensive screening and intervention programs to diagnose those vulnerable students early, offer immediate treatment, and cater appropriate support.

Strengths and limitations of this study

- This research is among a very few studies in which standardized tools are used, and rigorous analyses were performed to explore social and behavioral factors that may determine mental health status of university students in resource-poor settings.
- It included a large sample students randomly selected from all departments in two public universities – one in the capital city and another one in a provincial town – using a multi-stage cluster sampling method.
- Several factors in different domains were identified highlighting particular efforts that should be invested in comprehensive screening and intervention programs to improve mental health of university students.
- Limitations of the study included the representativeness of the study sample, the cross-sectional nature of the data that limits causation inferences, and potential bias of self-reported measures.

INTRODUCTION

University students have poorer health and higher rates of mental disorders, notably depression and anxiety, compared with their peers globally.[1-5] Depression is one of the most prevalent mental health problems among university students, and the prevalence is rising.[6 7] There are varied prevalence estimates of depressive symptoms among university students, ranging from in the area of 10%[8-11] to in the region of 20%[12] and up to 40% and 80%.[13-15] However, the mean prevalence of depression in university students stands at 30.6%.[6] University students are in a critical period of life since they transition from adolescence to adulthood, which requires them to make many major decisions. During this period, they encounter tremendous pressures, chiefly from economic stress, academic demands, interpersonal relationships, and struggles with making crucial decisions.[16]

Depression manifests in a wide range of symptoms, encompassing sleep and eating disturbances, lack of self-care, poor concentration, anxiety, and disinterest in everyday activities.[17] For university students, depression is correlated with poor academic achievements;[18] drop-out;[19 20] relationship instability;[21] suicidal ideation, attempts, and conducts;[18 23 23] poor work performance;[24] substance abuse;[25 26] acute infectious illnesses;[27] and

poor physical and mental health in general.[28 29] Moreover, depression in this early period can build up negative consequences in adult life through its impacts on career prospects and social relationships.[30 31]

Thus, tackling depression among university students is vital since most lifetime mental disorders commence during the university age,[32] and their mental health has essential ramifications for campus health services in particular and mental health policy-making in general. [33 34] Put another way, from a public health standpoint, early detection and prevention of mental health problems among young adults in higher education is paramount. Comprehension of their salient psychological distress, namely depression, and its correlates, would enable tailor-made screening and intervention programs to prevent mental health defects in this population. This is integral for their educational performance and triumph in their prospective profession as well as for the national advancement since they are future leaders.

The prevalence of depression is induced by many factors, including study populations, socio-demographics,[16 35] study sites,[16 36] diagnostic tools and sampling methods,[36 37] and socio-cultural environments.[16] Contextualization of facets linked with depression thus is significant for mitigation measures.

In Cambodia, little is known about social and behavioral determinants of depressive symptoms among student populations. In 2012, a study on 1,943 students at 11 junior high and high schools found that exposure to violence among community members, peers, or family was a predictor for depressive symptoms in the students.[38 39] A 2013 study on a sample of 28 students at a Cambodian university found that life events, problems of everyday life, and availability of social support were the main stress factors affecting students' life satisfaction.[40] Moreover, exposure to daily hassles was a stress factor having a strong impact on students' psychological and somatic responses. Nonetheless, no research has been conducted to examine social and behavioral determinants of depression among Cambodian university students. This study therefore intends to identify factors associated with depressive symptoms among university students in Cambodia.

METHODS

Study sites and population

This cross-sectional study was conducted with students at the University of Battambang (UB) in Battambang province and the Royal University of Phnom Penh (RUPP) in the capital city of Cambodia in June and July 2015. Epi Info was used to calculate the sample size from the university student population of approximately 168,000.[41] The anticipated percentage frequency was not known, so 50% was put for the calculation to prevent any underestimated prevalence. Based on a 95% confidence level (CI) and a +5% margin of error, the minimum sample size required for this study was 767 students. Adjusted for 10% of incomplete responses, missing data, and rejection rate, the final minimum required sample size was 850 students.

Sampling and data collection procedure

A multi-stage cluster sampling method was used to select the participants. First, the two universities were purposively selected, considering administration and logistic limitations. All departments of the selected universities were included in the study. In each department, non-proportion to sample size sampling method was used to select the sample from a name list provided by the department administrator to meet the required sample size. On the designated date of data collection, all selected students were approached by trained data collectors, and questionnaires and instructions were delivered to them. Students were informed that the survey concerned questions related to health, and they were asked for a written informed consent. The participants then completed the questionnaires by themselves.

Questionnaire development and training

We first developed a structured questionnaire in English and translated it into Khmer, the national language of Cambodia. Then, the Khmer questionnaire was back-translated into English by local experts to check its accuracy. The Khmer questionnaire was pretested with a sample of 20 students at RUPP to ensure that the wording and contents were culturally suitable and clearly understandable. We also received comments on the questionnaire from experts

working on health and education in Cambodia. The questionnaire was finalized based on their feedback and findings from the piloting.

All researchers spent two days to provide training on the study protocol and data collection method to the data enumerators and supervisors. The training focused on building familiarity with the study protocol and questionnaire, interview techniques, privacy assurance, and confidentiality. It also addressed quality control strategies, such as rechecking and reviewing the questionnaires after administration, and resolving issues that might arise during the fieldwork. The data collection supervisors were instructed to perform regular reviews with the data enumerators to monitor progress and settle any issues occurring during the process.

Variables and measurements

Depressive symptoms

Depressive symptoms were assessed by using the Center for Epidemiologic Studies Depression scale (CES-D).[42] This scale consists of 20 questions addressing six symptoms of depression, including depressed mood, guilt or worthlessness, helplessness or hopelessness, psychomotor retardation, loss of appetite, and sleep disturbance experienced during the preceding week. Each question is scored on a scale of 0 to 3 according to the frequency of the symptoms, and the total CES-D score ranges from 0 to 60. To calculate the total score, four items (I felt I was just as good as other people, I felt hopeful about the future, I was happy, and I enjoyed life) were reverse coded. The criterion validity of the CES-D scale has been well established in Western[42] and Asian[43] populations. We defined depressive symptoms as present when a subject had a CES-D score of ≥16. A cutoff value of ≥23 was also used to define severe depressive state.[44]

Socio-demographic characteristics, substance use, and sexual behaviors

We adapted standardized tools from the most recent Cambodia Demographic and Health Survey[45] as well as from our previous student and young people health surveys in Cambodia[38 39 46-48] to measure socioeconomic characteristics, sexual behaviors with different partners, and substance use (alcohol, tobacco, and illicit drugs). Socio-demographic characteristics of the

respondents included study site, gender, age, marital status, year of the study, living situations, perceived family economic status, and perceived academic performance.

Health related behaviors

We used the Health Behavior Survey,[49] which was designed as a broad survey of health-related behaviors and beliefs, components of the "national college health risk behavior survey" (1997),[50] and the Global School-based Student Health Survey.[51] Each health behavior area was addressed by only a limited number of items. For example, frequency of consumption of fast food in an average week was assessed by a question, "On average, how many times do you eat fast food per week?" with response options of 0 time, 1-2 times a week, and 3 or more times a week. Similar questions and response options were used to assess consumption of several other kinds of healthy and unhealthy food, such as high-fat snack or fruits/vegetables. Self-ratings were also used for some questions, such as perceived body size (rated from very overweight to very underweight), general health status (rated from very good to very poor), and problems with sleeping in the past 30 days (rated from none to severe).

Adverse childhood experiences (ACEs)

Five questions were adapted from the brief screening version of the Childhood Trauma Questionnaire to measure ACEs.[52] The five questions asked about the experiences of physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect during the time when they were growing up. The response options for each question ranged from (1) 'never' to (5) 'very often.' Participants who responded 'never' and 'rarely' were grouped together as those without ACEs. Participants who answered 'sometimes,' 'often', and 'very often' were grouped together as those with ACEs.

Self-rated health

SF-12 Health Survey (SF-12) was used to measure self-rated health.[53 54] The SF-12 is a multipurpose short-form generic measure of health status. It is a subset of the larger SF-36 and monitors health in general and in specific populations. The SF-12 measures eight health

aspects, namely physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality (energy/fatigue), social functioning, role limitations due to emotional problems, and mental health (psychological distress and psychological well-being).

Data analyses

Double data entry was performed using EpiData version 3 (Odense, Denmark). χ^2 test, or Fisher's exact test when the sample sizes were smaller than five in one cell, was used for categorical variables and Student's *t*-test was used for continuous variables to compare socio-demographic characteristics, health risk behaviors (sexual behaviors, substance use, eating behaviors, body size, and problems with sleeping), self-rated health (SF-12), and ACEs among students with depressive symptoms, defined by a CES-D score of ≥16, to those without depressive symptoms. The same comparisons were also made among students with and without severe depressive symptoms, defined by a CES-D score of ≥23.

To control for potential confounding factors, two multivariate logistic regression models were constructed, one for depressive symptoms and the other for severe depressive symptoms. In the multivariate models, we first included all variables significantly associated with the outcome variables in the bivariate analyses at a level of *p*-value <0.05 simultaneously in the models. Variables with a *p*-value >0.05 were then removed, and the models were refitted. The steps were repeated until all *p*-values of the remaining variables were <0.05 in the final models. Adjusted odds ratio (AOR) were obtained and presented with CI and *p*-values. SPSS version 22 (IBM Corporation, New York, USA) was used for all statistical analyses.

Ethical considerations

The National Ethics Committee for Health Research of the Ministry of Health, Cambodia, approved the study protocol and materials (No. 191NECHR). Participation in this study was voluntary. In the process of obtaining their written informed consent, participants were made clear that they could refuse or discontinue their participation at any time and for any reason. The confidentiality and privacy of the respondents were protected by administering the questionnaires in a private premise and by excluding personal identifiers in the survey.

RESULTS

Socio-demographic characteristics

The study sample included 493 students (36.3%) from UB and 866 students (63.7%) from RUPP. Of the total, 50.8% of the respondents were male, with a mean age of 21.3 years [standard deviation (SD)=2.3]. The majority of the respondents (97.9%) were unmarried; and 43.4% were living with their parents. Regarding their family economic status, 59.2% reported that their family was neither rich nor poor. The proportion of students with depressive symptoms and severe depressive symptoms were 50.6% and 19.6%, respectively.

Table 1 shows the comparisons of socio-demographic characteristics of students with and without depressive symptoms. Compared to their comparison groups, students with depressive symptoms were significantly more likely to be from UB (p=0.004), to be from a poorer family (p=0.002), and to report poorer academic performance (p<0.001). Similarly, students with severe depressive symptoms were significantly more likely to be female (p=0.002), to be from a poorer family (p=0.04), and to report poorer academic performance (p<0.001).

Table 1 Comparisons of socio-demographic characteristics of university students with and without depressive symptoms

Characteristics	Depressive symptoms*			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Study site			0.004			0.08
Battambang	218 (44.2)	275 (55.8)		384 (77.9)	109 (22.1)	
Phnom Penh	454 (52.4)	412 (47.6)		709 (81.9)	157 (18.1)	
Gender			0.20			0.002
Female	319 (47.7)	350 (52.3)		515 (77.0)	154 (23.0)	
Male	353 (51.2)	337 (48.8)		578 (83.8)	112 (16.2)	
Age (mean ± SD)	21.3 ± 2.4	21.4 ± 2.3	0.82	21.4 ± 2.3	21.1 ± 2.4	0.12
Marital status			0.34			0.08
Unmarried	655 (49.2)	675 (50.8)		1066 (80.2)	264 (19.8)	

Married	17 (58.6)	12 (41.4)		27 (93.1)	2 (6.9)	
Year of study			0.59			0.66
1	240 (48.4)	256 (51.6)		394 (79.4)	102 (20.6)	
2	145 (51.6)	136 (48.4)		224 (79.7)	57 (20.3)	
3	123 (49.0)	128 (51.0)		201 (80.1)	50 (19.9)	
4	164 (49.5)	167 (50.5)		274 (82.8)	57 (17.2)	
Currently living with			0.35			0.70
Parents	297 (49.9)	298 (50.1)		486 (81.7)	109 (18.3)	
Relatives	81 (45.0)	99 (55.0)		139 (77.2)	41 (22.8)	
Sibling	87 (56.1)	68 (43.9)		124 (80.0)	31 (20.0)	
Friend	162 (50.2)	161 (49.8)		258 (79.9)	65 (20.1)	
Spouse/partners	10 (47.6)	11 (52.4)		19 (90.5)	2 (9.5)	
Alone	26 (41.9)	36 (58.1)		50 (80.6)	12 (19.4)	
Other	9 (39.1)	14 (60.9)		17 (73.9)	6 (26.1)	
Perceived family economic status			0.002			0.04
Well-off/quite well-off	248 (55.7)	197 (44.3)		374 (84.0)	71 (16.0)	
Neither poor nor well-off	398 (47.0)	448 (53.0)		669 (71.1)	177 (20.9)	
Poor	26 (38.2)	42 (61.8)		50 (73.5)	18 (26.5)	
Perceived academic performance			<0.001			<0.001
Very good	44 (77.2)	13 (22.8)		52 (91.2)	5 (5.8)	
Good	180 (59.0)	123 (40.6)		263 (86.8)	40 (13.2)	
Fairly good	301 (50.5)	295 (49.5		484 (81.2)	112 (18.8)	
Fair	138 (37.7)	228 (62.3)		275 (75.1)	91 (24.9)	
Poor	9 (24.3)	28 (75.7)		19 (51.4)	18 (48.6)	

Abbreviation: SD, standard deviation.

Values are numbers of subjects (%) for categorical variables and means ± standard deviation (SD) for continuous variables.

[*] *Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.*

[†] *Defined by a CES-D score of ≥23.*

[‡] *Chi-square test was used for categorical variables; independent Student's t-test was used for continuous variables.*

Health risk behaviors

As shown in Table 2, compared to students without symptoms, students with symptoms were significantly more probable to report having thought of ending life (p<0.001 for both depressive symptoms and severe depressive symptoms) and higher consumption of unhealthy food, such as high-fat snack (p=0.001 for depressive symptoms; p<0.001 for severe depressive symptoms), margarine, butter, or meat fat (p=0.02 for depressive symptoms; p<0.001 for severe depressive symptoms). The students with depressive symptoms were significantly less likely to report higher consumption of healthy food, such as fruits and vegetables (p=0.009 for depressive symptoms; p=0.007 for severe depressive symptoms), or lean protein (p<0.001 for depressive symptoms; p=0.03 for severe depressive symptoms). The students with depressive symptoms were significantly more likely to report not having desert over the past week (p=0.003 for depressive symptoms; p=0.008 for severe depressive symptoms). Moreover, the students with depressive symptoms were significantly more likely to perceive that their body size was very overweight or very underweight (p<0.001 for both depressive symptoms and severe depressive symptoms) and report having moderate or severe problems with sleeping in the past 30 days (p<0.001 for both depressive symptoms and severe depressive symptoms).

Table 2 Comparisons of health risk behaviors among university students with and without depressive symptoms

Health and health risk behaviors	Depressive symptoms*			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Current tobacco smokers	5 (33.3)	10 (66.7)		12 (80.0)	3 (20.0)	0.97
Self-perception regarding alcohol use			0.25			0.004
Non drinker	425 (50.7)	413 (49.3)		681 (81.3)	157 (18.7)	
Occasional drinker	247 (47.4)	271 (52.6)		412 (78.7)	106 (21.3)	
Regular drinker	0 (0.0)	3 (100)		0 (0.0)	3 (100)	
Current illicit drug users	0 (0.0)	4 (100)	0.05	1 (25.0)	3 (75.0)	0.03
Condom use at last sex	39 (47.0)	44 (53.0)	0.95	73 (88.0)	10 (12.0)	0.08
Diagnosed with an STI	4 (40.0)	6 (60.0)	0.75	110 (84.0)	21 (16.0)	0.67
Thought of ending life	40 (24.8)	121 (75.2)	<0.001	84 (52.2)	77 (47.8)	<0.001

Attempted to end life	5 (20.0)	20 (80.0)	0.63	11 (44.0)	14 (56.0)	0.47
Frequency of eating fast food per week			0.49			0.24
0 time	410 (49.3)	421 (50.7)		679 (81.7)	152 (18.3)	
1-2 times	231 (50.7)	225 (49.3)		360 (78.9)	96 (21.1)	
3 times or more	31 (43.1)	41 (56.9)		54 (75.0)	18 (25.0)	
Frequency of daily soft drink consumption			0.31			0.01
0 time	105 (46.5)	121 (53.5)		178 (78.8)	48 (21.2)	
1-2 times	399 (51.2)	380 (48.8)		647 (83.1)	132 (16.9)	
3 times or more	168 (47.5)	186 (52.5)		268 (75.7)	86 (24.3)	
Frequency of weekly high-fat snack consumption			0.001			<0.001
0 time	162 (52.8)	145 (47.2)		260 (84.7)	47 (15.3)	
1-2 times	443 (51.0)	426 (49.0)		711 (81.8)	158 (18.2)	
3 times or more	67 (36.6)	116 (63.4)		122 (66.7)	61 (33.3)	
Frequency of weekly desert consumption			0.003			0.008
0 time	106 (40.6)	155 (59.4)		192 (73.6)	69 (26.4)	
1-2 times	434 (52.7)	389 (47.3)		676 (82.1)	147 (17.9)	
3 times or more	132 (48.0)	143 (52.0)		225 (81.8)	50 (18.2)	
Frequency of weekly fruit/vegetable consumption			0.009			0.007
0 time	50 (37.3)	84 (62.7)		94 (70.1)	40 (29.9)	
1-2 times	390 (51.7)	365 (48.3)		617 (81.7)	138 (18.3)	
3 times or more	232 (49.4)	238 (50.6)		382 (81.3)	88 (12.7)	
Frequency of weekly lean protein consumption			<0.001			0.03
0 time	57 (34.8)	107 (65.2)		119 (72.6)	45 (27.4)	
1-2 times	453 (51.8)	421 (48.2)		714 (81.7)	160 (18.3)	
3 times or more	162 (50.5)	159 (49.5)		260 (81.0)	61 (19.0)	
Amount of margarine/butter/meat fat consumption			0.02			<0.001
None/very little	296 (52.4)	269 (47.6)		471 (83.4)	94 (16.6)	
Some	339 (48.7)	357 (51.3)		558 (80.2)	138 (19.8)	
A lot	37 (37.8)	61 (62.2)		64 (65.3)	34 (34.7)	
Self-perception about body size			<0.001			<0.001
About right	275 (55.4)	221 (44.6)		428 (86.3)	68 (13.7)	
Very overweight	27 (34.2)	52 (65.8)		55 (69.6)	24 (30.4)	

Slightly overweight	161 (48.9)	168 (51.1)		247 (75.1)	82 (24.9)	
Slightly underweight	191 (49.6)	194 (50.4)		319 (82.9)	66 (17.1)	
Very underweight	18 (25.7)	52 (74.3)		44 (62.9)	26 (37.1)	
Problem with sleeping in the past 30 days			<0.001			<0.001
None	133 (61.9)	82 (38.1)		194 (90.2)	21 (9.8)	
Mild	283 (62.3)	171 (37.7)		409 (90.1)	45 (9.9)	
Moderate	243 (41.4)	344 (58.6)		447 (76.1)	140 (23.9)	
Severe	13 (12.6)	90 (87.4)		43 (41.7)	60 (58.3)	

Abbreviations: STI, sexually transmitted infections.
Values are numbers of subjects (%).
[*] *Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.*
[†] *Defined by a CES-D score of ≥23.*
[‡] *Chi-square test was used or Fisher's exact test was used as appropriate.*

Self-rated health (SF-12)

The comparisons of self-rated health (SF-12) among students with and without depressive symptoms and severe depressive symptoms are shown in Table 3. The students with depressive symptoms were significantly more likely to perceive that their general health status was poor (p<0.001 for both depressive symptoms and severe depressive symptoms). The students with depressive symptoms were significantly more probable to report higher levels of limitation in several daily activities, such as limitation in moderate activities (p<0.001 for depressive symptoms; p=0.02 for severe depressive symptoms), climbing several flights of stairs (p<0.001 for depressive symptoms), or other kinds of activities in the past four weeks as a result of their physical or emotional health problems (p<0.001 for both depressive symptoms and severe depressive symptoms). Further, they reported higher levels of problems in several other physical and emotional health aspects in the past four weeks, such as the feeling that they had accomplished less than they would like (p<0.001 for both depressive symptoms and severe depressive symptoms), pain interferes with their normal work (p<0.001 for both depressive symptoms and severe depressive symptoms), having less energy (p<0.001 for both depressive symptoms and severe depressive symptoms), down-hearted and blue (p<0.001 for both depressive symptoms and severe depressive symptoms), and their physical health interferes with their social acts (p<0.001 for both depressive symptoms and severe depressive symptoms).

Table 3 Comparisons of self-rated health (SF-12) among university students with and without depressive symptoms

Self-rated health (SF-12)	Depressive symptoms*			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Self-perception on general health status			<0.001			<0.001
Very good	106 (64.2)	59 (35.8)		147 (89.1)	18 (10.9)	
Good	380 (58.5)	270 (41.5)		566 (87.1)	84 (12.9)	
Neither good nor poor	176 (38.0)	287 (62.0)		351 (75.8)	112 (24.2)	
Poor	10 (12.3)	71 (87.7)		29 (35.8)	52 (64.2)	
Limitation in moderate activities on a typical day			<0.001			0.02
Greatly limited	20 (28.2)	51 (71.8)		50 (70.4)	21 (29.6)	
Mildly limited	291 (45.6)	347 (54.4)		505 (79.2)	133 (20.8)	
Not limited	361 (55.5)	289 (44.5)		538 (82.8)	112 (17.2)	
Limitation in climbing several flights of stairs			<0.001			0.24
Greatly limited	64 (35.8)	115 (64.2)		140 (78.2)	39 (21.8)	
Mildly limited	323 (47.8)	353 (52.2)		536 (79.3)	140 (20.7)	
Not limited	285 (56.5)	219 (43.5)		417 (82.7)	87 (17.2)	
Limitation in other kinds of activities in past 4 weeks	271 (37.8)	446 (62.2)	<0.001	516 (72.0)	201 (28.0)	<0.001
Accomplished less than you would like in past 4 weeks as a result of emotional health	377 (61.9)	232 (38.1)	<0.001	553 (50.6)	197 (26.3)	<0.001
Accomplished less than you would like in past 4 weeks as a result of physical health	304 (67.3)	148 (32.7)	<0.001	675 (74.4)	232 (25.6)	<0.001
Did activities less carefully than usual in past 4 weeks	378 (41.8)	526 (58.2)	<0.001	677 (74.9)	227 (25.1)	<0.001
Pain interferes with your normal work in past 4 weeks			<0.001			<0.001
Not at all	141 (75.8)	45 (24.2)		176 (94.6)	10 (5.4)	

A little bit	401 (57.6)	295 (42.4)		635 (91.2)	61 (8.8)	
Moderately	106 (32.9)	216 (31.4)		216 (67.1)	106 (32.9)	
Quite a bit	23 (16.5)	116 (83.5)		62 (44.6)	77 (55.4)	
Extremely	1 (6.3)	15 (93.8)		4 (25.0)	12 (75.0)	
Feeling calm and peaceful in past 4 weeks			0.33			0.06
A lot of the time	22 (42.3)	30 (57.7)		38 (73.1)	14 (26.9)	
Most of the time	68 (53.5)	59 (46.5)		92 (72.9)	35 (27.6)	
A good bit of time	115 (50.9)	111 (49.1)		188 (83.2)	38 (16.2)	
Some of the time	278 (46.8)	316 (53.2)		477 (80.3)	117 (17.7)	
A little of the time	170 (51.8)	158 (48.2)		274 (83.5)	54 (16.5)	
None of the time	19 (59.4)	13 (40.6)		24 (75.0)	8 (25.0)	
Having a lot of energy in past 4 weeks			<0.001			<0.001
A lot of the time	46 (61.3)	29 (38.7)		66 (88.0)	9 (12.0)	
Most of the time	111 (68.9)	50 (31.1)		149 (92.5)	12 (7.5)	
A good bit of time	245 (56.8)	186 (43.2)		383 (88.9)	48 (11.1)	
Some of the time	207 (41.5)	292 (58.5)		364 (72.9)	135 (27.1)	
A little of the time	57 (33.7)	112 (66.3)		116 (68.6)	53 (31.4)	
None of the time	6 (25.0)	18 (75.0)		15 (62.5)	9 (37.5)	
Feeling down-hearted and blue in past 4 weeks			<0.001			<0.001
A lot of the time	7 (21.9)	25 (78.1)		14 (43.8)	18 (56.3)	
Most of the time	8 (8.3)	88 (91.7)		36 (37.5)	60 (62.5)	
A good bit of the time	42 (17.9)	171 (80.3)		117 (54.9)	96 (45.1)	
Some of the time	222 (46.7)	253 (53.3)		412 (86.7)	63 (13.3)	
A little of the time	354 (71.5)	141 (28.5)		469 (94.7)	26 (5.3)	
None of the time	39 (81.3)	9 (18.8)		45 (93.8)	3 (6.3)	
Physical health interferes social act in past 4 weeks			<0.001			<0.001
A lot of the time	4 (33.3)	8 (66.7)		6 (50.0)	6 (50.0)	
Most of the time	10 (23.3)	33 (76.7)		18 (41.9)	58 (58.1)	
Some of the time	146 (38.1)	237 (61.9)		275 (71.8)	108 (28.2)	
A little of the time	355 (53.7)	306 (46.3)		568 (85.9)	93 (14.1)	
None of the time	157 (60.4)	103 (39.6)		226 (26.9)	34 (13.2)	

Values are numbers of subjects (%) for categorical variables.

*Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.

†Defined by a CES-D score of ≥23.

‡Chi-square test was used for categorical variables or Fisher's exact test was used as appropriate.

Adverse childhood experiences (ACEs)

Table 4 shows the comparisons of ACEs among students with and without depressive symptoms and severe depressive symptoms. The students with depressive symptoms were significantly more likely to report having been hit, slapped, or kicked by a parent or guardian (p<0.001 for both depressive symptoms and severe depressive symptoms); that people in their family had said hurtful or insulting things to them (p<0.001 for both depressive symptoms and severe depressive symptoms); and that someone had tried to touch them or make them touch him/her in a sexual way (p=0.001 for depressive symptoms; p<0.001 for severe depressive symptoms). The students with depressive symptoms were significantly less likely to report that there had been someone to take care of them and take them to medical care when they got sick (p=0.04 for depressive symptoms; p=0.03 for severe depressive symptoms), and there had been someone who helped them feel that they were loved and important (p=0.03 for depressive symptoms; p<0.001 for severe depressive symptoms).

Table 4 Comparisons of adverse childhood experiences among university students with and without depressive symptoms

Adverse childhood experiences	Depressive symptoms*			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Had been hit, slapped, kicked, by a parent/guardian	200 (38.2)	323 (61.8)	<0.001	384 (73.4)	139 (26.6)	<0.001
People in my family had said hurtful or insulting things to me	297 (39.0)	464 (61.0)	<0.001	558 (73.3)	203 (26.7)	<0.001
Someone had tried to touch me or make me touch them in a sexual way	87 (39.2)	135 (60.8)	0.001	159 (71.6)	63 (28.4)	<0.001

	There had been someone to take care me and take me to medical care when I got sick	636 (50.2)	632 (49.8)	0.04	1028 (81.1)	240 (18.9)	0.03
	There had been someone who helped me feel that I was loved and important	647 (50.1)	644 (49.9)	0.03	1050 (81.3)	266 (19.6)	<0.001

Values are numbers of subjects (%).
[*] Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.
[†] Defined by a CES-D score of ≥23.
[‡] Chi-square test was used.

Risk factors of depressive symptoms

The results of multivariate logistic analyses are shown in Table 5. After controlling for potential confounding factors, the students with symptoms remained significantly more likely to report poor academic performance (depressive symptoms: AOR=7.31, 95% CI=2.24-23.86; severe depressive symptoms: AOR=7.38, 95% CI=1.75-10.94); having thought of ending life (depressive symptoms: AOR=1.60, 95% CI=1.01-2.56; severe depressive symptoms: AOR=2.52, 95% CI=1.58-4.01); higher consumption of unhealthy food, including high-fat snack, margarine, butter, or meat fat (depressive symptoms: AOR=1.72, 95% CI=1.08-2.76; severe depressive symptoms: AOR=2.13, 95% CI=1.15-3.95); and severe problem with sleeping in the past 30 days (depressive symptoms: AOR=2.81, 95% CI=1.31-6.06; severe depressive symptoms: AOR=2.84, 95% CI=1.32-6.13). They remained significantly less likely to perceive that their body size was slightly underweight (depressive symptoms: AOR=0.54, 95% CI=0.29-0.99; severe depressive symptoms: AOR=0.37, 95% CI=0.18-0.77).

Regarding self-rated health, the students with symptoms remained significantly more likely to perceive that their general health status was poor (depressive symptoms: AOR=2.99, 95% CI=1.28-7.00; severe depressive symptoms: AOR=5.43, 95% CI=2.19-13.46), to report higher level of limitation in moderate activities (depressive symptoms: AOR=0.30 (95% CI=0.16-0.58), to report higher level of pain interference with their normal work (depressive symptoms: AOR=10.43, 95% CI=1.05-10.94; severe depressive symptoms: AOR=10.02, 95% CI=1.99-9.28),

and to report higher level of feeling down-hearted and blue (depressive symptoms: AOR=6.69, 95% CI=1.87-23.90; severe depressive symptoms: AOR=8.72, 95% CI=1.69-14.86).

For ACEs, they remained significantly more likely to report having been hit, slapped, or kicked by a parent or guardian (depressive symptoms: AOR=1.39, 95% CI=1.04-1.86); to report that people in their family had said hurtful or insulting things to them (depressive symptoms: AOR=1.82, 95% CI=1.37-2.42; severe depressive symptoms: AOR=2.18, 95% CI=1.46-3.24); and less likely to report that there had been someone to take care of them and take them to medical care when they got sick (depressive symptoms: AOR=0.51, 95% CI=0.30-0.86; severe depressive symptoms: AOR=0.26, 95% CI=0.13-0.52).

Table 5 Factors associated with depressive symptoms and severe depressive symptoms

Variables in the final model*	Depressive symptoms†		Severe depressive symptoms‡	
	AOR (95% CI)	P-value	AOR (95% CI)	P-value
Perceived academic performance				
Very good	Reference		Reference	
Good	2.28 (1.01-5.15)	0.04	1.22 (0.35-4.19)	0.76
Fairly good	3.51 (1.58-7.78)	0.002	2.15 (0.65-7.11)	0.21
Fair	5.30 (2.35-11.93)	<0.001	2.52 (0.75-8-43)	0.13
Poor	7.31 (2.24-23.86)	0.001	7.38 (1.75-10.94)	0.006
Thought of ending life				
No	Reference		Reference	
Yes	1.60 (1.01-2.56)	0.04	2.52 (1.58-4.01)	<0.001
Frequency of weekly high-fat snack consumption				
0 time	Reference		Reference	
1-2 times	0.99 (0.72-1.37)	0.95	1.25 (0.78-1.99)	0.36
3 times or more	1.72 (1.08-2.76)	0.02	2.13 (1.15-3.95)	0.02
Frequency of weekly lean protein consumption				
0 time	Reference		Reference	
1-2 times	0.52 (0.34-0.79)	0.002	0.69 (0.41-1.18)	0.17
3 times or more	0.62 (0.38-0.96)	0.04	0.80 (0.44-1.47)	0.48
Amount of margarine/butter/meat fat consumption				

	None/very little			Reference	
	Some			0.98 (0.66-1.46)	0.91
	A lot			1.92 (1.02-3.64)	0.04
Self-perception about body shape					
	Very overweight	Reference			
	Slightly overweight	0.56 (0.31-1.07)	0.08	0.65 (0.32-1.14)	0.25
	About right	0.58 (0.32-1.05	0.07	0.45 (0.22-0.93)	0.03
	Slightly underweight	0.54 (0.29-0.99)	0.04	0.37 (0.18-0.77)	0.008
	Very underweight	0.92 (0.38-2.25)	0.86	0.38 (0.14-0.99)	0.04
Problem with sleeping in the past 30 days					
	None	Reference			
	Mild	0.79 (0.53-1.19)	0.26	1.08 (0.55-2.16)	0.82
	Moderate	1.06 (0.72-1.58)	0.76	1.45 (0.89-2.66)	0.26
	Severe	2.81 (1.31-6.06)	0.008	2.84 (1.32-6.13)	0.008
Self-perception on general health status					
	Very good				
	Good	1.05 (0.68-1.64)	0.82	1.19 (0.60-2.38)	0.62
	Fair	1.58 (0.99-2-51)	0.05	1.47 (0.73-2.96)	0.28
	Poor	2.99 (1.28-7.00)	0.01	5.43 (2.19-13.46)	<0.001
Limitation in moderate activities on a typical day					
	Greatly limited	Reference		Reference	
	Mildly limited	0.39 (0.20-0.74)	0.004	0.64 (0.29-1.34)	0.23
	Not limited	0.30 (0.16-0.58)	<0.001	0.63 (0.30-1.36)	0.24
Pain interferes with your normal work in past 4 weeks					
	Not at all	Reference		Reference	
	A little bit	1.68 (1.08-2.61)	0.02	1.01 (0.46-2.22)	0.99
	Moderately	3.10 (1.89-5.10)	<0.001	3.69 (1.68-7.11)	0.001
	Quite a bit	4.14 (2.13-8.05)	<0.001	4.68 (2.01-10.92)	<0.001
	Extremely	10.43 (1.05-10.94)	0.04	10.02 (1.99-9.28)	0.005
Feeling down-hearted and blue in past 4 weeks					
	None of the time	Reference		Reference	
	A little of the time	0.52 (0.63-3.66)	0.35	1.02 (0.24-4.29)	0.98

Some of the time	3.42 (1.42-8.23)	0.006	1.83 (0.45-7.45)	0.40
A good bit of the time	7.70 (3.02-19.66)	<0.001	6.01 (1.45-4.85)	0.01
Most of the time	20.71 (6.47-66.37)	<0.001	9.04 (2.31-13.71)	0.002
A lot of the time	6.69 (1.87-23.90)	0.003	8.72 (1.69-14.86)	0.01
Had been hit, slapped, kicked, by a parent/guardian				
No	Reference		Reference	
Yes	1.39 (1.04-1.86)	0.03	1.11 (0.75-1.65)	0.59
People in my family had said hurtful or insulting things to me				
No	Reference		Reference	
Yes	1.82 (1.37-2.42)	<0.001	2.18 (1.46-3.24)	<0.001
There had been someone to take care of me and take me to medical care when I got sick				
No	Reference		Reference	
Yes	0.51 (0.30-0.86)	0.01	0.26 (0.13-0.52)	<0.001

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.

[*] Variables in the table were the ones that remained statistically significant in the final multivariate logistic regression model after several steps of model fitting.

[†] Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.

[‡] Defined by a CES-D score of ≥23.

DISCUSSION

This study unearthed a number of factors correlated with depressive symptoms among university students in Cambodia. The salient factors comprised cultural and socio-economic dimensions (gender, socio-economic background, and lack of general and medical care by family), individual behaviors and attitudes (poor academic accomplishment, suicidal ideation, consumption of unhealthy food, severe problem with sleeping, negative perception about their body and their general health status, and limited physical activeness), and nurture-related facets (physical violence and psychological abuse by family).

The bivariate outcomes display that students from the provincial university (UB) and a poorer family were more susceptible to depressive symptoms. Likewise, students from a poorer family and female students were more prone to severe depressive symptoms. Albeit not manifesting in the multivariate model, these factors are corroborated by the existing scholarship. Various studies revealed that university students from rural areas and low socio-

economic backgrounds were predisposed to higher depression.[1 16 28 55 56] This could be explained by an economic situation where students with a rural background tended to stipulate a poorer family status. Plus, financial vulnerability could further exacerbate depression in students from low-income families. A meta-analysis of 60 studies unveiled that people in the lowest socio-economic quintile had 1.81 the probability of depression compared with those in the highest socio-economic quintile.[57] A global study on 17,348 university students from 23 high-, middle-, and low-income countries also uncovered that higher depressive symptoms were recorded among students in low-income countries and economies with greater income inequality.[16] The Cambodian economy has been growing rapidly in terms of income per capita; yet, income gaps between the rich and the poor and between rural and urban areas remain large.[58] The gaps in income and material growth, which typify economic conditions, may induce people's mental health problems. In another word, poor economic status may bring about low self-esteem and self-confidence, which would lead to depression.

Some research also discovered that female students were more at risk to depression.[1 6 59-62] This might be due to social difficulties, physiological tenets, higher self-expectations, and perceived lack of competence among female students.[59] In the Cambodian culture, young women would perceive a great deal of challenges when living away from their family or parents since they need to maintain the cultural behavior and meanwhile cope with independent habitation. Over half (56.6%) of the student respondents in our study were not living with their parents. Moreover, women tended to over-report medical and psychological symptoms as indicated in a study on 440 undergraduate students in America.[63] Articulating their emotions may be one strategy for dealing with stressful events.

Our multivariate results depict that students with depressive symptoms, regardless of severity, tended to report poor academic performance, having thought of ending life, and higher consumption of unhealthy food. These findings conform to a systematic review of 24 studies[6] and studies in Asia, such as China,[7] which pinpoint low scholastic merit and suicidal ideation as consistent correlates of depression in university students probably as a culmination of poor concentration and solitude. On the consumption of unhealthy food, the transition from adolescence to adulthood, and thus the changes in lifestyle such as living arrangements and

independence, might have rendered university students to indulge in unhealthy food, as pinpointed by a meta-analysis of 39 studies in China.[7] As afore-mentioned, more than half of our sample were not living with their parents; therefore, it might have been hard for them to maintain healthy daily food. Conversely, depression might have made students care-free about themselves and consequently eat unhealthily.[17] This implies that nutrition education for both physical and mental health, stressing healthy food for the body and mind, is imperative for university students.

Students with depressive symptoms, regardless of magnitude, also tended to have severe problem with sleeping and a negative perception about their body and their general health status. This finding confirms the general perception among depressed people who are not gratified with their body and health.[17] Further, depressed students were more likely to have limited physical activeness, more pain interference with their normal work, and more dismay or sorrow. This reflects scientific facts that lack of physical activities may cause blue feelings and subsequently depression.[64 65] Therefore, physical exercises, such as sports, should be regularly promoted among university students.

Finally, students with depressive symptoms were more likely to encounter physical violence by their parent or guardian, psychological abuse by their family members (for both students with depressive and severely depressive symptoms), and lack of general and medical care by their family (for both students with depressive and severely depressive symptoms). As for the physical violence and psychological abuse, this finding tends to acquiesce with a study in Cambodia that postulates that exposure to violence within family is associated with depression in high school students.[38 39] On the lack of general and medical care by family, a Chinese study on 5,245 students at six universities found that students who had a poor parental relationship were more vulnerable to depression.[66] Also, a global study on 17,348 university students from 23 high, middle-, and low-income countries iterated that university students with less individualistic cultures, particularly in Asia, reported higher extents of depressive symptoms.[16] Students of these cultures longed for more familial and societal ties and assistance, and thus felt depressed once this social capital was unavailable.[16] This highlights a significant role of family bonds and scaffolding in association with depression among university students. In an

Asian culture like Cambodian, family is an integral part for young adults and is pivotal for their study and career advancement. Family environment and support, especially from parents, affect students' emotional state. Poor parental relationships could cause negligence over children, which could deteriorate their mental health. Thus, family atmosphere and support are vital for mitigating mental health defects, such as depression, in university students.

A study on a sample of 2,671 respondents in nine provinces and a capital city in 2012 revealed that Cambodia greatly needs more and better counseling and mental health services.[67] The study also pointed out the shortage of skilled professionals in the field of mental health, particularly those with high clinical and counseling skills to treat mental disorders. In 2012, Cambodia had only 49 trained psychiatrists and 45 psychiatric nurses working in mental health facilities and private practices.[67 68] Many health staff lack training, supervision, and experience in these areas. Only about 300 doctors completed basic mental healthcare training.[69] At university level, the 2012 study called for more awareness raising for self-care and burnout prevention and mental health counseling services for staff and students.[67] Given the paucity of mental health services in general, let alone at universities, our findings fuel the needs for more and better mental healthcare in Cambodia.

This study contains certain limitations. First, it examined students at only two public universities, one in a city and the other in a province. Hence, its findings cannot be generalized at a national level. Second, the cross-sectional design did not enable an establishment of the causal linkages between depressive symptoms and the related factors. Given the temporal order and the cross-sectional nature of the data, causal relationships between the variables could not be derived. Potential bi-directionality of the associations could occur either way. For instance, physical inactivity could cause depression. Nonetheless, the reverse could also be true—that depression could lead to inactivity, and of course both could be true simultaneously, where depressive symptoms worsen with physical inactivity, making physical activity less likely. Third, this study employed self-reported data, which might have been subject to recall bias of over-reporting and under-reporting. Nonetheless, the quality of the data was ensured by thorough training of the enumerators and field supervisors on the study protocols and data collection method. Finally, some of the measures, such as ACEs, were modified from other

research, and have not been validated in the Cambodian setting. Notwithstanding these malfeasances, the findings of this study offer first and foremost implications for policy development and future research in the Cambodian context.

CONCLUSIONS

This study identified social and behavioral factors associated with depressive symptoms among Cambodian students at two universities. While causation could not be drawn between these factors and depression, we surmise that these factors were inter-twined, and thus need to be addressed in an integrated and holistic fashion.

These findings render three major implications. First, given the current educational reform and labor market that demand better quality and ergo more competition among university students, the correlates of depressive symptoms could not be more critical for tackling for the time being. Failure to ameliorate these factors would jeopardize the qualification and career development of this populace and finally the human capital for nation-building. Second, these findings warrant an acceleration of on-campus counseling services for university students throughout the course of studentship. Efforts should be invested in comprehensive screening and intervention programs to diagnose those susceptible students early, offer immediate treatment, and cater appropriate support. Ultimately, the jurisdiction of refining students' mental state should go beyond universities to families and pertinent governmental bodies at large, provided we are to assist the young to overcome their academic challenges and enjoy a prosperous post-graduation life. Further research could delve into changing lifestyles and their associations with depressive symptoms among a larger sample of university students.

Acknowledgements The authors thank KHANA's Senior Management Team, research assistants, and the participants for their contribution to this study. Without their support, this study would have been impossible.

Contributions SY, KP and TS conceived research questions, designed the study and developed the research protocol and tools. SY and CN analyzed the data and interpreted the results and drafted the manuscript. KP, PC and RY supported the protocol and tools development and were responsible for training and data collection. All authors contributed to the writing and approved the final manuscript.

Funding Data used for this analysis were collected as part of a larger study funded by the United States Agency for International Development (USAID). The funder had no role in study design, data collection and analyses, decision to publish, or preparation of the manuscript.

Disclaimer Content of this paper is the responsibility of the authors and does not reflect the view of USAID or our respective institutions

Competing interests None declared

Ethics approval The National Ethics Committee for Health Research of the Ministry of Health, Cambodia approved this study (Reference no. 082NECHR), and a written informed consent was obtained from each participant.

Data sharing statement Data used for this analysis are available upon request from the Principal Investigator (Dr. Siyan Yi) at siyan@doctor.com. The data cannot be made publicly available due to ethical restriction.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Confirmed (Lines 1-55)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found. Confirmed (Lines 30-55)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported. Confirmed (Lines 71-110)
Objectives	3	State specific objectives, including any prespecified hypotheses. Confirmed (Lines 110-112)
Methods		
Study design	4	Present key elements of study design early in the paper. Confirmed (Line 116)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection. Confirmed (Line 1160-118)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Confirmed (Lines 118-134)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable. Confirmed (Lines 152-201)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Confirmed (Lines 152-201)
Bias	9	Describe any efforts to address potential sources of bias. Confirmed (Lines 136-150)
Study size	10	Explain how the study size was arrived at. Confirmed (118-123)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why. Confirmed (Lines 203-219)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding. Confirmed (Lines 204-218)
		(*b*) Describe any methods used to examine subgroups and interactions. (Not applicable)
		(*c*) Explain how missing data were addressed (Not applicable)
		(*d*) If applicable, describe analytical methods taking account of sampling strategy. (Not applicable)
		(*e*) Describe any sensitivity analyses. (Not applicable)
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Confirmed (Lines 231)
		(b) Give reasons for non-participation at each stage (Not applicable)
		(c) Consider use of a flow diagram (Not applicable)
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Confirmed (Lines 231-242)
		(b) Indicate number of participants with missing data for each variable of interest. (Not applicable)
Outcome data	15*	Report numbers of outcome events or summary measures. Confirmed (235-236)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and

		their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included. Confirmed (237-242, 254-269, 279-296, 305-317, 326-353)
		(*b*) Report category boundaries when continuous variables were categorized. (Not applicable)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period. (Not applicable)
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses. Confirmed (320-325)
Discussion		
Key results	18	Summarise key results with reference to study objectives. Confirmed (Lines 363-369)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. Confirmed (Lines 449-464)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. Confirmed (Lines 370-448)
Generalisability	21	Discuss the generalisability (external validity) of the study results. Confirmed (Lines 449-451)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based. Confirmed (Lines 496-498)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019918.R1
Article Type:	Research
Date Submitted by the Author:	17-May-2018
Complete List of Authors:	Ngin, Chanrith; KHANA Center for Population Health Research; Royal University of Phnom Penh, Faculty of Development Studies Pal, Khuondyla; KHANA Center for Population Health Research Tuot, Sovannary; KHANA, Research Center Chhoun, Pheak; KHANA, Research Center Yi, Rosa; Royal University of Phnom Penh, Faculty of Development Studies Yi, Siyan; KHANA, KHANA Center for Population Health Research; Touro University California, Center for Global Health Research
Primary Subject Heading:	Mental health
Secondary Subject Heading:	Public health, Epidemiology, Sociology, Health services research
Keywords:	Cross-sectional survey, Depressive symptoms, MENTAL HEALTH, Social and behavioral factors, University students, Cambodia

Social and behavioral factors associated with depressive symptoms among university students in Cambodia: A cross-sectional study

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ABSTRACT

Objective To explore social and behavioral factors associated with depressive symptoms among university students in Cambodia.

Design Cross-sectional study.

Settings Two public universities, one in the capital city of Phnom Penh and another in Battambang provincial town.

Participants This study included 1,359 students randomly selected from all departments in the two universities using a multi-stage cluster sampling method for a self-administered questionnaire survey in 2015.

Primary outcome measure Depressive symptoms measured by using the Center for Epidemiologic Studies Depression scale (CES-D).

Results The proportion of students with depressive symptoms and severe depressive symptoms were 50.6% and 19.6%, respectively. After adjustment in multivariate logistic regression analysis, depressive symptoms remained significantly associated with poor academic performance (AOR=7.31, 95% CI=2.24-23.86), higher consumption of unhealthy food (AOR=1.72, 95% CI=1.08-2.76), a negative self-perception about body shape (AOR=0.54, 95% CI=0.29-0.99) and general health status (AOR=2.99, 95% CI= 1.28-7.00), and limited physical activeness (AOR=0.30, 95% CI=0.16-0.58). Depressive symptoms also remained significantly associated with adverse childhood experiences including physical violence (AOR=1.39, 95% CI=1.04-1.86), psychological abuse (AOR=1.82, 95% CI=1.37-2.42), and lack of general and medical care (AOR=0.51, 95% CI=0.30-0.86) by family during childhood.

Conclusions The key factors associated with depressive symptoms were family-related and individual behaviors and attitudes. Thus, efforts should be invested in comprehensive screening and intervention programs to diagnose those vulnerable students early, offer immediate treatment, and cater appropriate support.

Strengths and limitations of this study

- This research is among a very few studies in which standardized tools are used and rigorous analyses are performed.

- It included a large sample of students randomly selected from all departments in two public universities – one in the capital city and the other in a provincial town – using a multi-stage cluster sampling method.
- Limitations of the study, however, included the representativeness of the study sample, the cross-sectional nature of the data that limits causation inferences, unknown validity of the scales used to measures important constructs in Cambodian contexts, and potential bias of self-reported measures.

INTRODUCTION

Several studies have suggested that the aspects of mental health among university students are considerably poorer than that of their peers in the general population.[1-5] Depression is one of the most prevalent mental health problems among university students, and the prevalence is rising.[6 7] There are varied prevalence estimates of depressive symptoms among university students, ranging from in the area of 10%[8-11] to in the region of 20%[12] and up to 40% and 80%.[13-15] However, the mean prevalence of depression in university students stands at 30.6%.[6] University students are in a critical period of life since they transition from adolescence to adulthood, which requires them to make many major decisions. During this period, they encounter tremendous pressures, chiefly from economic stress, academic demands, interpersonal relationships, and struggles with making crucial decisions.[16]

Depression manifests in a wide range of symptoms, encompassing sleep and eating disturbances, lack of self-care, poor concentration, anxiety, and disinterest in everyday activities.[17] For university students, depression is correlated with poor academic achievements;[18] drop-out;[19 20] relationship instability;[21] suicidal ideation, attempts, and commitments;[18 22 23] poor work performance;[24] substance abuse;[25 26] acute infectious illnesses;[27] and poor physical and mental health in general.[28 29] Moreover, depression in this early period can build up negative consequences in adult life through its impacts on career prospects and social relationships.[30 31]

Thus, tackling depression among university students is vital since most lifetime mental disorders commence during the university age,[32] and their mental health has essential

ramifications for campus health services in particular and mental health policy-making in general. [33 34] Put another way, from a public health standpoint, early detection and prevention of mental health problems among young adults in higher education is paramount. Comprehension of their salient psychological distress, namely depression, and its correlates, would enable tailor-made and early screening and intervention programs to reduce mental health problems in this population. This is integral for their educational performance and triumph in their prospective profession as well as for the national advancement since they are future leaders.

The prevalence of depression is induced by many factors, including study populations, socio-demographics,[16 35] study sites,[16 36] diagnostic tools and sampling methods,[36 37] and socio-cultural environments.[16] Contextualization of facets linked with depression thus is significant for mitigation measures.

In Cambodia, little is known about social and behavioral determinants of depressive symptoms among student populations. In 2012, a study on 1,943 students at 11 junior high and high schools found that exposure to violence among community members, peers, or family was a predictor for depressive symptoms in the students.[38 39] A 2013 qualitative study on a sample of 28 students at a Cambodian university found that life events, problems of everyday life, and availability of social support were the main stress factors affecting students' life satisfaction.[40] Moreover, exposure to daily hassles was a stress factor having a strong impact on students' psychological and somatic responses. Nonetheless, no research has been conducted to examine social and behavioral determinants of depression among Cambodian university students. This study therefore intends to identify factors associated with depressive symptoms among university students in Cambodia.

METHODS

Study sites and population

This cross-sectional study was conducted with students at the University of Battambang (UB) in Battambang province and the Royal University of Phnom Penh (RUPP) in the capital city of Cambodia in June and July 2015. Epi Info (Centers for Disease Control and Prevention, Atlanta,

GA) was used to calculate the sample size from the university student population of approximately 168,000.[41] The anticipated percentage frequency was not known, so 50% was put for the calculation to prevent any underestimated prevalence. Based on a 95% confidence interval (CI) and a +5% margin of error, the minimum sample size required for this study was 767 students. Adjusted for 10% of incomplete responses, missing data, and rejection rate, the final minimum required sample size was 850 students.

Patient and public involvement

The development of the research questions and outcome measures was informed by university students' priorities, experience, and preferences gathered though consultative meetings with representatives of students, faculty members, and school administrators. The workshops aimed to collect inputs from the representatives for designing the study and developing the study protocol and materials. The representatives were also invited to participate in the study finding dissemination workshops in each participating university.

Sampling and data collection procedure

A multi-stage cluster sampling method was used to select the participants. First, the two universities were purposively selected, considering administration and logistic limitations. All departments of the selected universities were included in the study. In each department, non-proportion to sample size sampling method was used to select the sample from a name list provided by the department administrator to meet the required sample size. On the designated date of data collection, all selected students were approached by trained data collectors with support from a school administrator. Questionnaires and instructions were then distributed to them in a classroom for self-administration, which took approximately 30min to complete. The participants then completed the questionnaires by themselves.

Questionnaire development and training

We first developed a structured questionnaire in English and translated it into Khmer, the national language of Cambodia. Then, the Khmer questionnaire was back-translated into

English by a local expert to check its accuracy. The Khmer questionnaire was pretested with a sample of 20 students at RUPP to ensure that the wording and contents were culturally suitable and clearly understandable. We also received comments on the questionnaire from experts working on health and education in Cambodia. The questionnaire was finalized based on their feedback and findings from the pretest.

A two-day training on the study protocol and data collection methods was provided to the data enumerators and supervisors. The training focused on building familiarity with the study protocol and questionnaire, interview techniques, privacy assurance, and confidentiality. It also addressed quality control strategies, such as rechecking and reviewing the questionnaires after administration, and resolving issues that might arise during the fieldwork. The data collection supervisors were instructed to perform regular reviews with the data enumerators to monitor progress and settle any issues occurring during the process.

Variables and measurements

Depressive symptoms

Depressive symptoms were assessed by using the Center for Epidemiologic Studies Depression scale (CES-D).[42] This scale consists of 20 questions addressing six symptoms of depression, including depressed mood, guilt or worthlessness, helplessness or hopelessness, psychomotor retardation, loss of appetite, and sleep disturbance experienced during the preceding week. Each question is scored on a scale of 0 to 3 according to the frequency of the symptoms, and the total CES-D score ranges from 0 to 60. To calculate the total score, four items (I felt I was just as good as other people, I felt hopeful about the future, I was happy, and I enjoyed life) were reverse coded. The criterion validity of the CES-D scale has been well established in Western[42] and Asian[43] populations. We defined depressive symptoms as present when a subject had a CES-D score of ≥16. A cutoff value of ≥23 was also used to define severe depressive state.[44]

Socio-demographic characteristics, substance use, and sexual behaviors

We adapted standardized tools from the most recent Cambodia Demographic and Health Survey[45] as well as from our previous student and young people health surveys in Cambodia[38 39 46-48] to measure socioeconomic characteristics, sexual behaviors with different partners, and substance use (alcohol, tobacco, and illicit drugs). Socio-demographic characteristics of the respondents included study site, gender, age, marital status, academic year, living situations, perceived family economic status, and perceived academic performance.

Health related behaviors

We used the Health Behavior Survey,[49] which was designed as a broad survey of health-related behaviors and beliefs, components of the "National College Health Risk Behavior Survey" (1997),[50] and the Global School-based Student Health Survey.[51] Each health behavior area was addressed by only a limited number of items. For example, frequency of consumption of fast food in an average week was assessed by a question, "On average, how many times do you eat fast food per week?" with response options of 0 time, 1-2 times a week, and 3 or more times a week. Similar questions and response options were used to assess consumption of several other kinds of healthy and unhealthy food, such as high-fat snack or fruits/vegetables. Self-ratings were also used for some questions, such as perceived body size (rated from very overweight to very underweight) and general health status (rated from very good to very poor).

Adverse childhood experiences (ACEs)

Five questions were adapted from the brief screening version of the Childhood Trauma Questionnaire to measure ACEs.[52] The five yes/no questions asked about the experiences of physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect during childhood.

Self-rated health

SF-12 Health Survey (SF-12) was used to measure self-rated health.[53 54] The SF-12 is a multipurpose short-form generic measure of health status. It is a subset of the larger SF-36 and monitors health in general and in specific populations. The SF-12 measures eight health

aspects, namely physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality (energy/fatigue), social functioning, role limitations due to emotional problems, and mental health (psychological distress and psychological well-being).

Data analyses

Double data entry was performed using EpiData version 3 (Odense, Denmark). χ^2 test, or Fisher's exact test when a sample size was smaller than five in one cell, was used for categorical variables, and Student's *t*-test was used for continuous variables to compare socio-demographic characteristics, health risk behaviors (sexual behaviors, substance use, and eating behaviors), self-rated health (SF-12), and ACEs among students with depressive symptoms, defined by a CES-D score of ≥16, to those without depressive symptoms. The same comparisons were also made among students with and without severe depressive symptoms, defined by a CES-D score of ≥23.

In multivariate models, we first included all variables significantly associated with depressive symptoms in the bivariate analyses at a level of *p*-value <0.05 simultaneously in the models. Variables with a *p*-value >0.05 were then removed, and the models were refitted. The steps were repeated until all *p*-values of the remaining variables were <0.05 in the final models. Adjusted odds ratio (AOR) were obtained and presented with CI and *p*-values. SPSS version 22 (IBM Corporation, New York) was used for all statistical analyses.

Ethical considerations

The National Ethics Committee for Health Research of the Ministry of Health, Cambodia, approved the study protocol and materials (No. 191NECHR). Participation in this study was voluntary. In the process of obtaining a written informed consent, students were made clear that they could refuse or discontinue their participation at any time and for any reason. The confidentiality and privacy of the respondents were protected by administering the questionnaires in a private premise and by excluding personal identifiers from the data and field notes. After completing the survey, each participant received a small gift (costing approximately $US 2.0) for their time compensation.

RESULTS

Socio-demographic characteristics

The study sample included 493 students (36.3%) from UB and 866 students (63.7%) from RUPP. About half (50.8%) of the respondents were male, with a mean age of 21.3 years [standard deviation (SD)=2.3]. Less than 2.0% (*n*= 26) of the students initially selected for the study declined the participation, mostly due to their time constrains. They were then replaced by the next gender-matched student in the student name list. The majority of the respondents (97.9%) were unmarried, and 43.4% were living with their parents. Regarding their family economic status, 59.2% reported that their family was neither rich nor poor. The proportion of students with depressive symptoms and severe depressive symptoms were 50.6% and 19.6%, respectively.

Table 1 that a significantly higher proportion of students with depressive symptoms were from UB (p=0.004) and from a poorer family (p=0.002) and reported poorer academic performance (p<0.001). Similarly, a significantly higher proportion of students with severe depressive symptoms were female (p=0.002) and from a poorer family (p=0.04) and reported poorer academic performance (p<0.001).

Table 1 Comparisons of socio-demographic characteristics of university students with and without depressive symptoms

Characteristics	Depressive symptoms			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Study site			0.004			0.08
Battambang	218 (44.2)	275 (55.8)		384 (77.9)	109 (22.1)	
Phnom Penh	454 (52.4)	412 (47.6)		709 (81.9)	157 (18.1)	
Gender			0.20			0.002
Female	319 (47.7)	350 (52.3)		515 (77.0)	154 (23.0)	
Male	353 (51.2)	337 (48.8)		578 (83.8)	112 (16.2)	
Age (mean ± SD)	21.3 ± 2.4	21.4 ± 2.3	0.82	21.4 ± 2.3	21.1 ± 2.4	0.12
Marital status			0.34			0.08

Unmarried	655 (49.2)	675 (50.8)		1066 (80.2)	264 (19.8)	
Married	17 (58.6)	12 (41.4)		27 (93.1)	2 (6.9)	
Academic year			0.59			0.66
1	240 (48.4)	256 (51.6)		394 (79.4)	102 (20.6)	
2	145 (51.6)	136 (48.4)		224 (79.7)	57 (20.3)	
3	123 (49.0)	128 (51.0)		201 (80.1)	50 (19.9)	
4	164 (49.5)	167 (50.5)		274 (82.8)	57 (17.2)	
Currently living with			0.35			0.70
Parents	297 (49.9)	298 (50.1)		486 (81.7)	109 (18.3)	
Relatives	81 (45.0)	99 (55.0)		139 (77.2)	41 (22.8)	
Sibling	87 (56.1)	68 (43.9)		124 (80.0)	31 (20.0)	
Friend	162 (50.2)	161 (49.8)		258 (79.9)	65 (20.1)	
Spouse/partners	10 (47.6)	11 (52.4)		19 (90.5)	2 (9.5)	
Alone	26 (41.9)	36 (58.1)		50 (80.6)	12 (19.4)	
Other	9 (39.1)	14 (60.9)		17 (73.9)	6 (26.1)	
Perceived family economic status			0.002			0.04
Well-off/quite well-off	248 (55.7)	197 (44.3)		374 (84.0)	71 (16.0)	
Neither poor nor well-off	398 (47.0)	448 (53.0)		669 (71.1)	177 (20.9)	
Poor	26 (38.2)	42 (61.8)		50 (73.5)	18 (26.5)	
Perceived academic performance			<0.001			<0.001
Very good	44 (77.2)	13 (22.8)		52 (91.2)	5 (5.8)	
Good	180 (59.0)	123 (40.6)		263 (86.8)	40 (13.2)	
Fairly good	301 (50.5)	295 (49.5		484 (81.2)	112 (18.8)	
Fair	138 (37.7)	228 (62.3)		275 (75.1)	91 (24.9)	
Poor	9 (24.3)	28 (75.7)		19 (51.4)	18 (48.6)	

Abbreviation: SD, standard deviation.

Values are numbers of subjects (%) for categorical variables and means ± standard deviation (SD) for continuous variables.

[*] *Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.*

[†] *Defined by a CES-D score of ≥23.*

[‡] *Chi-square test was used for categorical variables; independent Student's t-test was used for continuous variables.*

Health risk behaviors

As shown in Table 2, a significantly higher proportion of students with depressive symptoms reported consuming unhealthy food frequently, such as high-fat snack (p=0.001 for depressive symptoms; p<0.001 for severe depressive symptoms), margarine, butter, or meat fat (p=0.02 for depressive symptoms; p<0.001 for severe depressive symptoms). A significantly lower proportion of students with depressive symptoms reported consuming of healthy food frequently, such as fruits and vegetables (p=0.009 for depressive symptoms; p=0.007 for severe depressive symptoms), or lean protein (p<0.001 for depressive symptoms; p=0.03 for severe depressive symptoms). A significantly higher proportion of students with depressive symptoms reported not having desert over the past week (p=0.003 for depressive symptoms; p=0.008 for severe depressive symptoms). Moreover, a significantly higher proportion of students with depressive symptoms perceived that their body size was very overweight or very underweight (p<0.001 for both depressive symptoms and severe depressive symptoms).

Table 2 Comparisons of health risk behaviors among university students with and without depressive symptoms

Health and health risk behaviors	Depressive symptoms*			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Current tobacco smokers	5 (33.3)	10 (66.7)		12 (80.0)	3 (20.0)	0.97
Self-perception regarding alcohol use			0.25			0.004
Non drinker	425 (50.7)	413 (49.3)		681 (81.3)	157 (18.7)	
Occasional drinker	247 (47.4)	271 (52.6)		412 (78.7)	106 (21.3)	
Regular drinker	0 (0.0)	3 (100)		0 (0.0)	3 (100)	
Current illicit drug users	0 (0.0)	4 (100)	0.05	1 (25.0)	3 (75.0)	0.03
Condom use at last sex	39 (47.0)	44 (53.0)	0.95	73 (88.0)	10 (12.0)	0.08
Diagnosed with an STI	4 (40.0)	6 (60.0)	0.75	110 (84.0)	21 (16.0)	0.67
Thought of ending life	40 (24.8)	121 (75.2)	<0.001	84 (52.2)	77 (47.8)	<0.001
Attempted to end life	5 (20.0)	20 (80.0)	0.63	11 (44.0)	14 (56.0)	0.47
Frequency of eating fast food per week			0.49			0.24

0 time	410 (49.3)	421 (50.7)		679 (81.7)	152 (18.3)	
1-2 times	231 (50.7)	225 (49.3)		360 (78.9)	96 (21.1)	
3 times or more	31 (43.1)	41 (56.9)		54 (75.0)	18 (25.0)	
Frequency of daily soft drink consumption			0.31			0.01
0 time	105 (46.5)	121 (53.5)		178 (78.8)	48 (21.2)	
1-2 times	399 (51.2)	380 (48.8)		647 (83.1)	132 (16.9)	
3 times or more	168 (47.5)	186 (52.5)		268 (75.7)	86 (24.3)	
Frequency of weekly high-fat snack consumption			0.001			<0.001
0 time	162 (52.8)	145 (47.2)		260 (84.7)	47 (15.3)	
1-2 times	443 (51.0)	426 (49.0)		711 (81.8)	158 (18.2)	
3 times or more	67 (36.6)	116 (63.4)		122 (66.7)	61 (33.3)	
Frequency of weekly desert consumption			0.003			0.008
0 time	106 (40.6)	155 (59.4)		192 (73.6)	69 (26.4)	
1-2 times	434 (52.7)	389 (47.3)		676 (82.1)	147 (17.9)	
3 times or more	132 (48.0)	143 (52.0)		225 (81.8)	50 (18.2)	
Frequency of weekly fruit/vegetable consumption			0.009			0.007
0 time	50 (37.3)	84 (62.7)		94 (70.1)	40 (29.9)	
1-2 times	390 (51.7)	365 (48.3)		617 (81.7)	138 (18.3)	
3 times or more	232 (49.4)	238 (50.6)		382 (81.3)	88 (12.7)	
Frequency of weekly lean protein consumption			<0.001			0.03
0 time	57 (34.8)	107 (65.2)		119 (72.6)	45 (27.4)	
1-2 times	453 (51.8)	421 (48.2)		714 (81.7)	160 (18.3)	
3 times or more	162 (50.5)	159 (49.5)		260 (81.0)	61 (19.0)	
Amount of margarine/butter/meat fat consumption			0.02			<0.001
None/very little	296 (52.4)	269 (47.6)		471 (83.4)	94 (16.6)	
Some	339 (48.7)	357 (51.3)		558 (80.2)	138 (19.8)	
A lot	37 (37.8)	61 (62.2)		64 (65.3)	34 (34.7)	
Self-perception about body size			<0.001			<0.001
About right	275 (55.4)	221 (44.6)		428 (86.3)	68 (13.7)	
Very overweight	27 (34.2)	52 (65.8)		55 (69.6)	24 (30.4)	
Slightly overweight	161 (48.9)	168 (51.1)		247 (75.1)	82 (24.9)	
Slightly underweight	191 (49.6)	194 (50.4)		319 (82.9)	66 (17.1)	

Very underweight	18 (25.7)	52 (74.3)	44 (62.9)	26 (37.1)

Abbreviations: STI, sexually transmitted infections.
Values are numbers of subjects (%).
[*] Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.
[†] Defined by a CES-D score of ≥23.
[‡] Chi-square test was used or Fisher's exact test was used as appropriate.

Self-rated health (SF-12)

Table 3 shows that significantly higher proportion of students with depressive symptoms perceived that their general health status was poor (p<0.001 for both depressive symptoms and severe depressive symptoms). A significantly higher proportion of students with depressive symptoms reported higher levels of limitation in several daily activities, such as limitation in moderate activities (p<0.001 for depressive symptoms; p=0.02 for severe depressive symptoms), climbing several flights of stairs (p<0.001 for depressive symptoms), or other kinds of activities in the past four weeks as a result of their physical or emotional health problems (p<0.001 for both depressive symptoms and severe depressive symptoms). Further, they reported higher levels of problems in several other physical and emotional health aspects in the past four weeks, such as the feeling that they had accomplished less than they would like (p<0.001 for both depressive symptoms and severe depressive symptoms), pain interferes with their normal work (p<0.001 for both depressive symptoms and severe depressive symptoms), having less energy (p<0.001 for both depressive symptoms and severe depressive symptoms), down-hearted and blue (p<0.001 for both depressive symptoms and severe depressive symptoms), and that their physical health interferes with their social acts (p<0.001 for both depressive symptoms and severe depressive symptoms).

Table 3 Comparisons of self-rated health (SF-12) among university students with and without depressive symptoms

Self-rated health (SF-12)	**Depressive symptoms[*]**			**Severe depressive symptoms[†]**		
	No	**Yes**	**P-value[‡]**	**No**	**Yes**	**P-value[‡]**
Self-perception on general health status			<0.001			<0.001
Very good	106 (64.2)	59 (35.8)		147 (89.1)	18 (10.9)	
Good	380 (58.5)	270 (41.5)		566 (87.1)	84 (12.9)	

Neither good nor poor	176 (38.0)	287 (62.0)		351 (75.8)	112 (24.2)	
Poor	10 (12.3)	71 (87.7)		29 (35.8)	52 (64.2)	
Limitation in moderate activities on a typical day			<0.001			0.02
Greatly limited	20 (28.2)	51 (71.8)		50 (70.4)	21 (29.6)	
Mildly limited	291 (45.6)	347 (54.4)		505 (79.2)	133 (20.8)	
Not limited	361 (55.5)	289 (44.5)		538 (82.8)	112 (17.2)	
Limitation in climbing several flights of stairs			<0.001			0.24
Greatly limited	64 (35.8)	115 (64.2)		140 (78.2)	39 (21.8)	
Mildly limited	323 (47.8)	353 (52.2)		536 (79.3)	140 (20.7)	
Not limited	285 (56.5)	219 (43.5)		417 (82.7)	87 (17.2)	
Limitation in other kinds of activities in past 4 weeks	271 (37.8)	446 (62.2)	<0.001	516 (72.0)	201 (28.0)	<0.001
Accomplished less than you would like in past 4 weeks as a result of emotional health	377 (61.9)	232 (38.1)	<0.001	553 (50.6)	197 (26.3)	<0.001
Accomplished less than you would like in past 4 weeks as a result of physical health	304 (67.3)	148 (32.7)	<0.001	675 (74.4)	232 (25.6)	<0.001
Did activities less carefully than usual in past 4 weeks	378 (41.8)	526 (58.2)	<0.001	677 (74.9)	227 (25.1)	<0.001
Pain interferes with your normal work in past 4 weeks			<0.001			<0.001
Not at all	141 (75.8)	45 (24.2)		176 (94.6)	10 (5.4)	
A little bit	401 (57.6)	295 (42.4)		635 (91.2)	61 (8.8)	
Moderately	106 (32.9)	216 (31.4)		216 (67.1)	106 (32.9)	
Quite a bit	23 (16.5)	116 (83.5)		62 (44.6)	77 (55.4)	
Extremely	1 (6.3)	15 (93.8)		4 (25.0)	12 (75.0)	
Feeling calm and peaceful in past 4 weeks			0.33			0.06
A lot of the time	22 (42.3)	30 (57.7)		38 (73.1)	14 (26.9)	
Most of the time	68 (53.5)	59 (46.5)		92 (72.9)	35 (27.6)	
A good bit of time	115 (50.9)	111 (49.1)		188 (83.2)	38 (16.2)	

Some of the time	278 (46.8)	316 (53.2)		477 (80.3)	117 (17.7)	
A little of the time	170 (51.8)	158 (48.2)		274 (83.5)	54 (16.5)	
None of the time	19 (59.4)	13 (40.6)		24 (75.0)	8 (25.0)	
Having a lot of energy in past 4 weeks			<0.001			<0.001
A lot of the time	46 (61.3)	29 (38.7)		66 (88.0)	9 (12.0)	
Most of the time	111 (68.9)	50 (31.1)		149 (92.5)	12 (7.5)	
A good bit of time	245 (56.8)	186 (43.2)		383 (88.9)	48 (11.1)	
Some of the time	207 (41.5)	292 (58.5)		364 (72.9)	135 (27.1)	
A little of the time	57 (33.7)	112 (66.3)		116 (68.6)	53 (31.4)	
None of the time	6 (25.0)	18 (75.0)		15 (62.5)	9 (37.5)	
Feeling down-hearted and blue in past 4 weeks			<0.001			<0.001
A lot of the time	7 (21.9)	25 (78.1)		14 (43.8)	18 (56.3)	
Most of the time	8 (8.3)	88 (91.7)		36 (37.5)	60 (62.5)	
A good bit of the time	42 (17.9)	171 (80.3)		117 (54.9)	96 (45.1)	
Some of the time	222 (46.7)	253 (53.3)		412 (86.7)	63 (13.3)	
A little of the time	354 (71.5)	141 (28.5)		469 (94.7)	26 (5.3)	
None of the time	39 (81.3)	9 (18.8)		45 (93.8)	3 (6.3)	
Physical health interferes social act in past 4 weeks			<0.001			<0.001
A lot of the time	4 (33.3)	8 (66.7)		6 (50.0)	6 (50.0)	
Most of the time	10 (23.3)	33 (76.7)		18 (41.9)	58 (58.1)	
Some of the time	146 (38.1)	237 (61.9)		275 (71.8)	108 (28.2)	
A little of the time	355 (53.7)	306 (46.3)		568 (85.9)	93 (14.1)	
None of the time	157 (60.4)	103 (39.6)		226 (26.9)	34 (13.2)	

Values are numbers of subjects (%) for categorical variables.

[*] *Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.*

[†] *Defined by a CES-D score of ≥23.*

[‡] *Chi-square test was used for categorical variables or Fisher's exact test was used as appropriate.*

Adverse childhood experiences (ACEs)

Table 4 shows that a significantly higher proportion of students with depressive symptoms reported having been hit, slapped, or kicked by a parent or guardian (p<0.001 for both depressive symptoms and severe depressive symptoms); that people in their family had said hurtful or insulting things to them (p<0.001 for both depressive symptoms and severe

depressive symptoms); and that someone had tried to touch them or make them touch him/her in a sexual way (p=0.001 for depressive symptoms; p<0.001 for severe depressive symptoms). In contrast, significantly lower proportion of students with depressive symptoms reported that there had been someone to take care of them and take them to medical care when they got sick (p=0.04 for depressive symptoms; p=0.03 for severe depressive symptoms), and someone who helped them feel that they were loved and important (p=0.03 for depressive symptoms; p<0.001 for severe depressive symptoms).

Table 4 Comparisons of adverse childhood experiences among university students with and without depressive symptoms

Adverse childhood experiences	Depressive symptoms*			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Had been hit, slapped, kicked, by a parent/guardian	200 (38.2)	323 (61.8)	<0.001	384 (73.4)	139 (26.6)	<0.001
People in my family had said hurtful or insulting things to me	297 (39.0)	464 (61.0)	<0.001	558 (73.3)	203 (26.7)	<0.001
Someone had tried to touch me or make me touch them in a sexual way	87 (39.2)	135 (60.8)	0.001	159 (71.6)	63 (28.4)	<0.001
There had been someone to take care me and take me to medical care when I got sick	636 (50.2)	632 (49.8)	0.04	1028 (81.1)	240 (18.9)	0.03
There had been someone who helped me feel that I was loved and important	647 (50.1)	644 (49.9)	0.03	1050 (81.3)	266 (19.6)	<0.001

Values are numbers of subjects (%).

Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.

†Defined by a CES-D score of ≥23.*

‡Chi-square test was used.*

Risk factors of depressive symptoms

Results of multivariate logistic analyses are shown in Table 5. After controlling for potential confounding factors, the odds of depressive symptoms increased significantly with self-reported poor academic performance (depressive symptoms: AOR=7.31, 95% CI=2.24-23.86; severe depressive symptoms: AOR=7.38, 95% CI=1.75-10.94) and high consumption of unhealthy food, including high-fat snack, margarine, butter, or meat fat (depressive symptoms: AOR=1.72, 95% CI=1.08-2.76; severe depressive symptoms: AOR=2.13, 95% CI=1.15-3.95). The odds decreased significantly with the perception that their body size was slightly underweight compared to the perception that their body size was very overweight (depressive symptoms: AOR=0.54, 95% CI=0.29-0.99; severe depressive symptoms: AOR=0.37, 95% CI=0.18-0.77).

Regarding self-rated health, the odds of depressive symptoms increased significantly with the perception that their general health status was poor (depressive symptoms: AOR=2.99, 95% CI=1.28-7.00; severe depressive symptoms: AOR=5.43, 95% CI=2.19-13.46) and the report of higher level of limitation in moderate activities (depressive symptoms: AOR=0.30 (95% CI=0.16-0.58), higher level of pain interference with their normal work (depressive symptoms: AOR=10.43, 95% CI=1.05-10.94; severe depressive symptoms: AOR=10.02, 95% CI=1.99-9.28), and higher level of feeling down-hearted and blue (depressive symptoms: AOR=6.69, 95% CI=1.87-23.90; severe depressive symptoms: AOR=8.72, 95% CI=1.69-14.86).

For ACEs, the odds of depressive symptoms increased significantly with the report of having been hit, slapped, or kicked by a parent or guardian (depressive symptoms: AOR=1.39, 95% CI=1.04-1.86) and that people in their family had said hurtful or insulting things to them (depressive symptoms: AOR=1.82, 95% CI=1.37-2.42; severe depressive symptoms: AOR=2.18, 95% CI=1.46-3.24) during their childhood. In contrast, the odds of depressive symptoms decreased significantly with the report that there had been someone to take care of them and take them to medical care when they got sick (depressive symptoms: AOR=0.51, 95% CI=0.30-0.86; severe depressive symptoms: AOR=0.26, 95% CI=0.13-0.52).

Table 5 Factors associated with depressive symptoms and severe depressive symptoms

Variables in the final model*	Depressive symptoms†		Severe depressive symptoms‡	
	AOR (95% CI)	P-value	AOR (95% CI)	P-value
Perceived academic performance				
Very good	Reference		Reference	
Good	2.28 (1.01-5.15)	0.04	1.22 (0.35-4.19)	0.76
Fairly good	3.51 (1.58-7.78)	0.002	2.15 (0.65-7.11)	0.21
Fair	5.30 (2.35-11.93)	<0.001	2.52 (0.75-8-43)	0.13
Poor	7.31 (2.24-23.86)	0.001	7.38 (1.75-10.94)	0.006
Frequency of weekly high-fat snack consumption				
0 time	Reference		Reference	
1-2 times	0.99 (0.72-1.37)	0.95	1.25 (0.78-1.99)	0.36
3 times or more	1.72 (1.08-2.76)	0.02	2.13 (1.15-3.95)	0.02
Frequency of weekly lean protein consumption				
0 time	Reference		Reference	
1-2 times	0.52 (0.34-0.79)	0.002	0.69 (0.41-1.18)	0.17
3 times or more	0.62 (0.38-0.96)	0.04	0.80 (0.44-1.47)	0.48
Amount of margarine/butter/meat fat consumption				
None/very little			Reference	
Some			0.98 (0.66-1.46)	0.91
A lot			1.92 (1.02-3.64)	0.04
Self-perception about body shape				
Very overweight	Reference			
Slightly overweight	0.56 (0.31-1.07)	0.08	0.65 (0.32-1.14)	0.25
About right	0.58 (0.32-1.05	0.07	0.45 (0.22-0.93)	0.03
Slightly underweight	0.54 (0.29-0.99)	0.04	0.37 (0.18-0.77)	0.008
Very underweight	0.92 (0.38-2.25)	0.86	0.38 (0.14-0.99)	0.04
Self-perception on general health status				
Very good				
Good	1.05 (0.68-1.64)	0.82	1.19 (0.60-2.38)	0.62
Fair	1.58 (0.99-2-51)	0.05	1.47 (0.73-2.96)	0.28
Poor	2.99 (1.28-7.00)	0.01	5.43 (2.19-13.46)	<0.001
Limitation in moderate activities on a typical day				

Greatly limited	Reference		Reference	
Mildly limited	0.39 (0.20-0.74)	0.004	0.64 (0.29-1.34)	0.23
Not limited	0.30 (0.16-0.58)	<0.001	0.63 (0.30-1.36)	0.24
Pain interferes with your normal work in past 4 weeks				
Not at all	Reference		Reference	
A little bit	1.68 (1.08-2.61)	0.02	1.01 (0.46-2.22)	0.99
Moderately	3.10 (1.89-5.10)	<0.001	3.69 (1.68-7.11)	0.001
Quite a bit	4.14 (2.13-8.05)	<0.001	4.68 (2.01-10.92)	<0.001
Extremely	10.43 (1.05-10.94)	0.04	10.02 (1.99-9.28)	0.005
Feeling down-hearted and blue in past 4 weeks				
None of the time	Reference		Reference	
A little of the time	0.52 (0.63-3.66)	0.35	1.02 (0.24-4.29)	0.98
Some of the time	3.42 (1.42-8.23)	0.006	1.83 (0.45-7.45)	0.40
A good bit of the time	7.70 (3.02-19.66)	<0.001	6.01 (1.45-4.85)	0.01
Most of the time	20.71 (6.47-66.37)	<0.001	9.04 (2.31-13.71)	0.002
A lot of the time	6.69 (1.87-23.90)	0.003	8.72 (1.69-14.86)	0.01
Had been hit, slapped, kicked, by a parent/guardian				
No	Reference		Reference	
Yes	1.39 (1.04-1.86)	0.03	1.11 (0.75-1.65)	0.59
People in my family had said hurtful or insulting things to me				
No	Reference		Reference	
Yes	1.82 (1.37-2.42)	<0.001	2.18 (1.46-3.24)	<0.001
There had been someone to take care of me and take me to medical care when I got sick				
No	Reference		Reference	
Yes	0.51 (0.30-0.86)	0.01	0.26 (0.13-0.52)	<0.001

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.

**Variables in the table were the ones that remained statistically significant in the final multivariate logistic regression model after several steps of model fitting.*

† Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.

‡Defined by a CES-D score of ≥23.

DISCUSSION

This study unearthed a number of factors correlated with depressive symptoms among university students in Cambodia. The salient factors comprised cultural and socio-economic dimensions (gender, socio-economic background, and lack of general and medical care by family during their childhood), individual behaviors and attitudes (poor academic accomplishment, consumption of unhealthy food, negative perception about their body and their general health status, and limited physical activeness), and nurture-related facets (physical violence and psychological abuse by family during their childhood).

The bivariate outcomes display that students from the provincial university (UB) and a poorer family were more susceptible to depressive symptoms. Likewise, students from a poorer family and female students were more prone to severe depressive symptoms. Albeit not manifesting in the multivariate model, these factors are corroborated by the existing scholarship. Various studies revealed that university students from rural areas and low socio-economic backgrounds were predisposed to higher depression.[1 16 28 55 56] This could be explained by an economic situation where students with a rural background tended to stipulate a poorer family status. Plus, financial vulnerability could further exacerbate depression in students from low-income families. A meta-analysis of 60 studies unveiled that people in the lowest socio-economic quintile had 1.81 the probability of depression compared with those in the highest socio-economic quintile.[57] A global study on 17,348 university students from 23 high-, middle-, and low-income countries also uncovered that higher depressive symptoms were recorded among students in low-income countries and economies with greater income inequality.[16] The Cambodian economy has been growing rapidly in terms of income per capita; yet, income gaps between the rich and the poor and between rural and urban areas remain large.[58] The gaps in income and material growth, which typify economic conditions, may induce people's mental health problems. In another word, poor economic status may bring about low self-esteem and self-confidence, which would lead to depression.

Some research also discovered that female students were more at risk to depression.[1 6 59-62] This might be due to social difficulties, physiological tenets, higher self-expectations, and perceived lack of competence among female students.[59] In the Cambodian culture, young women would perceive a great deal of challenges when living away from their family or parents

since they need to maintain the cultural behaviors and meanwhile cope with independent habitation. Over half (56.6%) of the student respondents in our study were not living with their parents. Moreover, women tended to over-report medical and psychological symptoms as indicated in a study on 440 undergraduate students in America.[63] Articulating their emotions may be one strategy for dealing with stressful events.

Our multivariate results depict that students with depressive symptoms, regardless of severity, tended to report poor academic performance and higher consumption of unhealthy food. These findings conform to a systematic review of 24 studies[6] and studies in Asia, such as China,[7] which pinpoint low scholastic merit and suicidal ideation as consistent correlates of depression in university students probably as a culmination of poor concentration and solitude. On the consumption of unhealthy food, the transition from adolescence to adulthood, and thus the changes in lifestyle such as living arrangements and independence, might have rendered university students to indulge in unhealthy food, as pinpointed by a meta-analysis of 39 studies in China.[7] As afore-mentioned, more than half of our sample were not living with their parents; therefore, it might have been hard for them to maintain healthy daily food. Conversely, depression might have made students care-free about themselves and consequently eat unhealthily.[17] This implies that nutrition education for both physical and mental health, stressing healthy food for the body and mind, is imperative for university students.

Students with depressive symptoms, regardless of magnitude, also tended to have a negative perception about their body and their general health status. These findings confirms the general perception among depressed people who are not gratified with their body and health,[17] although these relationships require a cautious interpretation given that CES-D also measures some aspects of negative self-perception. Further, depressed students were more likely to have limited physical activeness, more pain interference with their normal work, and more dismay or sorrow.[64 65] Therefore, physical exercises, such as sports, should be regularly promoted among university students.

Finally, students with depressive symptoms, disregard of severity, were more likely to encounter physical violence by their parent or guardian, psychological abuse by their family members, and lack of general and medical care by their family when they were growing up. As

for the physical violence and psychological abuse, this finding tends to acquiesce with a study in Cambodia that postulates that exposure to violence within family is associated with depression in high school students.[38 39] On the lack of general and medical care by family, a Chinese study on 5,245 students at six universities found that students who had a poor parental relationship were more vulnerable to depression.[66] Also, a global study on 17,348 university students from 23 high, middle-, and low-income countries iterated that university students with less individualistic cultures, particularly in Asia, reported higher extents of depressive symptoms.[16] Students of these cultures longed for more familial and societal ties and assistance, and thus felt depressed once this social capital was unavailable.[16] This highlights a significant role of family bonds and scaffolding in association with depression among university students. The lack of social support from the family presumably would only be a factor for students living independently. But, for those living with relatives, friends, or spouse, they would still have such support.

A study on a sample of 2,671 respondents in nine provinces and a capital city in 2012 revealed that Cambodia greatly needs more and better counseling and mental health services.[67] The study also pointed out the shortage of skilled professionals in the field of mental health, particularly those with high clinical and counseling skills to treat mental disorders. In 2012, Cambodia had only 49 trained psychiatrists and 45 psychiatric nurses working in mental health facilities and private practices.[67 68] Many health staff lack training, supervision, and experience in these areas. Only about 300 doctors completed basic mental healthcare training.[69] At university level, the 2012 study called for more awareness raising for self-care and burnout prevention and mental health counseling services for staff and students.[67] Given the paucity of mental health services in general, let alone at universities, our findings fuel the needs for more and better mental healthcare in Cambodia. Further to medical care, universities should provide measures, such as student loans and healthy canteens, to mitigate some key predictors of depression among students, such as financial hardship and poor diets.

This study contains certain limitations. First, it examined students at only two public universities, one in a city and the other in a province. Hence, its findings cannot be generalized at a national level. Second, the cross-sectional design did not enable an establishment of the

causal linkages between depressive symptoms and the related factors. Given the temporal order and the cross-sectional nature of the data, causal relationships between the variables could not be derived. Potential bi-directionality of the associations could occur either way. For instance, physical inactivity could cause depression. Nonetheless, the reverse could also be true—that depression could lead to inactivity, and of course both could be true simultaneously, where depressive symptoms worsen with physical inactivity, making physical activity less likely. Third, this study employed self-reported data, which might have been subject to recall bias of over-reporting and under-reporting. Future studies should attempt to use more objective data (e.g., linking participants' responses to university records of academic performance) to increase validity of the information. Nonetheless, the quality of the data was ensured by thorough training of the enumerators and field supervisors on the study protocols and data collection method. Finally, the main outcome measure (CES-D) and some other measures, such as ACEs and SF-12, were modified from other research and have not been validated in the Cambodian settings. Therefore, the interpretation of the findings must be made with caution. Notwithstanding these malfeasances, the findings of this study offer first and foremost implications for policy development and future research in the Cambodian context.

CONCLUSIONS

This study identified social and behavioral factors associated with depressive symptoms among Cambodian students at two universities. While causation could not be drawn between these factors and depression, we surmise that these factors were inter-twined, and thus need to be addressed in an integrated and holistic fashion.

These findings render three major implications. First, given the current educational reform and labor market that demand better quality and ergo more competition among university students, the correlates of depressive symptoms could not be more critical for tackling for the time being. Failure to ameliorate these factors would jeopardize the qualification and career development of this populace and finally the human capital for nation-building. Second, these findings warrant an acceleration of on-campus counseling services for university students throughout the course of studentship. Efforts should be invested in

comprehensive screening and intervention programs to diagnose those susceptible students early, offer immediate treatment, and cater appropriate support. Ultimately, the jurisdiction of refining students' mental state should go beyond universities to families and pertinent governmental bodies at large, provided we are to assist the young to overcome their academic challenges and enjoy a prosperous post-graduation life. Further research could delve into changing lifestyles and their associations with depressive symptoms among a larger sample of university students. Furthermore, validation studies are required to develop and validate reliable instruments for use in Cambodian populations.

Acknowledgements The authors thank research assistants; representatives of students, faculty members, and school administrators who supported the development of the study design and tools; and the study participants for their contribution to this study.

Contributions SY, KP and TS conceived research questions, designed the study and developed the research protocol and tools. SY and CN analyzed the data and interpreted the results and drafted the manuscript. KP, PC and RY supported the protocol and tools development and were responsible for training and data collection. All authors contributed to the writing and approved the final manuscript.

Funding Data used for this analysis were collected as part of a larger study funded by the United States Agency for International Development (USAID). The funder had no role in study design, data collection and analyses, decision to publish, or preparation of the manuscript.

Disclaimer Content of this paper is the responsibility of the authors and does not reflect the view of USAID or our respective institutions

Competing interests None declared

Ethics approval The National Ethics Committee for Health Research of the Ministry of Health, Cambodia approved this study (Reference no. 082NECHR), and a written informed consent was obtained from each participant.

Data sharing statement Data used for this analysis are available upon request from the Principal Investigator (Dr. Siyan Yi) at siyan@doctor.com. The data cannot be made publicly available due to ethical restriction.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Confirmed (Lines 1-54)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found. Confirmed (Lines 30-54)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported. Confirmed (Lines 67-110)
Objectives	3	State specific objectives, including any prespecified hypotheses. Confirmed (Lines 108-110)
Methods		
Study design	4	Present key elements of study design early in the paper. Confirmed (Line 114)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection. Confirmed (Line 114-116)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Confirmed (Lines 124-133)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable. Confirmed (Lines 152-201)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Confirmed (Lines 159-205)
Bias	9	Describe any efforts to address potential sources of bias. Confirmed (Lines 143-157)
Study size	10	Explain how the study size was arrived at. Confirmed (116-122)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why. Confirmed (Lines 207-215)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding. Confirmed (Lines 216-221)
		(*b*) Describe any methods used to examine subgroups and interactions. (Not applicable)
		(*c*) Explain how missing data were addressed (Not applicable)
		(*d*) If applicable, describe analytical methods taking account of sampling strategy. (Not applicable)
		(*e*) Describe any sensitivity analyses. (Not applicable)
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Confirmed (Lines 235)
		(b) Give reasons for non-participation at each stage (Not applicable)
		(c) Consider use of a flow diagram (Not applicable)
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Confirmed (Lines 236-243)
		(b) Indicate number of participants with missing data for each variable of interest. (Not applicable)
Outcome data	15*	Report numbers of outcome events or summary measures. Confirmed (241-243)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and

		their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included. Confirmed (244-359)
		(*b*) Report category boundaries when continuous variables were categorized. (Not applicable)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period. (Not applicable)
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses. Not applicable.
Discussion		
Key results	18	Summarise key results with reference to study objectives. Confirmed (Lines 362-368)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. Confirmed (Lines 446-464)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. Confirmed (Lines 369-445)
Generalisability	21	Discuss the generalisability (external validity) of the study results. Confirmed (Lines 446-448)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based. Confirmed (Lines 497-499)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Social and behavioral factors associated with depressive symptoms among university students in Cambodia: A cross-sectional study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019918.R2
Article Type:	Research
Date Submitted by the Author:	03-Sep-2018
Complete List of Authors:	Ngin, Chanrith; KHANA Center for Population Health Research; Royal University of Phnom Penh, Faculty of Development Studies Pal, Khuondyla; KHANA Center for Population Health Research Tuot, Sovannary; KHANA, KHANA Center for Population Health Research Chhoun, Pheak; KHANA, KHANA Center for Population Health Research Yi, Rosa; Royal University of Phnom Penh, Faculty of Development Studies Yi, Siyan; KHANA, KHANA Center for Population Health Research; Touro University California, Center for Global Health Research
Primary Subject Heading:	Mental health
Secondary Subject Heading:	Public health, Epidemiology, Sociology, Health services research
Keywords:	Cross-sectional survey, Depressive symptoms, MENTAL HEALTH, Social and behavioral factors, University students, Cambodia

Social and behavioral factors associated with depressive symptoms among university students in Cambodia: A cross-sectional study

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ABSTRACT

Objective To explore social and behavioral factors associated with depressive symptoms among university students in Cambodia.

Design Cross-sectional study.

Settings Two public universities, one in the capital city of Phnom Penh and another in Battambang provincial town.

Participants This study included 1,359 students randomly selected from all departments in the two universities using a multi-stage cluster sampling method for a self-administered questionnaire survey in 2015.

Primary outcome measure Depressive symptoms measured by using the Center for Epidemiologic Studies Depression scale (CES-D). All measures in the study were self-reported.

Results The proportion of students with depressive symptoms and severe depressive symptoms were 50.6% and 19.6%, respectively. After adjustment in multivariate logistic regression analysis, depressive symptoms remained significantly associated with poor academic performance (AOR= 7.31, 95% CI= 2.24-23.86), higher consumption of unhealthy food (AOR= 1.72, 95% CI= 1.08-2.76), a negative self-perception about body shape (AOR= 0.54, 95% CI= 0.29-0.99) and general health status (AOR= 2.99, 95% CI= 1.28-7.00), and limited physical activeness (AOR= 0.30, 95% CI= 0.16-0.58). Depressive symptoms also remained significantly associated with adverse childhood experiences including physical violence (AOR= 1.39, 95% CI= 1.04-1.86), psychological abuse (AOR= 1.82, 95% CI= 1.37-2.42), and lack of general and medical care (AOR= 0.51, 95% CI= 0.30-0.86) by family during childhood.

Conclusions The key factors associated with depressive symptoms were family-related and individual behaviors and attitudes. Thus, efforts should be invested in comprehensive screening and intervention programs to diagnose those vulnerable students early, offer immediate treatment, and cater appropriate support.

Strengths and limitations of this study

- This research is among a very few studies in developing countries in which standardized tools are used and rigorous analyses are performed.

- It included a large sample of students randomly selected from all departments in two public universities – one in the capital city and the other in a provincial town – using a multi-stage cluster sampling method.
- Limitations of the study, however, included the representativeness of the study sample, the cross-sectional nature of the data that limits causation inferences, unknown validity of the scales used to measures important constructs in Cambodian contexts, and potential bias of self-reported measures.

INTRODUCTION

Several studies have suggested that the aspects of mental health among university students are considerably poorer than that of their peers in the general population.[1-5] Depression is one of the most prevalent mental health problems among university students, and the prevalence is rising.[6 7] There are varied prevalence estimates of depressive symptoms among university students, ranging from in the area of 10%[8-11] to in the region of 20%[12] and up to 40% and 80%.[13-15] However, the mean prevalence of depression in university students stands at 30.6%.[6] University students are in a critical period of life since they transition from adolescence to adulthood, which requires them to make many major decisions. During this period, they encounter tremendous pressures, chiefly from economic stress, academic demands, interpersonal relationships, and struggles with making crucial decisions.[16]

Depression manifests in a wide range of symptoms, encompassing sleep and eating disturbances, lack of self-care, poor concentration, anxiety, and disinterest in everyday activities.[17] For university students, depression is correlated with poor academic achievements,[18] drop-out,[19 20] relationship instability,[21] suicidal ideation and attempts,[18 22 23] poor work performance,[24] substance abuse,[25 26] acute infectious illnesses,[27] and poor physical and mental health in general.[28 29] Moreover, depression in this early period can build up negative consequences in adult life through its impacts on career prospects and social relationships.[30 31]

Thus, tackling depression among university students is vital since most lifetime mental disorders commence during the university age,[32] and their mental health has essential

ramifications for campus health services in particular and mental health policy-making in general.[33 34] Put another way, from a public health standpoint, early detection and prevention of mental health problems among young adults in higher education is paramount. Comprehension of their salient psychological distress, namely depression, and its correlates would enable tailor-made and early screening and intervention programs to reduce mental health problems in this population. This is integral for their educational performance and triumph in their prospective profession as well as for the national advancement since they are future leaders.

The prevalence of depression is induced by many factors, including study populations, socio-demographics,[16 35] study sites,[16 36] diagnostic tools and sampling methods,[36 37] and socio-cultural environments.[16] Contextualization of facets linked with depression thus is significant for mitigation measures.

In Cambodia, little is known about social and behavioral determinants of depressive symptoms among student populations. In 2012, a study on 1,943 students at 11 junior high and high schools found that exposure to violence among community members, peers, or family was a predictor for depressive symptoms in the students.[38 39] A 2013 qualitative study on a sample of 28 students at a Cambodian university found that life events, problems of everyday life, and availability of social support were the main stress factors affecting university students' life satisfaction.[40] Moreover, exposure to daily hassles was a stress factor having a strong impact on students' psychological and somatic responses. Nonetheless, no research has been conducted to examine social and behavioral determinants of depression among Cambodian university students. This study therefore intends to identify factors associated with depressive symptoms among university students in Cambodia.

METHODS

Study sites and population

This cross-sectional study was conducted with students at the University of Battambang (UB) in Battambang province and the Royal University of Phnom Penh (RUPP) in the capital city of Cambodia in June and July 2015. Epi Info (Centers for Disease Control and Prevention, Atlanta,

GA) was used to calculate the sample size from the university student population of approximately 168,000.[41] The anticipated percentage frequency was not known, so 50% was put for the calculation to prevent any underestimated prevalence. Based on a 95% confidence interval (CI) and a +5% margin of error, the minimum sample size required for this study was 767 students. Adjusted for 10% of incomplete responses, missing data, and rejection rate, the final minimum required sample size was 850 students.

Patient and public involvement

The development of the research questions and outcome measures was informed by university students' priorities, experience, and preferences gathered through consultative meetings with representatives of students, faculty members, and school administrators. The workshops aimed to collect inputs from the representatives for designing the study and developing the study protocol and materials. The representatives were also invited to participate in the study finding dissemination workshops in each participating university.

Sampling and data collection procedure

A multi-stage cluster sampling method was used to select the participants. First, the two universities were purposively selected, considering administration and logistic limitations. All departments of the selected universities were included in the study. In each department, a non-proportionate quota sampling method was used to select the sample from a name list provided by the department administrator to meet the required sample size. On the designated date of data collection, all selected students were approached by trained data collectors with support from a school administrator. Questionnaires and instructions were then distributed to them in a classroom for self-administration, which took approximately 30min to complete.

Questionnaire development and training

We first developed a structured questionnaire in English and translated it into Khmer, the national language of Cambodia. Then, the Khmer questionnaire was back-translated into English by a local expert to check its accuracy. The Khmer questionnaire was pretested with a

sample of 20 students at RUPP to ensure that the wording and contents were culturally suitable and clearly understandable. We also received comments on the questionnaire from experts working on health and education in Cambodia. The questionnaire was finalized based on their feedback and findings from the pretest. The questionnaire is available on request from the corresponding author.

A two-day training on the study protocol and data collection methods was provided to the data enumerators and supervisors. The training focused on building familiarity with the study protocol and questionnaire, interview techniques, privacy assurance, and confidentiality. It also addressed quality control strategies, such as rechecking and reviewing the questionnaires after administration, and resolving issues that might arise during the fieldwork. The data collection supervisors were instructed to perform regular reviews with the data enumerators to monitor progress and settle any issues occurring during the process.

Variables and measurements

Depressive symptoms

Depressive symptoms were assessed by using the Center for Epidemiologic Studies Depression scale (CES-D).[42] This scale consists of 20 questions addressing six symptoms of depression, including depressed mood, guilt or worthlessness, helplessness or hopelessness, psychomotor retardation, loss of appetite, and sleep disturbance experienced during the preceding week. Each question is scored on a scale of 0 to 3 according to the frequency of the symptoms, and the total CES-D score ranges from 0 to 60. To calculate the total score, four items (I felt I was just as good as other people, I felt hopeful about the future, I was happy, and I enjoyed life) were reverse coded. The criterion validity of the CES-D scale has been well established in Western[42] and Asian[43] populations. We defined depressive symptoms as present when a subject had a CES-D score of ≥16. A cutoff value of ≥23 was also used to define severe depressive state.[44]

Socio-demographic characteristics, substance use, and sexual behaviors

We adapted standardized tools from the most recent Cambodia Demographic and Health Survey[45] as well as from our previous student and young people health surveys in Cambodia[38 39 46-48] to measure socioeconomic characteristics, sexual behaviors with different partners, and substance use (alcohol, tobacco, and illicit drugs). Socio-demographic characteristics of the respondents included study site, gender, age, marital status, academic year, living situations, perceived family economic status, and perceived academic performance.

Health related behaviors

We used the Health Behavior Survey,[49] which was designed as a broad survey of health-related behaviors and beliefs, components of the "National College Health Risk Behavior Survey" (1997),[50] and the Global School-based Student Health Survey.[51] Each health behavior area was addressed by only a limited number of items. For example, frequency of consumption of fast food in an average week was assessed by a question, "On average, how many times do you eat fast food per week?" with response options of 0 time, 1-2 times a week, and 3 or more times a week. Similar questions and response options were used to assess consumption of several other kinds of healthy and unhealthy food, such as high-fat snack or fruits/vegetables. Self-ratings were also used for some questions, such as perceived body size (rated from very overweight to very underweight) and general health status (rated from very good to very poor).

Adverse childhood experiences (ACEs)

Five questions were adapted from the brief screening version of the Childhood Trauma Questionnaire to measure ACEs.[52] The five yes/no questions asked about the experiences of physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect during childhood.

Self-rated health

SF-12 Health Survey (SF-12) was used to measure self-rated health.[53 54] The SF-12 is a multipurpose short-form generic measure of health status. It is a subset of the larger SF-36 and monitors health in general and in specific populations. The SF-12 measures eight health

aspects, namely physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality (energy/fatigue), social functioning, role limitations due to emotional problems, and mental health (psychological distress and psychological well-being).

Data analyses

Double data entry was performed using EpiData version 3 (Odense, Denmark). χ^2 test, or Fisher's exact test when a sample size was smaller than five in one cell, was used for categorical variables, and Student's *t*-test was used for continuous variables to compare socio-demographic characteristics, health risk behaviors (sexual behaviors, substance use, and eating behaviors), self-rated health (SF-12), and ACEs among students with depressive symptoms, defined by a CES-D score of ≥16, to those among students without depressive symptoms. The same comparisons were also made among students with and without severe depressive symptoms, defined by a CES-D score of ≥23.

In multivariate models, we first included all variables significantly associated with depressive symptoms in the bivariate analyses at a level of *p*-value <0.05 simultaneously in the models. Variables with a *p*-value >0.05 were then removed, and the models were refitted. The steps were repeated until all *p*-values of the remaining variables were <0.05 in the final models. Adjusted odds ratios (AOR) were obtained and presented with CI and *p*-values. SPSS version 22 (IBM Corporation, New York) was used for all statistical analyses.

Ethical considerations

The National Ethics Committee for Health Research of the Ministry of Health, Cambodia, approved the study protocol and materials (No. 191NECHR). Participation in this study was voluntary. In the process of obtaining a written informed consent, students were made clear that they could refuse or discontinue their participation at any time and for any reason. The confidentiality and privacy of the respondents were protected by administering the questionnaires in a private premise and by excluding personal identifiers from the data and field notes. After completing the survey, each participant received a small gift (costing approximately $US 2.0) for their time compensation.

RESULTS

Socio-demographic characteristics

The study sample included 493 students (36.3%) from UB and 866 students (63.7%) from RUPP. About half (50.8%) of the respondents were male, with a mean age of 21.3 years [standard deviation (SD)= 2.3]. Less than 2.0% (*n*= 26) of the students initially selected for the study declined the participation, mostly due to their time constrains. They were then replaced by the next gender-matched student in the student name list. The majority of the respondents (97.9%) were unmarried, and 43.4% were living with their parents. Regarding their family economic status, 59.2% reported that their family was neither rich nor poor. The proportion of students with depressive symptoms and severe depressive symptoms were 50.6% and 19.6%, respectively.

Table 1 shows that a significantly higher proportion of students with depressive symptoms were from UB (p= 0.004) and from a poorer family (p= 0.002) and reported poorer academic performance (p< 0.001). Similarly, a significantly higher proportion of students with severe depressive symptoms were female (p= 0.002) and from a poorer family (p= 0.04) and reported poorer academic performance (p< 0.001).

Table 1 Comparisons of socio-demographic characteristics of university students with and without depressive symptoms

Characteristics	Depressive symptoms			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Study site			0.004			0.08
Battambang	218 (44.2)	275 (55.8)		384 (77.9)	109 (22.1)	
Phnom Penh	454 (52.4)	412 (47.6)		709 (81.9)	157 (18.1)	
Gender			0.20			0.002
Female	319 (47.7)	350 (52.3)		515 (77.0)	154 (23.0)	
Male	353 (51.2)	337 (48.8)		578 (83.8)	112 (16.2)	
Age (mean ± SD)	21.3 ± 2.4	21.4 ± 2.3	0.82	21.4 ± 2.3	21.1 ± 2.4	0.12
Marital status			0.34			0.08

Unmarried	655 (49.2)	675 (50.8)		1066 (80.2)	264 (19.8)	
Married	17 (58.6)	12 (41.4)		27 (93.1)	2 (6.9)	
Academic year			0.59			0.66
1	240 (48.4)	256 (51.6)		394 (79.4)	102 (20.6)	
2	145 (51.6)	136 (48.4)		224 (79.7)	57 (20.3)	
3	123 (49.0)	128 (51.0)		201 (80.1)	50 (19.9)	
4	164 (49.5)	167 (50.5)		274 (82.8)	57 (17.2)	
Currently living with			0.35			0.70
Parents	297 (49.9)	298 (50.1)		486 (81.7)	109 (18.3)	
Relatives	81 (45.0)	99 (55.0)		139 (77.2)	41 (22.8)	
Sibling	87 (56.1)	68 (43.9)		124 (80.0)	31 (20.0)	
Friend	162 (50.2)	161 (49.8)		258 (79.9)	65 (20.1)	
Spouse/partners	10 (47.6)	11 (52.4)		19 (90.5)	2 (9.5)	
Alone	26 (41.9)	36 (58.1)		50 (80.6)	12 (19.4)	
Other	9 (39.1)	14 (60.9)		17 (73.9)	6 (26.1)	
Perceived family economic status			0.002			0.04
Well-off/quite well-off	248 (55.7)	197 (44.3)		374 (84.0)	71 (16.0)	
Neither poor nor well-off	398 (47.0)	448 (53.0)		669 (71.1)	177 (20.9)	
Poor	26 (38.2)	42 (61.8)		50 (73.5)	18 (26.5)	
Perceived academic performance			<0.001			<0.001
Very good	44 (77.2)	13 (22.8)		52 (91.2)	5 (5.8)	
Good	180 (59.0)	123 (40.6)		263 (86.8)	40 (13.2)	
Fairly good	301 (50.5)	295 (49.5		484 (81.2)	112 (18.8)	
Fair	138 (37.7)	228 (62.3)		275 (75.1)	91 (24.9)	
Poor	9 (24.3)	28 (75.7)		19 (51.4)	18 (48.6)	

Abbreviation: SD, standard deviation.

Values are numbers of subjects (%) for categorical variables and means ± standard deviation (SD) for continuous variables.

[*] *Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.*

[†] *Defined by a CES-D score of ≥23.*

[‡] *Chi-square test was used for categorical variables; independent Student's t-test was used for continuous variables.*

Health risk behaviors

As shown in Table 2, a significantly higher proportion of students with depressive symptoms reported consuming unhealthy food frequently, such as high-fat snack (p= 0.001 for depressive symptoms; p< 0.001 for severe depressive symptoms), margarine, butter, or meat fat (p= 0.02 for depressive symptoms; p< 0.001 for severe depressive symptoms). A significantly lower proportion of students with depressive symptoms reported consuming of healthy food frequently, such as fruits and vegetables (p= 0.009 for depressive symptoms; p= 0.007 for severe depressive symptoms), or lean protein (p< 0.001 for depressive symptoms; p= 0.03 for severe depressive symptoms). A significantly higher proportion of students with depressive symptoms reported not having desert over the past week (p= 0.003 for depressive symptoms; p= 0.008 for severe depressive symptoms). Moreover, a significantly higher proportion of students with depressive symptoms perceived that their body size was very overweight or very underweight (p< 0.001 for both depressive symptoms and severe depressive symptoms).

Table 2 Comparisons of health risk behaviors among university students with and without depressive symptoms

Health and health risk behaviors	Depressive symptoms*			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Current tobacco smokers	5 (33.3)	10 (66.7)		12 (80.0)	3 (20.0)	0.97
Self-perception regarding alcohol use			0.25			0.004
Non drinker	425 (50.7)	413 (49.3)		681 (81.3)	157 (18.7)	
Occasional drinker	247 (47.4)	271 (52.6)		412 (78.7)	106 (21.3)	
Regular drinker	0 (0.0)	3 (100)		0 (0.0)	3 (100)	
Current illicit drug users	0 (0.0)	4 (100)	0.05	1 (25.0)	3 (75.0)	0.03
Condom use at last sex	39 (47.0)	44 (53.0)	0.95	73 (88.0)	10 (12.0)	0.08
Diagnosed with an STI	4 (40.0)	6 (60.0)	0.75	110 (84.0)	21 (16.0)	0.67
Thought of ending life	40 (24.8)	121 (75.2)	<0.001	84 (52.2)	77 (47.8)	<0.001
Attempted to end life	5 (20.0)	20 (80.0)	0.63	11 (44.0)	14 (56.0)	0.47
Frequency of eating fast food per week			0.49			0.24

0 time	410 (49.3)	421 (50.7)		679 (81.7)	152 (18.3)
1-2 times	231 (50.7)	225 (49.3)		360 (78.9)	96 (21.1)
3 times or more	31 (43.1)	41 (56.9)		54 (75.0)	18 (25.0)
Frequency of daily soft drink consumption			0.31		0.01
0 time	105 (46.5)	121 (53.5)		178 (78.8)	48 (21.2)
1-2 times	399 (51.2)	380 (48.8)		647 (83.1)	132 (16.9)
3 times or more	168 (47.5)	186 (52.5)		268 (75.7)	86 (24.3)
Frequency of weekly high-fat snack consumption			0.001		<0.001
0 time	162 (52.8)	145 (47.2)		260 (84.7)	47 (15.3)
1-2 times	443 (51.0)	426 (49.0)		711 (81.8)	158 (18.2)
3 times or more	67 (36.6)	116 (63.4)		122 (66.7)	61 (33.3)
Frequency of weekly dessert consumption			0.003		0.008
0 time	106 (40.6)	155 (59.4)		192 (73.6)	69 (26.4)
1-2 times	434 (52.7)	389 (47.3)		676 (82.1)	147 (17.9)
3 times or more	132 (48.0)	143 (52.0)		225 (81.8)	50 (18.2)
Frequency of weekly fruit/vegetable consumption			0.009		0.007
0 time	50 (37.3)	84 (62.7)		94 (70.1)	40 (29.9)
1-2 times	390 (51.7)	365 (48.3)		617 (81.7)	138 (18.3)
3 times or more	232 (49.4)	238 (50.6)		382 (81.3)	88 (12.7)
Frequency of weekly lean protein consumption			<0.001		0.03
0 time	57 (34.8)	107 (65.2)		119 (72.6)	45 (27.4)
1-2 times	453 (51.8)	421 (48.2)		714 (81.7)	160 (18.3)
3 times or more	162 (50.5)	159 (49.5)		260 (81.0)	61 (19.0)
Amount of margarine/butter/meat fat consumption			0.02		<0.001
None/very little	296 (52.4)	269 (47.6)		471 (83.4)	94 (16.6)
Some	339 (48.7)	357 (51.3)		558 (80.2)	138 (19.8)
A lot	37 (37.8)	61 (62.2)		64 (65.3)	34 (34.7)
Self-perception about body size			<0.001		<0.001
About right	275 (55.4)	221 (44.6)		428 (86.3)	68 (13.7)
Very overweight	27 (34.2)	52 (65.8)		55 (69.6)	24 (30.4)
Slightly overweight	161 (48.9)	168 (51.1)		247 (75.1)	82 (24.9)
Slightly underweight	191 (49.6)	194 (50.4)		319 (82.9)	66 (17.1)

Very underweight	18 (25.7)	52 (74.3)	44 (62.9)	26 (37.1)

Abbreviations: STI, sexually transmitted infections.
Values are numbers of subjects (%).
[*] Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.
[†] Defined by a CES-D score of ≥23.
[‡] Chi-square test was used or Fisher's exact test was used as appropriate.

Self-rated health (SF-12)

Table 3 shows that significantly higher proportion of students with depressive symptoms perceived that their general health status was poor (p< 0.001 for both depressive symptoms and severe depressive symptoms). A significantly higher proportion of students with depressive symptoms reported higher levels of limitation in several daily activities, such as limitation in moderate activities (p< 0.001 for depressive symptoms; p= 0.02 for severe depressive symptoms), climbing several flights of stairs (p< 0.001 for depressive symptoms), or other kinds of activities in the past four weeks as a result of their physical or emotional health problems (p< 0.001 for both depressive symptoms and severe depressive symptoms). Further, they reported higher levels of problems in several other physical and emotional health aspects in the past four weeks, such as a feeling that they had accomplished less than they would like (p< 0.001 for both depressive symptoms and severe depressive symptoms), pain interferes with their normal work (p< 0.001 for both depressive symptoms and severe depressive symptoms), having less energy (p< 0.001 for both depressive symptoms and severe depressive symptoms), down-hearted and blue (p< 0.001 for both depressive symptoms and severe depressive symptoms), and that their physical health interferes with their social acts (p< 0.001 for both depressive symptoms and severe depressive symptoms).

Table 3 Comparisons of self-rated health (SF-12) among university students with and without depressive symptoms

Self-rated health (SF-12)	Depressive symptoms[*]			Severe depressive symptoms[†]		
	No	Yes	P-value[‡]	No	Yes	P-value[‡]
Self-perception on general health status			<0.001			<0.001
Very good	106 (64.2)	59 (35.8)		147 (89.1)	18 (10.9)	
Good	380 (58.5)	270 (41.5)		566 (87.1)	84 (12.9)	

Neither good nor poor	176 (38.0)	287 (62.0)		351 (75.8)	112 (24.2)	
Poor	10 (12.3)	71 (87.7)		29 (35.8)	52 (64.2)	
Limitation in moderate activities on a typical day			<0.001			0.02
Greatly limited	20 (28.2)	51 (71.8)		50 (70.4)	21 (29.6)	
Mildly limited	291 (45.6)	347 (54.4)		505 (79.2)	133 (20.8)	
Not limited	361 (55.5)	289 (44.5)		538 (82.8)	112 (17.2)	
Limitation in climbing several flights of stairs			<0.001			0.24
Greatly limited	64 (35.8)	115 (64.2)		140 (78.2)	39 (21.8)	
Mildly limited	323 (47.8)	353 (52.2)		536 (79.3)	140 (20.7)	
Not limited	285 (56.5)	219 (43.5)		417 (82.7)	87 (17.2)	
Limitation in other kinds of activities in past 4 weeks	271 (37.8)	446 (62.2)	<0.001	516 (72.0)	201 (28.0)	<0.001
Accomplished less than you would like in past 4 weeks as a result of emotional health	377 (61.9)	232 (38.1)	<0.001	553 (50.6)	197 (26.3)	<0.001
Accomplished less than you would like in past 4 weeks as a result of physical health	304 (67.3)	148 (32.7)	<0.001	675 (74.4)	232 (25.6)	<0.001
Did activities less carefully than usual in past 4 weeks	378 (41.8)	526 (58.2)	<0.001	677 (74.9)	227 (25.1)	<0.001
Pain interferes with your normal work in past 4 weeks			<0.001			<0.001
Not at all	141 (75.8)	45 (24.2)		176 (94.6)	10 (5.4)	
A little bit	401 (57.6)	295 (42.4)		635 (91.2)	61 (8.8)	
Moderately	106 (32.9)	216 (31.4)		216 (67.1)	106 (32.9)	
Quite a bit	23 (16.5)	116 (83.5)		62 (44.6)	77 (55.4)	
Extremely	1 (6.3)	15 (93.8)		4 (25.0)	12 (75.0)	
Feeling calm and peaceful in past 4 weeks			0.33			0.06
A lot of the time	22 (42.3)	30 (57.7)		38 (73.1)	14 (26.9)	
Most of the time	68 (53.5)	59 (46.5)		92 (72.9)	35 (27.6)	
A good bit of time	115 (50.9)	111 (49.1)		188 (83.2)	38 (16.2)	

Some of the time	278 (46.8)	316 (53.2)		477 (80.3)	117 (17.7)	
A little of the time	170 (51.8)	158 (48.2)		274 (83.5)	54 (16.5)	
None of the time	19 (59.4)	13 (40.6)		24 (75.0)	8 (25.0)	
Having a lot of energy in past 4 weeks			<0.001			<0.001
A lot of the time	46 (61.3)	29 (38.7)		66 (88.0)	9 (12.0)	
Most of the time	111 (68.9)	50 (31.1)		149 (92.5)	12 (7.5)	
A good bit of time	245 (56.8)	186 (43.2)		383 (88.9)	48 (11.1)	
Some of the time	207 (41.5)	292 (58.5)		364 (72.9)	135 (27.1)	
A little of the time	57 (33.7)	112 (66.3)		116 (68.6)	53 (31.4)	
None of the time	6 (25.0)	18 (75.0)		15 (62.5)	9 (37.5)	
Feeling down-hearted and blue in past 4 weeks			<0.001			<0.001
A lot of the time	7 (21.9)	25 (78.1)		14 (43.8)	18 (56.3)	
Most of the time	8 (8.3)	88 (91.7)		36 (37.5)	60 (62.5)	
A good bit of the time	42 (17.9)	171 (80.3)		117 (54.9)	96 (45.1)	
Some of the time	222 (46.7)	253 (53.3)		412 (86.7)	63 (13.3)	
A little of the time	354 (71.5)	141 (28.5)		469 (94.7)	26 (5.3)	
None of the time	39 (81.3)	9 (18.8)		45 (93.8)	3 (6.3)	
Physical health interferes social act in past 4 weeks			<0.001			<0.001
A lot of the time	4 (33.3)	8 (66.7)		6 (50.0)	6 (50.0)	
Most of the time	10 (23.3)	33 (76.7)		18 (41.9)	58 (58.1)	
Some of the time	146 (38.1)	237 (61.9)		275 (71.8)	108 (28.2)	
A little of the time	355 (53.7)	306 (46.3)		568 (85.9)	93 (14.1)	
None of the time	157 (60.4)	103 (39.6)		226 (26.9)	34 (13.2)	

Values are numbers of subjects (%) for categorical variables.

[*] *Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.*

[†] *Defined by a CES-D score of ≥23.*

[‡] *Chi-square test was used for categorical variables or Fisher's exact test was used as appropriate.*

Adverse childhood experiences (ACEs)

As shown in Table 4, a significantly higher proportion of students with depressive symptoms reported having been hit, slapped, or kicked by a parent or guardian (p< 0.001 for both depressive symptoms and severe depressive symptoms); that people in their family had said hurtful or insulting things to them (p< 0.001 for both depressive symptoms and severe

depressive symptoms); and that someone had tried to touch them or make them touch him/her in a sexual way (p= 0.001 for depressive symptoms; p< 0.001 for severe depressive symptoms). In contrast, significantly lower proportion of students with depressive symptoms reported that there had been someone to take care of them and take them to medical care when they got sick (p= 0.04 for depressive symptoms; p= 0.03 for severe depressive symptoms), and someone who helped them feel that they were loved and important (p= 0.03 for depressive symptoms; p< 0.001 for severe depressive symptoms).

Table 4 Comparisons of adverse childhood experiences among university students with and without depressive symptoms

Adverse childhood experiences	Depressive symptoms*			Severe depressive symptoms†		
	No	Yes	P-value‡	No	Yes	P-value‡
Had been hit, slapped, kicked, by a parent/guardian	200 (38.2)	323 (61.8)	<0.001	384 (73.4)	139 (26.6)	<0.001
People in my family had said hurtful or insulting things to me	297 (39.0)	464 (61.0)	<0.001	558 (73.3)	203 (26.7)	<0.001
Someone had tried to touch me or make me touch them in a sexual way	87 (39.2)	135 (60.8)	0.001	159 (71.6)	63 (28.4)	<0.001
There had been someone to take care me and take me to medical care when I got sick	636 (50.2)	632 (49.8)	0.04	1028 (81.1)	240 (18.9)	0.03
There had been someone who helped me feel that I was loved and important	647 (50.1)	644 (49.9)	0.03	1050 (81.3)	266 (19.6)	<0.001

Values are numbers of subjects (%).

Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.

†Defined by a CES-D score of ≥23.*

‡Chi-square test was used.*

Risk factors of depressive symptoms

Results of multivariate logistic analyses are shown in Table 5. After controlling for potential confounding factors, the odds of depressive symptoms increased significantly with self-reported poor academic performance (depressive symptoms: AOR=7.31, 95% CI=2.24-23.86; severe depressive symptoms: AOR=7.38, 95% CI=1.75-10.94) and high consumption of unhealthy food, including high-fat snack, margarine, butter, or meat fat (depressive symptoms: AOR=1.72, 95% CI=1.08-2.76; severe depressive symptoms: AOR=2.13, 95% CI=1.15-3.95). The odds decreased significantly with the perception that their body size was slightly underweight compared to the perception that their body size was very overweight (depressive symptoms: AOR= 0.54, 95% CI= 0.29-0.99; severe depressive symptoms: AOR= 0.37, 95% CI= 0.18-0.77).

Regarding self-rated health, the odds of depressive symptoms increased significantly with the perception that their general health status was poor (depressive symptoms: AOR= 2.99, 95% CI=1.28-7.00; severe depressive symptoms: AOR=5.43, 95% CI=2.19-13.46) and the report of higher level of limitation in moderate activities (depressive symptoms: AOR= 0.30 (95% CI= 0.16-0.58), higher level of pain interference with their normal work (depressive symptoms: AOR= 10.43, 95% CI= 1.05-10.94; severe depressive symptoms: AOR= 10.02, 95% CI= 1.99-9.28), and higher level of feeling down-hearted and blue (depressive symptoms: AOR= 6.69, 95% CI= 1.87-23.90; severe depressive symptoms: AOR= 8.72, 95% CI= 1.69-14.86).

For ACEs, the odds of depressive symptoms increased significantly with the report of having been hit, slapped, or kicked by a parent or guardian (depressive symptoms: AOR= 1.39, 95% CI= 1.04-1.86) and that people in their family had said hurtful or insulting things to them (depressive symptoms: AOR= 1.82, 95% CI= 1.37-2.42; severe depressive symptoms: AOR= 2.18, 95% CI=1.46-3.24) during their childhood. In contrast, the odds of depressive symptoms decreased significantly with the report that there had been someone to take care of them and take them to medical care when they got sick (depressive symptoms: AOR= 0.51, 95% CI= 0.30-0.86; severe depressive symptoms: AOR= 0.26, 95% CI= 0.13-0.52).

Table 5 Factors associated with depressive symptoms and severe depressive symptoms

Variables in the final model*	Depressive symptoms†		Severe depressive symptoms‡	
	AOR (95% CI)	P-value	AOR (95% CI)	P-value
Perceived academic performance				
Very good	Reference		Reference	
Good	2.28 (1.01-5.15)	0.04	1.22 (0.35-4.19)	0.76
Fairly good	3.51 (1.58-7.78)	0.002	2.15 (0.65-7.11)	0.21
Fair	5.30 (2.35-11.93)	<0.001	2.52 (0.75-8-43)	0.13
Poor	7.31 (2.24-23.86)	0.001	7.38 (1.75-10.94)	0.006
Frequency of weekly high-fat snack consumption				
0 time	Reference		Reference	
1-2 times	0.99 (0.72-1.37)	0.95	1.25 (0.78-1.99)	0.36
3 times or more	1.72 (1.08-2.76)	0.02	2.13 (1.15-3.95)	0.02
Frequency of weekly lean protein consumption				
0 time	Reference		Reference	
1-2 times	0.52 (0.34-0.79)	0.002	0.69 (0.41-1.18)	0.17
3 times or more	0.62 (0.38-0.96)	0.04	0.80 (0.44-1.47)	0.48
Amount of margarine/butter/meat fat consumption				
None/very little			Reference	
Some			0.98 (0.66-1.46)	0.91
A lot			1.92 (1.02-3.64)	0.04
Self-perception about body shape				
Very overweight	Reference			
Slightly overweight	0.56 (0.31-1.07)	0.08	0.65 (0.32-1.14)	0.25
About right	0.58 (0.32-1.05	0.07	0.45 (0.22-0.93)	0.03
Slightly underweight	0.54 (0.29-0.99)	0.04	0.37 (0.18-0.77)	0.008
Very underweight	0.92 (0.38-2.25)	0.86	0.38 (0.14-0.99)	0.04
Self-perception on general health status				
Very good				
Good	1.05 (0.68-1.64)	0.82	1.19 (0.60-2.38)	0.62
Fair	1.58 (0.99-2-51)	0.05	1.47 (0.73-2.96)	0.28
Poor	2.99 (1.28-7.00)	0.01	5.43 (2.19-13.46)	<0.001
Limitation in moderate activities on a typical day				

Greatly limited	Reference		Reference	
Mildly limited	0.39 (0.20-0.74)	0.004	0.64 (0.29-1.34)	0.23
Not limited	0.30 (0.16-0.58)	<0.001	0.63 (0.30-1.36)	0.24
Pain interferes with your normal work in past 4 weeks				
Not at all	Reference		Reference	
A little bit	1.68 (1.08-2.61)	0.02	1.01 (0.46-2.22)	0.99
Moderately	3.10 (1.89-5.10)	<0.001	3.69 (1.68-7.11)	0.001
Quite a bit	4.14 (2.13-8.05)	<0.001	4.68 (2.01-10.92)	<0.001
Extremely	10.43 (1.05-10.94)	0.04	10.02 (1.99-9.28)	0.005
Feeling down-hearted and blue in past 4 weeks				
None of the time	Reference		Reference	
A little of the time	0.52 (0.63-3.66)	0.35	1.02 (0.24-4.29)	0.98
Some of the time	3.42 (1.42-8.23)	0.006	1.83 (0.45-7.45)	0.40
A good bit of the time	7.70 (3.02-19.66)	<0.001	6.01 (1.45-4.85)	0.01
Most of the time	20.71 (6.47-66.37)	<0.001	9.04 (2.31-13.71)	0.002
A lot of the time	6.69 (1.87-23.90)	0.003	8.72 (1.69-14.86)	0.01
Had been hit, slapped, kicked, by a parent/guardian				
No	Reference		Reference	
Yes	1.39 (1.04-1.86)	0.03	1.11 (0.75-1.65)	0.59
People in my family had said hurtful or insulting things to me				
No	Reference		Reference	
Yes	1.82 (1.37-2.42)	<0.001	2.18 (1.46-3.24)	<0.001
There had been someone to take care of me and take me to medical care when I got sick				
No	Reference		Reference	
Yes	0.51 (0.30-0.86)	0.01	0.26 (0.13-0.52)	<0.001

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.

**Variables in the table were the ones that remained statistically significant in the final multivariate logistic regression model after several steps of model fitting.*

† Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥16.

‡Defined by a CES-D score of ≥23.

DISCUSSION

This study explored the prevalence of depressive symptoms and unearthed a number of social and behavioral factors correlated with the symptoms among university students in Cambodia. The proportion of students with depressive symptoms and severe depressive symptoms was 50.6% and 19.6%, respectively. The salient factors comprised cultural and socio-economic dimensions (socio-economic background and lack of general and medical care by family during their childhood), individual behaviors and attitudes (poor academic accomplishment, consumption of unhealthy food, negative perception about their body and their general health status, and limited physical activeness), and nurture-related facets (physical violence and psychological abuse by family during their childhood).

The bivariate outcomes display that students from the provincial university (UB) and a poorer family were more susceptible to depressive symptoms. Albeit not manifesting in the multivariate model, these factors are corroborated by the existing scholarship. Various studies revealed that university students from rural areas and low socio-economic backgrounds were predisposed to higher depression.[1 16 28 55 56] This could be explained by an economic situation where students with a rural background tended to stipulate a poorer family status. Plus, financial vulnerability could further exacerbate depression in students from low-income families. A meta-analysis of 60 studies unveiled that people in the lowest socio-economic quintile had 1.81 the probability of depression compared with those in the highest socio-economic quintile.[57] A global study on 17,348 university students from 23 high-, middle-, and low-income countries also uncovered that higher depressive symptoms were recorded among students in low-income countries and economies with greater income inequality.[16] The Cambodian economy has been growing rapidly in terms of income per capita; yet, income gaps between the rich and the poor and between rural and urban areas remain large.[58] The gaps in income and material growth, which typify economic conditions, may induce people's mental health problems. In another word, poor economic status may bring about low self-esteem and self-confidence, which would lead to depression.

Our multivariate results depict that students with depressive symptoms, regardless of severity, tended to report poor academic performance and higher consumption of unhealthy food. These findings conform to a systematic review of 24 studies[6] and studies in Asia, such as

China,[7] which pinpoint low scholastic merit and suicidal ideation as consistent correlates of depression in university students probably as a culmination of poor concentration and solitude. On the consumption of unhealthy food, the transition from adolescence to adulthood, and thus the changes in lifestyle such as living arrangements and independence, might have rendered university students to indulge in unhealthy food, as pinpointed by a meta-analysis of 39 studies in China.[7] As afore-mentioned, more than half of our sample were not living with their parents; therefore, it might have been hard for them to maintain healthy daily food. Conversely, depression might have made students care-free about themselves and consequently eat unhealthily.[17] This implies that nutrition education for both physical and mental health, stressing healthy food for the body and mind, is imperative for university students.

Students with depressive symptoms, regardless of magnitude, also tended to have a negative perception about their body and their general health status. These findings confirms the general perception among depressed people who are not gratified with their body and health,[17] although these relationships require a cautious interpretation given that CES-D also measures some aspects of negative self-perception. Further, depressed students were more likely to have limited physical activeness, more pain interference with their normal work, and more dismay or sorrow. These findings are consistent with findings from previous studies in different populations and settings.[59 60] However, the interpretation of these complex relationships must be made with caution given that the nature of the data does not allow causal relationship to be established.

Finally, students with depressive symptoms, disregard of severity, were more likely to encounter physical violence by their parent or guardian, psychological abuse by their family members, and lack of general and medical care by their family when they were growing up. As for the physical violence and psychological abuse, this finding tends to acquiesce with a study in Cambodia that postulates that exposure to violence within family is associated with depression in high school students.[38 39] On the lack of general and medical care by family, a Chinese study on 5,245 students at six universities found that students who had a poor parental relationship were more vulnerable to depression.[61] Also, a global study on 17,348 university students from 23 high, middle-, and low-income countries iterated that university students with less

individualistic cultures, particularly in Asia, reported higher extents of depressive symptoms.[16] Students of these cultures longed for more familial and societal ties and assistance, and thus felt depressed once this social capital was unavailable.[16] This highlights a significant role of family bonds and scaffolding in association with depression among university students. The lack of social support from the family presumably would only be a factor for students living independently. But, for those living with relatives, friends, or spouse, they would still have such support.

A study on a sample of 2,671 respondents in nine provinces and a capital city in 2012 revealed that Cambodia greatly needs more and better counseling and mental health services.[62] The study also pointed out the shortage of skilled professionals in the field of mental health, particularly those with high clinical and counseling skills to treat mental disorders. In 2012, Cambodia had only 49 trained psychiatrists and 45 psychiatric nurses working in mental health facilities and private practices for a population of approximately 15 million.[62 63] This number equates to approximately 0.2 psychiatrists per 100,000 population, which is similar to the average in Southeast Asia.[63] Many health staff lack training, supervision, and experience in these areas. Only about 300 doctors completed basic mental healthcare training.[64] At university level, the 2012 study called for more awareness raising for self-care and burnout prevention and mental health counseling services for staff and students.[62] Given the paucity of mental health services in general, let alone at universities, our findings fuel the needs for more and better mental healthcare in Cambodia. Further to medical care, universities should provide measures, such as student loans and healthy canteens, to mitigate some key predictors of depression among students, such as financial hardship and poor diets.

This study contains certain limitations. First, it examined students at only two public universities, one in the capital city and the other in a province. Hence, its findings cannot be generalized at a national level. Second, the cross-sectional design did not enable an establishment of the causal linkages between depressive symptoms and the related factors. Given the temporal order and the cross-sectional nature of the data, causal relationships between the variables could not be derived. Potential bi-directionality of the associations could occur either way. For instance, physical inactivity could cause depression. Nonetheless, the

reverse could also be true—that depression could lead to inactivity, and of course both could be true simultaneously, where depressive symptoms worsen with physical inactivity, making physical activity less likely. Third, this study employed self-reported data, which might have been subject to over-reporting and under-reporting caused by the negative cognitive biases associated with depression as well as possible recall bias. Future studies should attempt to use more objective data (e.g., linking participants' responses to university records of academic performance) to increase validity of the information. Nonetheless, the quality of the data was ensured by thorough training of the enumerators and field supervisors on the study protocols and data collection method. Finally, the main outcome measure (CES-D) and some other measures, such as ACEs and SF-12, were modified from other research and have not been validated in the Cambodian settings. Therefore, the interpretation of the findings must be made with caution. Notwithstanding these malfeasances, the findings of this study offer first and foremost implications for policy development and future research in the Cambodian context.

CONCLUSIONS

This study identified social and behavioral factors associated with depressive symptoms among Cambodian students at two universities. While causation could not be drawn between these factors and depression, we surmise that these factors were inter-twined, and thus need to be addressed in an integrated and holistic fashion.

These findings render three major implications. First, given the current educational reform and labor market that demand better quality and ergo more competition among university students, the correlates of depressive symptoms could not be more critical for tackling for the time being. Failure to ameliorate these factors would jeopardize the qualification and career development of this populace and finally the human capital for nation-building. Second, these findings warrant an acceleration of on-campus counseling services for university students throughout the course of studentship. Efforts should be invested in comprehensive screening and intervention programs to diagnose those susceptible students early, offer immediate treatment, and cater appropriate support. Universities could play very

important roles in taking this research forwards by providing future research outputs to improve mental health of the students that would in turn improve their academic outcomes. Ultimately, the jurisdiction of refining students' mental state should go beyond universities to families and pertinent governmental bodies at large, provided we are to assist the young to overcome their academic challenges and enjoy a prosperous post-graduation life. Further research could delve into changing lifestyles and their associations with depressive symptoms among a larger sample of university students. Furthermore, validation studies are required to develop and validate reliable instruments for use in Cambodian populations.

Acknowledgements The authors thank research assistants; representatives of students, faculty members, and school administrators who supported the development of the study design and tools; and the study participants for their contribution to this study.

Contributions SY, KP and TS conceived research questions, designed the study and developed the research protocol and tools. SY and CN analyzed the data and interpreted the results and drafted the manuscript. KP, PC and RY supported the protocol and tools development and were responsible for training and data collection. All authors contributed to the writing and approved the final manuscript.

Funding Data used for this analysis were collected as part of a larger study funded by the United States Agency for International Development (USAID). The funder had no role in study design, data collection and analyses, decision to publish, or preparation of the manuscript.

Disclaimer Content of this paper is the responsibility of the authors and does not reflect the view of USAID or our respective institutions

Competing interests None declared

Ethics approval The National Ethics Committee for Health Research of the Ministry of Health, Cambodia approved this study (Reference no. 082NECHR), and a written informed consent was obtained from each participant.

Data sharing statement Data used for this analysis are available upon request from the Principal Investigator (Dr. Siyan Yi) at siyan@doctor.com. The data cannot be made publicly available due to ethical restriction.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Confirmed (Lines 1-54)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found. Confirmed (Lines 30-54)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported. Confirmed (Lines 67-108)
Objectives	3	State specific objectives, including any prespecified hypotheses. Confirmed (Lines 107-108)
Methods		
Study design	4	Present key elements of study design early in the paper. Confirmed (Line 112)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection. Confirmed (Line 112-114)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Confirmed (Lines 130-138)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable. Confirmed (Lines 157-202)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Confirmed (Lines 157-202)
Bias	9	Describe any efforts to address potential sources of bias. Confirmed (Lines 130-138)
Study size	10	Explain how the study size was arrived at. Confirmed (114-120)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why. Confirmed (Lines 204-218)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding. Confirmed (Lines 213-217)
		(*b*) Describe any methods used to examine subgroups and interactions. (Not applicable)
		(*c*) Explain how missing data were addressed (Not applicable)
		(*d*) If applicable, describe analytical methods taking account of sampling strategy. (Not applicable)
		(*e*) Describe any sensitivity analyses. (Not applicable)
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Confirmed (Lines 232)
		(b) Give reasons for non-participation at each stage (Not applicable)
		(c) Consider use of a flow diagram (Not applicable)
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Confirmed (Lines 231-244)
		(b) Indicate number of participants with missing data for each variable of interest. (Not applicable)
Outcome data	15*	Report numbers of outcome events or summary measures. Confirmed (238-239)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and

		their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included. Confirmed (213-217, 240-355)
		(*b*) Report category boundaries when continuous variables were categorized. (Not applicable)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period. (Not applicable)
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses. (Not applicable)
Discussion		
Key results	18	Summarise key results with reference to study objectives. Confirmed (Lines 358-366)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. Confirmed (Lines 436-455)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. Confirmed (Lines 367-435)
Generalisability	21	Discuss the generalisability (external validity) of the study results. Confirmed (Lines 436-438)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based. Confirmed (Lines 490-492)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.