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

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3 1 **Social and behavioral factors associated with depressive symptoms among university**
4 **students in Cambodia: A cross-sectional study**
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30 ABSTRACT

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

33 **Design** Cross-sectional study.

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

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

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

41 **Results** The proportion of students with depressive symptoms and severe depressive symptoms
42 were 50.6% and 19.6%, respectively. Students with depressive symptoms were significantly
43 more likely to report poor academic performance (AOR=7.31, 95% CI=2.24-23.86), having
44 thought of ending life (AOR=1.60, 95% CI=1.01-2.56), higher consumption of unhealthy food
45 (AOR=1.72, 95% CI=1.08-2.76), severe problem with sleeping (AOR=2.81, 95% CI=1.31-6.06), a
46 negative perception about their body shape (AOR=0.54, 95% CI=0.29-0.99) and their general
47 health status (AOR=2.99, 95% CI= 1.28-7.00), and limited physical activeness (AOR=0.30, 95%
48 CI=0.16-0.58). Students with depressive symptoms were also significantly more likely to
49 encounter physical violence (AOR=1.39, 95% CI=1.04-1.86) and psychological abuse (AOR=1.82,
50 95% CI=1.37-2.42), and lack of general and medical care (AOR=0.51, 95% CI=0.30-0.86) by their
51 family when they were growing up.

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

56
57 **Strengths and limitations of this study**

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

71 INTRODUCTION

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

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

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3 87 poor physical and mental health in general.^{28 29} Moreover, depression in this early period can
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5 88 build up negative consequences in adult life through its impacts on career prospects and social
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7 89 relationships.^{30 31}

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9 90 Thus, tackling depression among university students is vital since most lifetime mental
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11 91 disorders commence during the university age,³² and their mental health has essential
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13 92 ramifications for campus health services in particular and mental health policy-making in
14
15 93 general.^{33 34} Put another way, from a public health standpoint, early detection and prevention
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17 94 of mental health problems among young adults in higher education is paramount.
18
19 95 Comprehension of their salient psychological distress, namely depression, and its correlates,
20
21 96 would enable tailor-made screening and intervention programs to prevent mental health
22
23 97 defects in this population. This is integral for their educational performance and triumph in
24
25 98 their prospective profession as well as for the national advancement since they are future
26
27 99 leaders.

27 100 The prevalence of depression is induced by many factors, including study populations,
28
29 101 socio-demographics,^{16 35} study sites,^{16 36} diagnostic tools and sampling methods,^{36 37} and socio-
30
31 102 cultural environments.¹⁶ Contextualization of facets linked with depression thus is significant
32
33 103 for mitigation measures.

34 104 In Cambodia, little is known about social and behavioral determinants of depressive
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36 105 symptoms among student populations. In 2012, a study on 1,943 students at 11 junior high and
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38 106 high schools found that exposure to violence among community members, peers, or family was
39
40 107 a predictor for depressive symptoms in the students.^{38 39} A 2013 study on a sample of 28
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42 108 students at a Cambodian university found that life events, problems of everyday life, and
43
44 109 availability of social support were the main stress factors affecting students' life satisfaction.⁴⁰
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46 110 Moreover, exposure to daily hassles was a stress factor having a strong impact on students'
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48 111 psychological and somatic responses. Nonetheless, no research has been conducted to examine
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50 112 social and behavioral determinants of depression among Cambodian university students. This
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52 113 study therefore intends to identify factors associated with depressive symptoms among
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54 114 university students in Cambodia.

55 115

116 **METHODS**

117 **Study sites and population**

118 This cross-sectional study was conducted with students at the University of Battambang (UB) in
119 Battambang province and the Royal University of Phnom Penh (RUPP) in the capital city of
120 Cambodia in June and July 2015. Epi Info was used to calculate the sample size from the
121 university student population of approximately 168,000.⁴¹ The anticipated percentage
122 frequency was not known, so 50% was put for the calculation to prevent any underestimated
123 prevalence. Based on a 95% confidence level (CI) and a +5% margin of error, the minimum
124 sample size required for this study was 767 students. Adjusted for 10% of incomplete
125 responses, missing data, and rejection rate, the final minimum required sample size was 850
126 students.

127

128 **Sampling and data collection procedure**

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

138

139 **Questionnaire development and training**

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

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3 145 working on health and education in Cambodia. The questionnaire was finalized based on their
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5 146 feedback and findings from the piloting.
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7 147 All researchers spent two days to provide training on the study protocol and data
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9 148 collection method to the data enumerators and supervisors. The training focused on building
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11 149 familiarity with the study protocol and questionnaire, interview techniques, privacy assurance,
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13 150 and confidentiality. It also addressed quality control strategies, such as rechecking and
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15 151 reviewing the questionnaires after administration, and resolving issues that might arise during
16
17 152 the fieldwork. The data collection supervisors were instructed to perform regular reviews with
18
19 153 the data enumerators to monitor progress and settle any issues occurring during the process.
20

21 154

22 155 **Variables and measurements**

23 156 *Depressive symptoms*

25 157 Depressive symptoms were assessed by using the Center for Epidemiologic Studies Depression
26
27 158 scale (CES-D).⁴² This scale consists of 20 questions addressing six symptoms of depression,
28
29 159 including depressed mood, guilt or worthlessness, helplessness or hopelessness, psychomotor
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31 160 retardation, loss of appetite, and sleep disturbance experienced during the preceding week.
32
33 161 Each question is scored on a scale of 0 to 3 according to the frequency of the symptoms, and
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35 162 the total CES-D score ranges from 0 to 60. To calculate the total score, four items (I felt I was
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37 163 just as good as other people, I felt hopeful about the future, I was happy, and I enjoyed life)
38
39 164 were reverse coded. The criterion validity of the CES-D scale has been well established in
40
41 165 Western⁴² and Asian⁴³ populations. We defined depressive symptoms as present when a
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43 166 subject had a CES-D score of ≥ 16 . A cutoff value of ≥ 23 was also used to define severe
44
45 167 depressive state.⁴⁴
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47 169 *Socio-demographic characteristics, substance use, and sexual behaviors*

49 170 We adapted standardized tools from the most recent Cambodia Demographic and Health
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51 171 Survey⁴⁵ as well as from our previous student and young people health surveys in Cambodia^{38 39}
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53 172 ⁴⁶⁻⁴⁸ to measure socioeconomic characteristics, sexual behaviors with different partners, and
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55 173 substance use (alcohol, tobacco, and illicit drugs). Socio-demographic characteristics of the
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174 respondents included study site, gender, age, marital status, year of the study, living situations,
175 perceived family economic status, and perceived academic performance.

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177 *Health related behaviors*

178 We used the Health Behavior Survey,⁴⁹ which was designed as a broad survey of health-related
179 behaviors and beliefs, components of the “national college health risk behavior survey”
180 (1997),⁵⁰ and the Global School-based Student Health Survey.⁵¹ Each health behavior area was
181 addressed by only a limited number of items. For example, frequency of consumption of fast
182 food in an average week was assessed by a question, “On average, how many times do you eat
183 fast food per week?” with response options of 0 time, 1-2 times a week, and 3 or more times a
184 week. Similar questions and response options were used to assess consumption of several
185 other kinds of healthy and unhealthy food, such as high-fat snack or fruits/vegetables. Self-
186 ratings were also used for some questions, such as perceived body size (rated from very
187 overweight to very underweight), general health status (rated from very good to very poor),
188 and problems with sleeping in the past 30 days (rated from none to severe).

189

190 *Adverse childhood experiences (ACEs)*

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

198

199 *Self-rated health*

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

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3 203 aspects, namely physical functioning, role limitations due to physical health problems, bodily
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5 204 pain, general health, vitality (energy/fatigue), social functioning, role limitations due to
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7 205 emotional problems, and mental health (psychological distress and psychological well-being).
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10 207 **Data analyses**

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12 208 Double data entry was performed using EpiData version 3 (Odense, Denmark). χ^2 test, or
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14 209 Fisher's exact test when the sample sizes were smaller than five in one cell, was used for
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16 210 categorical variables and Student's *t*-test was used for continuous variables to compare socio-
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18 211 demographic characteristics, health risk behaviors (sexual behaviors, substance use, eating
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20 212 behaviors, body size, and problems with sleeping), self-rated health (SF-12), and ACEs among
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22 213 students with depressive symptoms, defined by a CES-D score of ≥ 16 , to those without
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24 214 depressive symptoms. The same comparisons were also made among students with and
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26 215 without severe depressive symptoms, defined by a CES-D score of ≥ 23 .

27 216 To control for potential confounding factors, two multivariate logistic regression models
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29 217 were constructed, one for depressive symptoms and the other for severe depressive symptoms.
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31 218 In the multivariate models, we first included all variables significantly associated with the
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33 219 outcome variables in the bivariate analyses at a level of *p*-value < 0.05 simultaneously in the
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35 220 models. Variables with a *p*-value > 0.05 were then removed, and the models were refitted. The
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37 221 steps were repeated until all *p*-values of the remaining variables were < 0.05 in the final models.
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39 222 Adjusted odds ratio (AOR) were obtained and presented with CI and *p*-values. SPSS version 22
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41 223 (IBM Corporation, New York, USA) was used for all statistical analyses.
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44 225 **Ethical considerations**

45 226 The National Ethics Committee for Health Research of the Ministry of Health, Cambodia,
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47 227 approved the study protocol and materials (No. 191NECHR). Participation in this study was
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49 228 voluntary. In the process of obtaining their written informed consent, participants were made
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51 229 clear that they could refuse or discontinue their participation at any time and for any reason.
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53 230 The confidentiality and privacy of the respondents were protected by administering the
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55 231 questionnaires in a private premise and by excluding personal identifiers in the survey.
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233 **RESULTS**234 **Socio-demographic characteristics**

235 The study sample included 493 students (36.3%) from UB and 866 students (63.7%) from RUPP.

236 Of the total, 50.8% of the respondents were male, with a mean age of 21.3 years [standard

237 deviation (SD)=2.3]. The majority of the respondents (97.9%) were unmarried; and 43.4% were

238 living with their parents. Regarding their family economic status, 59.2% reported that their

239 family was neither rich nor poor. The proportion of students with depressive symptoms and

240 severe depressive symptoms were 50.6% and 19.6%, respectively.

241 Table 1 shows the comparisons of socio-demographic characteristics of students with

242 and without depressive symptoms. Compared to their comparison groups, students with

243 depressive symptoms were significantly more likely to be from UB ($p=0.004$), to be from a

244 poorer family ($p=0.002$), and to report poorer academic performance ($p<0.001$). Similarly,

245 students with severe depressive symptoms were significantly more likely to be female

246 ($p=0.002$), to be from a poorer family ($p=0.04$), and to report poorer academic performance

247 ($p<0.001$).

248

249 **Table 1** Comparisons of socio-demographic characteristics of university students with and without

250 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 \pm SD)	21.3 \pm 2.4	21.4 \pm 2.3	0.82	21.4 \pm 2.3	21.1 \pm 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)

251 *Abbreviation: SD, standard deviation.*

252 *Values are numbers of subjects (%) for categorical variables and means \pm standard deviation (SD) for*

253 *continuous variables.*

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

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

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

257 *variables.*

258

259 Health risk behaviors

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

275
 276 **Table 2** Comparisons of health risk behaviors among university students with and without depressive
 277 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

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)

278 *Abbreviations: STI, sexually transmitted infections.*

279 *Values are numbers of subjects (%).*

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

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

282 *‡ Chi-square test was used or Fisher's exact test was used as appropriate.*

283

284 **Self-rated health (SF-12)**

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

302
303 **Table 3** Comparisons of self-rated health (SF-12) among university students with and without depressive
304 symptoms

Self-rated health (SF-12)	Depressive symptoms		P-value [‡]	Severe depressive symptoms [†]		P-value [‡]
	No	Yes		No	Yes	
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)

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

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

307 † Defined by a CES-D score of ≥ 23 .

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

309

310 Adverse childhood experiences (ACEs)

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

323

324 **Table 4** Comparisons of adverse childhood experiences among university students with and without
 325 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

1							
2							
3	There had been someone	636 (50.2)	632 (49.8)	0.04	1028 (81.1)	240 (18.9)	0.03
4	to take care me and take						
5	me to medical care when I						
6	got sick						
7							
8							
9	There had been someone	647 (50.1)	644 (49.9)	0.03	1050 (81.3)	266 (19.6)	<0.001
10	who helped me feel that I						
11	was loved and important						
12							
13							
14							

326 *Values are numbers of subjects (%).*

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

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

329 *‡Chi-square test was used.*

330

331 Risk factors of depressive symptoms

332 The results of multivariate logistic analyses are shown in Table 5. After controlling for potential
 333 confounding factors, the students with symptoms remained significantly more likely to report
 334 poor academic performance (depressive symptoms: AOR=7.31, 95% CI=2.24-23.86; severe
 335 depressive symptoms: AOR=7.38, 95% CI=1.75-10.94); having thought of ending life (depressive
 336 symptoms: AOR=1.60, 95% CI=1.01-2.56; severe depressive symptoms: AOR=2.52, 95% CI=1.58-
 337 4.01); higher consumption of unhealthy food, including high-fat snack, margarine, butter, or
 338 meat fat (depressive symptoms: AOR=1.72, 95% CI=1.08-2.76; severe depressive symptoms:
 339 AOR=2.13, 95% CI=1.15-3.95); and severe problem with sleeping in the past 30 days (depressive
 340 symptoms: AOR=2.81, 95% CI=1.31-6.06; severe depressive symptoms: AOR=2.84, 95% CI=1.32-
 341 6.13). They remained significantly less likely to perceive that their body size was slightly
 342 underweight (depressive symptoms: AOR=0.54, 95% CI=0.29-0.99; severe depressive
 343 symptoms: AOR=0.37, 95% CI=0.18-0.77).

344 Regarding self-rated health, the students with symptoms remained significantly more
 345 likely to perceive that their general health status was poor (depressive symptoms: AOR=2.99,
 346 95% CI=1.28-7.00; severe depressive symptoms: AOR=5.43, 95% CI=2.19-13.46), to report
 347 higher level of limitation in moderate activities (depressive symptoms: AOR=0.30 (95% CI=0.16-
 348 0.58), to report higher level of pain interference with their normal work (depressive symptoms:
 349 AOR=10.43, 95% CI=1.05-10.94; severe depressive symptoms: AOR=10.02, 95% CI=1.99-9.28),

350 and to report higher level of feeling down-hearted and blue (depressive symptoms: AOR=6.69,
351 95% CI=1.87-23.90; severe depressive symptoms: AOR=8.72, 95% CI=1.69-14.86).

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

359
360 **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				

1					
2					
3	None/very little			Reference	
4					
5	Some			0.98 (0.66-1.46)	0.91
6					
7	A lot			1.92 (1.02-3.64)	0.04
8	Self-perception about body shape				
9					
10	Very overweight	Reference			
11					
12	Slightly overweight	0.56 (0.31-1.07)	0.08	0.65 (0.32-1.14)	0.25
13					
14	About right	0.58 (0.32-1.05)	0.07	0.45 (0.22-0.93)	0.03
15					
16	Slightly underweight	0.54 (0.29-0.99)	0.04	0.37 (0.18-0.77)	0.008
17					
18	Very underweight	0.92 (0.38-2.25)	0.86	0.38 (0.14-0.99)	0.04
19	Problem with sleeping in the past 30 days				
20					
21	None	Reference			
22					
23	Mild	0.79 (0.53-1.19)	0.26	1.08 (0.55-2.16)	0.82
24					
25	Moderate	1.06 (0.72-1.58)	0.76	1.45 (0.89-2.66)	0.26
26					
27	Severe	2.81 (1.31-6.06)	0.008	2.84 (1.32-6.13)	0.008
28	Self-perception on general health status				
29					
30	Very good				
31					
32	Good	1.05 (0.68-1.64)	0.82	1.19 (0.60-2.38)	0.62
33					
34	Fair	1.58 (0.99-2.51)	0.05	1.47 (0.73-2.96)	0.28
35					
36	Poor	2.99 (1.28-7.00)	0.01	5.43 (2.19-13.46)	<0.001
37	Limitation in moderate activities on a typical day				
38					
39	Greatly limited	Reference		Reference	
40					
41	Mildly limited	0.39 (0.20-0.74)	0.004	0.64 (0.29-1.34)	0.23
42					
43	Not limited	0.30 (0.16-0.58)	<0.001	0.63 (0.30-1.36)	0.24
44	Pain interferes with your normal work in past 4 weeks				
45					
46	Not at all	Reference		Reference	
47					
48	A little bit	1.68 (1.08-2.61)	0.02	1.01 (0.46-2.22)	0.99
49					
50	Moderately	3.10 (1.89-5.10)	<0.001	3.69 (1.68-7.11)	0.001
51					
52	Quite a bit	4.14 (2.13-8.05)	<0.001	4.68 (2.01-10.92)	<0.001
53					
54	Extremely	10.43 (1.05-10.94)	0.04	10.02 (1.99-9.28)	0.005
55	Feeling down-hearted and blue in past 4 weeks				
56					
57	None of the time	Reference		Reference	
58					
59	A little of the time	0.52 (0.63-3.66)	0.35	1.02 (0.24-4.29)	0.98
60					

1					
2					
3	Some of the time	3.42 (1.42-8.23)	0.006	1.83 (0.45-7.45)	0.40
4	A good bit of the time	7.70 (3.02-19.66)	<0.001	6.01 (1.45-4.85)	0.01
5	Most of the time	20.71 (6.47-66.37)	<0.001	9.04 (2.31-13.71)	0.002
6	A lot of the time	6.69 (1.87-23.90)	0.003	8.72 (1.69-14.86)	0.01
7					
8					
9					
10	Had been hit, slapped, kicked, by a parent/guardian				
11	No	Reference		Reference	
12	Yes	1.39 (1.04-1.86)	0.03	1.11 (0.75-1.65)	0.59
13					
14	People in my family had said hurtful or insulting things to me				
15	No	Reference		Reference	
16	Yes	1.82 (1.37-2.42)	<0.001	2.18 (1.46-3.24)	<0.001
17					
18	There had been someone to take care of me and take me to medical care when I got sick				
19	No	Reference		Reference	
20	Yes	0.51 (0.30-0.86)	0.01	0.26 (0.13-0.52)	<0.001
21					
22					
23					
24					

25 361 *Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.*

26 362 **Variables in the table were the ones that remained statistically significant in the final multivariate*
 27 363 *logistic regression model after several steps of model fitting.*

28 364 *† Defined by a Center for Epidemiology Studies Depression Scale (CES-D) score of ≥ 16 .*

29 365 *‡ Defined by a CES-D score of ≥ 23 .*

30 366

31 367 **DISCUSSION**

32 368 This study unearthed a number of factors correlated with depressive symptoms among
 33 369 university students in Cambodia. The salient factors comprised cultural and socio-economic
 34 370 dimensions (gender, socio-economic background, and lack of general and medical care by
 35 371 family), individual behaviors and attitudes (poor academic accomplishment, suicidal ideation,
 36 372 consumption of unhealthy food, severe problem with sleeping, negative perception about their
 37 373 body and their general health status, and limited physical activeness), and nurture-related
 38 374 facets (physical violence and psychological abuse by family).

39 375 The bivariate outcomes display that students from the provincial university (UB) and a
 40 376 poorer family were more susceptible to depressive symptoms. Likewise, students from a poorer
 41 377 family and female students were more prone to severe depressive symptoms. Albeit not
 42 378 manifesting in the multivariate model, these factors are corroborated by the existing
 43 379 scholarship. Various studies revealed that university students from rural areas and low socio-

1
2
3 380 economic backgrounds were predisposed to higher depression.^{1 16 28 55 56} This could be
4
5 381 explained by an economic situation where students with a rural background tended to stipulate
6
7 382 a poorer family status. Plus, financial vulnerability could further exacerbate depression in
8
9 383 students from low-income families. A meta-analysis of 60 studies unveiled that people in the
10
11 384 lowest socio-economic quintile had 1.81 the probability of depression compared with those in
12
13 385 the highest socio-economic quintile.⁵⁷ A global study on 17,348 university students from 23
14
15 386 high-, middle-, and low-income countries also uncovered that higher depressive symptoms
16
17 387 were recorded among students in low-income countries and economies with greater income
18
19 388 inequality.¹⁶ The Cambodian economy has been growing rapidly in terms of income per capita;
20
21 389 yet, income gaps between the rich and the poor and between rural and urban areas remain
22
23 390 large.⁵⁸ The gaps in income and material growth, which typify economic conditions, may induce
24
25 391 people's mental health problems. In another word, poor economic status may bring about low
26
27 392 self-esteem and self-confidence, which would lead to depression.

27 393 Some research also discovered that female students were more at risk to depression.¹⁶
28
29 394⁵⁹⁻⁶² This might be due to social difficulties, physiological tenets, higher self-expectations, and
30
31 395 perceived lack of competence among female students.⁵⁹ In the Cambodian culture, young
32
33 396 women would perceive a great deal of challenges when living away from their family or parents
34
35 397 since they need to maintain the cultural behavior and meanwhile cope with independent
36
37 398 habitation. Over half (56.6%) of the student respondents in our study were not living with their
38
39 399 parents. Moreover, women tended to over-report medical and psychological symptoms as
40
41 400 indicated in a study on 440 undergraduate students in America.⁶³ Articulating their emotions
42
43 401 may be one strategy for dealing with stressful events.

44 402 Our multivariate results depict that students with depressive symptoms, regardless of
45
46 403 severity, tended to report poor academic performance, having thought of ending life, and
47
48 404 higher consumption of unhealthy food. These findings conform to a systematic review of 24
49
50 405 studies⁶ and studies in Asia, such as China,⁷ which pinpoint low scholastic merit and suicidal
51
52 406 ideation as consistent correlates of depression in university students probably as a culmination
53
54 407 of poor concentration and solitude. On the consumption of unhealthy food, the transition from
55
56 408 adolescence to adulthood, and thus the changes in lifestyle such as living arrangements and

1
2
3 409 independence, might have rendered university students to indulge in unhealthy food, as
4
5 410 pinpointed by a meta-analysis of 39 studies in China.⁷ As afore-mentioned, more than half of
6
7 411 our sample were not living with their parents; therefore, it might have been hard for them to
8
9 412 maintain healthy daily food. Conversely, depression might have made students care-free about
10
11 413 themselves and consequently eat unhealthily.¹⁷ This implies that nutrition education for both
12
13 414 physical and mental health, stressing healthy food for the body and mind, is imperative for
14
15 415 university students.

16 416 Students with depressive symptoms, regardless of magnitude, also tended to have
17
18 417 severe problem with sleeping and a negative perception about their body and their general
19
20 418 health status. This finding confirms the general perception among depressed people who are
21
22 419 not gratified with their body and health.¹⁷ Further, depressed students were more likely to have
23
24 420 limited physical activeness, more pain interference with their normal work, and more dismay or
25
26 421 sorrow. This reflects scientific facts that lack of physical activities may cause blue feelings and
27
28 422 subsequently depression.^{64 65} Therefore, physical exercises, such as sports, should be regularly
29
30 423 promoted among university students.

31 424 Finally, students with depressive symptoms were more likely to encounter physical
32
33 425 violence by their parent or guardian, psychological abuse by their family members (for both
34
35 426 students with depressive and severely depressive symptoms), and lack of general and medical
36
37 427 care by their family (for both students with depressive and severely depressive symptoms). As
38
39 428 for the physical violence and psychological abuse, this finding tends to acquiesce with a study in
40
41 429 Cambodia that postulates that exposure to violence within family is associated with depression
42
43 430 in high school students.^{38 39} On the lack of general and medical care by family, a Chinese study
44
45 431 on 5,245 students at six universities found that students who had a poor parental relationship
46
47 432 were more vulnerable to depression.⁶⁶ Also, a global study on 17,348 university students from
48
49 433 23 high, middle-, and low-income countries iterated that university students with less
50
51 434 individualistic cultures, particularly in Asia, reported higher extents of depressive symptoms.¹⁶
52
53 435 Students of these cultures longed for more familial and societal ties and assistance, and thus
54
55 436 felt depressed once this social capital was unavailable.¹⁶ This highlights a significant role of
56
57 437 family bonds and scaffolding in association with depression among university students. In an

1
2
3 438 Asian culture like Cambodian, family is an integral part for young adults and is pivotal for their
4
5 439 study and career advancement. Family environment and support, especially from parents,
6
7 440 affect students' emotional state. Poor parental relationships could cause negligence over
8
9 441 children, which could deteriorate their mental health. Thus, family atmosphere and support are
10
11 442 vital for mitigating mental health defects, such as depression, in university students.

12 443 A study on a sample of 2,671 respondents in nine provinces and a capital city in 2012
13
14 444 revealed that Cambodia greatly needs more and better counseling and mental health services.⁶⁷
15
16 445 The study also pointed out the shortage of skilled professionals in the field of mental health,
17
18 446 particularly those with high clinical and counseling skills to treat mental disorders. In 2012,
19
20 447 Cambodia had only 49 trained psychiatrists and 45 psychiatric nurses working in mental health
21
22 448 facilities and private practices.^{67 68} Many health staff lack training, supervision, and experience
23
24 449 in these areas. Only about 300 doctors completed basic mental healthcare training.⁶⁹ At
25
26 450 university level, the 2012 study called for more awareness raising for self-care and burnout
27
28 451 prevention and mental health counseling services for staff and students.⁶⁷ Given the paucity of
29
30 452 mental health services in general, let alone at universities, our findings fuel the needs for more
31
32 453 and better mental healthcare in Cambodia.

33 454 This study contains certain limitations. First, it examined students at only two public
34
35 455 universities, one in a city and the other in a province. Hence, its findings cannot be generalized
36
37 456 at a national level. Second, the cross-sectional design did not enable an establishment of the
38
39 457 causal linkages between depressive symptoms and the related factors. Given the temporal
40
41 458 order and the cross-sectional nature of the data, causal relationships between the variables
42
43 459 could not be derived. Potential bi-directionality of the associations could occur either way. For
44
45 460 instance, physical inactivity could cause depression. Nonetheless, the reverse could also be
46
47 461 true—that depression could lead to inactivity, and of course both could be true simultaneously,
48
49 462 where depressive symptoms worsen with physical inactivity, making physical activity less likely.
50
51 463 Third, this study employed self-reported data, which might have been subject to recall bias of
52
53 464 over-reporting and under-reporting. Nonetheless, the quality of the data was ensured by
54
55 465 thorough training of the enumerators and field supervisors on the study protocols and data
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57 466 collection method. Finally, some of the measures, such as ACEs, were modified from other

1
2
3 467 research, and have not been validated in the Cambodian setting. Notwithstanding these
4
5 468 malfeasances, the findings of this study offer first and foremost implications for policy
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7 469 development and future research in the Cambodian context.
8
9 470

10

11 471 **CONCLUSIONS**

12 472 This study identified social and behavioral factors associated with depressive symptoms among
13
14 473 Cambodian students at two universities. While causation could not be drawn between these
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16 474 factors and depression, we surmise that these factors were inter-twined, and thus need to be
17
18 475 addressed in an integrated and holistic fashion.

19
20 476 These findings render three major implications. First, given the current educational
21
22 477 reform and labor market that demand better quality and ergo more competition among
23
24 478 university students, the correlates of depressive symptoms could not be more critical for
25
26 479 tackling for the time being. Failure to ameliorate these factors would jeopardize the
27
28 480 qualification and career development of this populace and finally the human capital for nation-
29
30 481 building. Second, these findings warrant an acceleration of on-campus counseling services for
31
32 482 university students throughout the course of studentship. Efforts should be invested in
33
34 483 comprehensive screening and intervention programs to diagnose those susceptible students
35
36 484 early, offer immediate treatment, and cater appropriate support. Ultimately, the jurisdiction of
37
38 485 refining students' mental state should go beyond universities to families and pertinent
39
40 486 governmental bodies at large, provided we are to assist the young to overcome their academic
41
42 487 challenges and enjoy a prosperous post-graduation life. Further research could delve into
43
44 488 changing lifestyles and their associations with depressive symptoms among a larger sample of
45
46 489 university students.

47

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49
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51
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53 494

1
2
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4
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6
7 497 drafted the manuscript. KP, PC and RY supported the protocol and tools development and were
8
9 498 responsible for training and data collection. All authors contributed to the writing and approved
10
11 499 the final manuscript.

12 500
13
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15
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27 508 **Competing interests** None declared

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31 510 **Ethics approval** The National Ethics Committee for Health Research of the Ministry of Health,
32
33 511 Cambodia approved this study (Reference no. 082NECHR), and a written informed consent was
34
35 512 obtained from each participant.

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38 514 **Data sharing statement** Data used for this analysis are available upon request from the
39
40 515 Principal Investigator (Dr. Siyan Yi) at siyan@doctor.com. The data cannot be made publicly
41
42 516 available due to ethical restriction.

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For peer review only

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

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

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3 1 **Social and behavioral factors associated with depressive symptoms among university**
4 **students in Cambodia: A cross-sectional study**
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9 4 Chanrith Ngin,^{1,2} Khuondyla Pal,¹ Sovannary Tuot,¹ Pheak Chhoun,¹ Rosa Yi,² Siyan Yi^{1,3,*}

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30 ABSTRACT

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

33 **Design** Cross-sectional study.

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

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

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

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

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

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56 **Strengths and limitations of this study**

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

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3 59 • It included a large sample of students randomly selected from all departments in two
4 public universities – one in the capital city and the other in a provincial town – using a
5 60 multi-stage cluster sampling method.
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9 62 • Limitations of the study, however, included the representativeness of the study sample,
10 the cross-sectional nature of the data that limits causation inferences, unknown validity
11 63 of the scales used to measure important constructs in Cambodian contexts, and
12 64 potential bias of self-reported measures.
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18 67 INTRODUCTION

19
20 68 Several studies have suggested that the aspects of mental health among university students are
21 69 considerably poorer than that of their peers in the general population.¹⁻⁵ Depression is one of
22 the most prevalent mental health problems among university students, and the prevalence is
23 70 rising.⁶⁻⁷ There are varied prevalence estimates of depressive symptoms among university
24 71 students, ranging from in the area of 10%⁸⁻¹¹ to in the region of 20%¹² and up to 40% and
25 72 80%.¹³⁻¹⁵ However, the mean prevalence of depression in university students stands at 30.6%.⁶
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27 73
28 74 University students are in a critical period of life since they transition from adolescence to
29 75 adulthood, which requires them to make many major decisions. During this period, they
30 76 encounter tremendous pressures, chiefly from economic stress, academic demands,
31 77 interpersonal relationships, and struggles with making crucial decisions.¹⁶
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34 79 Depression manifests in a wide range of symptoms, encompassing sleep and eating
35 80 disturbances, lack of self-care, poor concentration, anxiety, and disinterest in everyday
36 81 activities.¹⁷ For university students, depression is correlated with poor academic
37 82 achievements;¹⁸ drop-out;¹⁹⁻²⁰ relationship instability;²¹ suicidal ideation, attempts, and
38 83 commitments;¹⁸⁻²²⁻²³ poor work performance;²⁴ substance abuse;²⁵⁻²⁶ acute infectious
39 84 illnesses;²⁷ and poor physical and mental health in general.²⁸⁻²⁹ Moreover, depression in this
40 85 early period can build up negative consequences in adult life through its impacts on career
41 86 prospects and social relationships.³⁰⁻³¹
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44 88 Thus, tackling depression among university students is vital since most lifetime mental
45 89 disorders commence during the university age,³² and their mental health has essential
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3 88 ramifications for campus health services in particular and mental health policy-making in
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5 89 general.^{33 34} Put another way, from a public health standpoint, early detection and prevention
6
7 90 of mental health problems among young adults in higher education is paramount.
8
9 91 Comprehension of their salient psychological distress, namely depression, and its correlates,
10
11 92 would enable tailor-made and early screening and intervention programs to reduce mental
12
13 93 health problems in this population. This is integral for their educational performance and
14
15 94 triumph in their prospective profession as well as for the national advancement since they are
16
17 95 future leaders.

18 96 The prevalence of depression is induced by many factors, including study populations,
19
20 97 socio-demographics,^{16 35} study sites,^{16 36} diagnostic tools and sampling methods,^{36 37} and socio-
21
22 98 cultural environments.¹⁶ Contextualization of facets linked with depression thus is significant
23
24 99 for mitigation measures.

25 100 In Cambodia, little is known about social and behavioral determinants of depressive
26
27 101 symptoms among student populations. In 2012, a study on 1,943 students at 11 junior high and
28
29 102 high schools found that exposure to violence among community members, peers, or family was
30
31 103 a predictor for depressive symptoms in the students.^{38 39} A 2013 qualitative study on a sample
32
33 104 of 28 students at a Cambodian university found that life events, problems of everyday life, and
34
35 105 availability of social support were the main stress factors affecting students' life satisfaction.⁴⁰
36
37 106 Moreover, exposure to daily hassles was a stress factor having a strong impact on students'
38
39 107 psychological and somatic responses. Nonetheless, no research has been conducted to examine
40
41 108 social and behavioral determinants of depression among Cambodian university students. This
42
43 109 study therefore intends to identify factors associated with depressive symptoms among
44
45 110 university students in Cambodia.

46 111

47 112 **METHODS**

48 113 **Study sites and population**

49 114 This cross-sectional study was conducted with students at the University of Battambang (UB) in
50
51 115 Battambang province and the Royal University of Phnom Penh (RUPP) in the capital city of
52
53 116 Cambodia in June and July 2015. Epi Info (Centers for Disease Control and Prevention, Atlanta,
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3 117 GA) was used to calculate the sample size from the university student population of
4
5 118 approximately 168,000.⁴¹ The anticipated percentage frequency was not known, so 50% was
6
7 119 put for the calculation to prevent any underestimated prevalence. Based on a 95% confidence
8
9 120 interval (CI) and a +5% margin of error, the minimum sample size required for this study was
10
11 121 767 students. Adjusted for 10% of incomplete responses, missing data, and rejection rate, the
12
13 122 final minimum required sample size was 850 students.
14
15

123

124 **Patient and public involvement**

125 The development of the research questions and outcome measures was informed by university
126 students' priorities, experience, and preferences gathered through consultative meetings with
127 representatives of students, faculty members, and school administrators. The workshops aimed
128 to collect inputs from the representatives for designing the study and developing the study
129 protocol and materials. The representatives were also invited to participate in the study finding
130 dissemination workshops in each participating university.
131

131

132 **Sampling and data collection procedure**

133 A multi-stage cluster sampling method was used to select the participants. First, the two
134 universities were purposively selected, considering administration and logistic limitations. All
135 departments of the selected universities were included in the study. In each department, non-
136 proportion to sample size sampling method was used to select the sample from a name list
137 provided by the department administrator to meet the required sample size. On the designated
138 date of data collection, all selected students were approached by trained data collectors with
139 support from a school administrator. Questionnaires and instructions were then distributed to
140 them in a classroom for self-administration, which took approximately 30min to complete. The
141 participants then completed the questionnaires by themselves.
142

142

143 **Questionnaire development and training**

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

1
2
3 146 English by a local expert to check its accuracy. The Khmer questionnaire was pretested with a
4
5 147 sample of 20 students at RUPP to ensure that the wording and contents were culturally suitable
6
7 148 and clearly understandable. We also received comments on the questionnaire from experts
8
9 149 working on health and education in Cambodia. The questionnaire was finalized based on their
10
11 150 feedback and findings from the pretest.

12
13 151 A two-day training on the study protocol and data collection methods was provided to
14
15 152 the data enumerators and supervisors. The training focused on building familiarity with the
16
17 153 study protocol and questionnaire, interview techniques, privacy assurance, and confidentiality.
18
19 154 It also addressed quality control strategies, such as rechecking and reviewing the
20
21 155 questionnaires after administration, and resolving issues that might arise during the fieldwork.
22
23 156 The data collection supervisors were instructed to perform regular reviews with the data
24
25 157 enumerators to monitor progress and settle any issues occurring during the process.
26

25 158

27 159 **Variables and measurements**

29 160 *Depressive symptoms*

30
31 161 Depressive symptoms were assessed by using the Center for Epidemiologic Studies Depression
32
33 162 scale (CES-D).⁴² This scale consists of 20 questions addressing six symptoms of depression,
34
35 163 including depressed mood, guilt or worthlessness, helplessness or hopelessness, psychomotor
36
37 164 retardation, loss of appetite, and sleep disturbance experienced during the preceding week.
38
39 165 Each question is scored on a scale of 0 to 3 according to the frequency of the symptoms, and
40
41 166 the total CES-D score ranges from 0 to 60. To calculate the total score, four items (I felt I was
42
43 167 just as good as other people, I felt hopeful about the future, I was happy, and I enjoyed life)
44
45 168 were reverse coded. The criterion validity of the CES-D scale has been well established in
46
47 169 Western⁴² and Asian⁴³ populations. We defined depressive symptoms as present when a
48
49 170 subject had a CES-D score of ≥ 16 . A cutoff value of ≥ 23 was also used to define severe
50
51 171 depressive state.⁴⁴

51 172

53 173 *Socio-demographic characteristics, substance use, and sexual behaviors*

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2
3 174 We adapted standardized tools from the most recent Cambodia Demographic and Health
4
5 175 Survey⁴⁵ as well as from our previous student and young people health surveys in Cambodia^{38 39}
6
7 176 ⁴⁶⁻⁴⁸ to measure socioeconomic characteristics, sexual behaviors with different partners, and
8
9 177 substance use (alcohol, tobacco, and illicit drugs). Socio-demographic characteristics of the
10
11 178 respondents included study site, gender, age, marital status, academic year, living situations,
12
13 179 perceived family economic status, and perceived academic performance.
14
15 180

16 181 *Health related behaviors*

17
18 182 We used the Health Behavior Survey,⁴⁹ which was designed as a broad survey of health-related
19
20 183 behaviors and beliefs, components of the “National College Health Risk Behavior Survey”
21
22 184 (1997),⁵⁰ and the Global School-based Student Health Survey.⁵¹ Each health behavior area was
23
24 185 addressed by only a limited number of items. For example, frequency of consumption of fast
25
26 186 food in an average week was assessed by a question, “On average, how many times do you eat
27
28 187 fast food per week?” with response options of 0 time, 1-2 times a week, and 3 or more times a
29
30 188 week. Similar questions and response options were used to assess consumption of several
31
32 189 other kinds of healthy and unhealthy food, such as high-fat snack or fruits/vegetables. Self-
33
34 190 ratings were also used for some questions, such as perceived body size (rated from very
35
36 191 overweight to very underweight) and general health status (rated from very good to very poor).
37

38 193 *Adverse childhood experiences (ACEs)*

39
40 194 Five questions were adapted from the brief screening version of the Childhood Trauma
41
42 195 Questionnaire to measure ACEs.⁵² The five yes/no questions asked about the experiences of
43
44 196 physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect during
45
46 197 childhood.
47

48 49 199 *Self-rated health*

50
51 200 SF-12 Health Survey (SF-12) was used to measure self-rated health.^{53 54} The SF-12 is a
52
53 201 multipurpose short-form generic measure of health status. It is a subset of the larger SF-36 and
54
55 202 monitors health in general and in specific populations. The SF-12 measures eight health
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3 203 aspects, namely physical functioning, role limitations due to physical health problems, bodily
4
5 204 pain, general health, vitality (energy/fatigue), social functioning, role limitations due to
6
7 205 emotional problems, and mental health (psychological distress and psychological well-being).
8
9 206

10 207 **Data analyses**

11
12 208 Double data entry was performed using EpiData version 3 (Odense, Denmark). χ^2 test, or
13
14 209 Fisher's exact test when a sample size was smaller than five in one cell, was used for categorical
15
16 210 variables, and Student's *t*-test was used for continuous variables to compare socio-
17
18 211 demographic characteristics, health risk behaviors (sexual behaviors, substance use, and eating
19
20 212 behaviors), self-rated health (SF-12), and ACEs among students with depressive symptoms,
21
22 213 defined by a CES-D score of ≥ 16 , to those without depressive symptoms. The same comparisons
23
24 214 were also made among students with and without severe depressive symptoms, defined by a
25
26 215 CES-D score of ≥ 23 .

27 216 In multivariate models, we first included all variables significantly associated with
28
29 217 depressive symptoms in the bivariate analyses at a level of *p*-value < 0.05 simultaneously in the
30
31 218 models. Variables with a *p*-value > 0.05 were then removed, and the models were refitted. The
32
33 219 steps were repeated until all *p*-values of the remaining variables were < 0.05 in the final models.
34
35 220 Adjusted odds ratio (AOR) were obtained and presented with CI and *p*-values. SPSS version 22
36
37 221 (IBM Corporation, New York) was used for all statistical analyses.
38
39 222

40 223 **Ethical considerations**

41 224 The National Ethics Committee for Health Research of the Ministry of Health, Cambodia,
42
43 225 approved the study protocol and materials (No. 191NECHR). Participation in this study was
44
45 226 voluntary. In the process of obtaining a written informed consent, students were made clear
46
47 227 that they could refuse or discontinue their participation at any time and for any reason. The
48
49 228 confidentiality and privacy of the respondents were protected by administering the
50
51 229 questionnaires in a private premise and by excluding personal identifiers from the data and
52
53 230 field notes. After completing the survey, each participant received a small gift (costing
54
55 231 approximately \$US 2.0) for their time compensation.
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232

233 **RESULTS**234 **Socio-demographic characteristics**

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

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

249

250 **Table 1** Comparisons of socio-demographic characteristics of university students with and without
 251 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 \pm SD)	21.3 \pm 2.4	21.4 \pm 2.3	0.82	21.4 \pm 2.3	21.1 \pm 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)

252 Abbreviation: SD, standard deviation.

253 Values are numbers of subjects (%) for categorical variables and means \pm standard deviation (SD) for
254 continuous variables.

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

256 † Defined by a CES-D score of ≥ 23 .

257 ‡ Chi-square test was used for categorical variables; independent Student's t-test was used for continuous
258 variables.

259

260 **Health risk behaviors**

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

273

274 **Table 2** Comparisons of health risk behaviors among university students with and without depressive
 275 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)
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276 *Abbreviations: STI, sexually transmitted infections.*

277 *Values are numbers of subjects (%).*

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

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

280 *‡Chi-square test was used or Fisher's exact test was used as appropriate.*

281

282 Self-rated health (SF-12)

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

299

300 **Table 3** Comparisons of self-rated health (SF-12) among university students with and without depressive
 301 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)

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

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

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

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

306

307 **Adverse childhood experiences (ACEs)**

308 Table 4 shows that a significantly higher proportion of students with depressive symptoms
 309 reported having been hit, slapped, or kicked by a parent or guardian ($p < 0.001$ for both
 310 depressive symptoms and severe depressive symptoms); that people in their family had said
 311 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.

326

327 Risk factors of depressive symptoms

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

337 Regarding self-rated health, the odds of depressive symptoms increased significantly
338 with the perception that their general health status was poor (depressive symptoms: AOR=2.99,
339 95% CI=1.28-7.00; severe depressive symptoms: AOR=5.43, 95% CI=2.19-13.46) and the report
340 of higher level of limitation in moderate activities (depressive symptoms: AOR=0.30 (95%
341 CI=0.16-0.58), higher level of pain interference with their normal work (depressive symptoms:
342 AOR=10.43, 95% CI=1.05-10.94; severe depressive symptoms: AOR=10.02, 95% CI=1.99-9.28),
343 and higher level of feeling down-hearted and blue (depressive symptoms: AOR=6.69, 95%
344 CI=1.87-23.90; severe depressive symptoms: AOR=8.72, 95% CI=1.69-14.86).

345 For ACEs, the odds of depressive symptoms increased significantly with the report of
346 having been hit, slapped, or kicked by a parent or guardian (depressive symptoms: AOR=1.39,
347 95% CI=1.04-1.86) and that people in their family had said hurtful or insulting things to them
348 (depressive symptoms: AOR=1.82, 95% CI=1.37-2.42; severe depressive symptoms: AOR=2.18,
349 95% CI=1.46-3.24) during their childhood. In contrast, the odds of depressive symptoms
350 decreased significantly with the report that there had been someone to take care of them and
351 take them to medical care when they got sick (depressive symptoms: AOR=0.51, 95% CI=0.30-
352 0.86; severe depressive symptoms: AOR=0.26, 95% CI=0.13-0.52).

353

354 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				

1					
2					
3	Greatly limited	Reference		Reference	
4					
5	Mildly limited	0.39 (0.20-0.74)	0.004	0.64 (0.29-1.34)	0.23
6					
7	Not limited	0.30 (0.16-0.58)	<0.001	0.63 (0.30-1.36)	0.24
8	Pain interferes with your normal work in past 4 weeks				
9					
10	Not at all	Reference		Reference	
11					
12	A little bit	1.68 (1.08-2.61)	0.02	1.01 (0.46-2.22)	0.99
13					
14	Moderately	3.10 (1.89-5.10)	<0.001	3.69 (1.68-7.11)	0.001
15					
16	Quite a bit	4.14 (2.13-8.05)	<0.001	4.68 (2.01-10.92)	<0.001
17					
18	Extremely	10.43 (1.05-10.94)	0.04	10.02 (1.99-9.28)	0.005
19	Feeling down-hearted and blue in past 4 weeks				
20					
21	None of the time	Reference		Reference	
22					
23	A little of the time	0.52 (0.63-3.66)	0.35	1.02 (0.24-4.29)	0.98
24					
25	Some of the time	3.42 (1.42-8.23)	0.006	1.83 (0.45-7.45)	0.40
26					
27	A good bit of the time	7.70 (3.02-19.66)	<0.001	6.01 (1.45-4.85)	0.01
28					
29	Most of the time	20.71 (6.47-66.37)	<0.001	9.04 (2.31-13.71)	0.002
30					
31	A lot of the time	6.69 (1.87-23.90)	0.003	8.72 (1.69-14.86)	0.01
32	Had been hit, slapped, kicked, by a parent/guardian				
33					
34	No	Reference		Reference	
35					
36	Yes	1.39 (1.04-1.86)	0.03	1.11 (0.75-1.65)	0.59
37	People in my family had said hurtful or insulting things to me				
38					
39	No	Reference		Reference	
40					
41	Yes	1.82 (1.37-2.42)	<0.001	2.18 (1.46-3.24)	<0.001
42	There had been someone to take care of me and take me to medical care when I got sick				
43					
44	No	Reference		Reference	
45					
46	Yes	0.51 (0.30-0.86)	0.01	0.26 (0.13-0.52)	<0.001

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

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

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

359 ‡ Defined by a CES-D score of ≥ 23 .

360

361 DISCUSSION

1
2
3 362 This study unearthed a number of factors correlated with depressive symptoms among
4
5 363 university students in Cambodia. The salient factors comprised cultural and socio-economic
6
7 364 dimensions (gender, socio-economic background, and lack of general and medical care by
8
9 365 family during their childhood), individual behaviors and attitudes (poor academic
10
11 366 accomplishment, consumption of unhealthy food, negative perception about their body and
12
13 367 their general health status, and limited physical activeness), and nurture-related facets
14
15 368 (physical violence and psychological abuse by family during their childhood).

16 369 The bivariate outcomes display that students from the provincial university (UB) and a
17
18 370 poorer family were more susceptible to depressive symptoms. Likewise, students from a poorer
19
20 371 family and female students were more prone to severe depressive symptoms. Albeit not
21
22 372 manifesting in the multivariate model, these factors are corroborated by the existing
23
24 373 scholarship. Various studies revealed that university students from rural areas and low socio-
25
26 374 economic backgrounds were predisposed to higher depression.^{1 16 28 55 56} This could be
27
28 375 explained by an economic situation where students with a rural background tended to stipulate
29
30 376 a poorer family status. Plus, financial vulnerability could further exacerbate depression in
31
32 377 students from low-income families. A meta-analysis of 60 studies unveiled that people in the
33
34 378 lowest socio-economic quintile had 1.81 the probability of depression compared with those in
35
36 379 the highest socio-economic quintile.⁵⁷ A global study on 17,348 university students from 23
37
38 380 high-, middle-, and low-income countries also uncovered that higher depressive symptoms
39
40 381 were recorded among students in low-income countries and economies with greater income
41
42 382 inequality.¹⁶ The Cambodian economy has been growing rapidly in terms of income per capita;
43
44 383 yet, income gaps between the rich and the poor and between rural and urban areas remain
45
46 384 large.⁵⁸ The gaps in income and material growth, which typify economic conditions, may induce
47
48 385 people's mental health problems. In another word, poor economic status may bring about low
49
50 386 self-esteem and self-confidence, which would lead to depression.

51 387 Some research also discovered that female students were more at risk to depression.¹⁶
52
53 388 ⁵⁹⁻⁶² This might be due to social difficulties, physiological tenets, higher self-expectations, and
54
55 389 perceived lack of competence among female students.⁵⁹ In the Cambodian culture, young
56
57 390 women would perceive a great deal of challenges when living away from their family or parents

1
2
3 391 since they need to maintain the cultural behaviors and meanwhile cope with independent
4
5 392 habitation. Over half (56.6%) of the student respondents in our study were not living with their
6
7 393 parents. Moreover, women tended to over-report medical and psychological symptoms as
8
9 394 indicated in a study on 440 undergraduate students in America.⁶³ Articulating their emotions
10
11 395 may be one strategy for dealing with stressful events.

12 396 Our multivariate results depict that students with depressive symptoms, regardless of
13
14 397 severity, tended to report poor academic performance and higher consumption of unhealthy
15
16 398 food. These findings conform to a systematic review of 24 studies⁶ and studies in Asia, such as
17
18 399 China,⁷ which pinpoint low scholastic merit and suicidal ideation as consistent correlates of
19
20 400 depression in university students probably as a culmination of poor concentration and solitude.
21
22 401 On the consumption of unhealthy food, the transition from adolescence to adulthood, and thus
23
24 402 the changes in lifestyle such as living arrangements and independence, might have rendered
25
26 403 university students to indulge in unhealthy food, as pinpointed by a meta-analysis of 39 studies
27
28 404 in China.⁷ As afore-mentioned, more than half of our sample were not living with their parents;
29
30 405 therefore, it might have been hard for them to maintain healthy daily food. Conversely,
31
32 406 depression might have made students care-free about themselves and consequently eat
33
34 407 unhealthily.¹⁷ This implies that nutrition education for both physical and mental health,
35
36 408 stressing healthy food for the body and mind, is imperative for university students.

37 409 Students with depressive symptoms, regardless of magnitude, also tended to have a
38
39 410 negative perception about their body and their general health status. These findings confirms
40
41 411 the general perception among depressed people who are not gratified with their body and
42
43 412 health,¹⁷ although these relationships require a cautious interpretation given that CES-D also
44
45 413 measures some aspects of negative self-perception. Further, depressed students were more
46
47 414 likely to have limited physical activeness, more pain interference with their normal work, and
48
49 415 more dismay or sorrow.^{64 65} Therefore, physical exercises, such as sports, should be regularly
50
51 416 promoted among university students.

52 417 Finally, students with depressive symptoms, disregard of severity, were more likely to
53
54 418 encounter physical violence by their parent or guardian, psychological abuse by their family
55
56 419 members, and lack of general and medical care by their family when they were growing up. As

1
2
3 420 for the physical violence and psychological abuse, this finding tends to acquiesce with a study in
4
5 421 Cambodia that postulates that exposure to violence within family is associated with depression
6
7 422 in high school students.^{38 39} On the lack of general and medical care by family, a Chinese study
8
9 423 on 5,245 students at six universities found that students who had a poor parental relationship
10
11 424 were more vulnerable to depression.⁶⁶ Also, a global study on 17,348 university students from
12
13 425 23 high, middle-, and low-income countries iterated that university students with less
14
15 426 individualistic cultures, particularly in Asia, reported higher extents of depressive symptoms.¹⁶
16
17 427 Students of these cultures longed for more familial and societal ties and assistance, and thus
18
19 428 felt depressed once this social capital was unavailable.¹⁶ This highlights a significant role of
20
21 429 family bonds and scaffolding in association with depression among university students. The lack
22
23 430 of social support from the family presumably would only be a factor for students living
24
25 431 independently. But, for those living with relatives, friends, or spouse, they would still have such
26
27 432 support.

27 433 A study on a sample of 2,671 respondents in nine provinces and a capital city in 2012
28
29 434 revealed that Cambodia greatly needs more and better counseling and mental health services.⁶⁷
30
31 435 The study also pointed out the shortage of skilled professionals in the field of mental health,
32
33 436 particularly those with high clinical and counseling skills to treat mental disorders. In 2012,
34
35 437 Cambodia had only 49 trained psychiatrists and 45 psychiatric nurses working in mental health
36
37 438 facilities and private practices.^{67 68} Many health staff lack training, supervision, and experience
38
39 439 in these areas. Only about 300 doctors completed basic mental healthcare training.⁶⁹ At
40
41 440 university level, the 2012 study called for more awareness raising for self-care and burnout
42
43 441 prevention and mental health counseling services for staff and students.⁶⁷ Given the paucity of
44
45 442 mental health services in general, let alone at universities, our findings fuel the needs for more
46
47 443 and better mental healthcare in Cambodia. Further to medical care, universities should provide
48
49 444 measures, such as student loans and healthy canteens, to mitigate some key predictors of
50
51 445 depression among students, such as financial hardship and poor diets.

51 446 This study contains certain limitations. First, it examined students at only two public
52
53 447 universities, one in a city and the other in a province. Hence, its findings cannot be generalized
54
55 448 at a national level. Second, the cross-sectional design did not enable an establishment of the

1
2
3 449 causal linkages between depressive symptoms and the related factors. Given the temporal
4
5 450 order and the cross-sectional nature of the data, causal relationships between the variables
6
7 451 could not be derived. Potential bi-directionality of the associations could occur either way. For
8
9 452 instance, physical inactivity could cause depression. Nonetheless, the reverse could also be
10
11 453 true—that depression could lead to inactivity, and of course both could be true simultaneously,
12
13 454 where depressive symptoms worsen with physical inactivity, making physical activity less likely.
14
15 455 Third, this study employed self-reported data, which might have been subject to recall bias of
16
17 456 over-reporting and under-reporting. Future studies should attempt to use more objective data
18
19 457 (e.g., linking participants' responses to university records of academic performance) to increase
20
21 458 validity of the information. Nonetheless, the quality of the data was ensured by thorough
22
23 459 training of the enumerators and field supervisors on the study protocols and data collection
24
25 460 method. Finally, the main outcome measure (CES-D) and some other measures, such as ACEs
26
27 461 and SF-12, were modified from other research and have not been validated in the Cambodian
28
29 462 settings. Therefore, the interpretation of the findings must be made with caution.
30
31 463 Notwithstanding these malfeasances, the findings of this study offer first and foremost
32
33 464 implications for policy development and future research in the Cambodian context.
34

465

466 **CONCLUSIONS**

36 467 This study identified social and behavioral factors associated with depressive symptoms among
37
38 468 Cambodian students at two universities. While causation could not be drawn between these
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40 469 factors and depression, we surmise that these factors were inter-twined, and thus need to be
41
42 470 addressed in an integrated and holistic fashion.

43
44 471 These findings render three major implications. First, given the current educational
45
46 472 reform and labor market that demand better quality and ergo more competition among
47
48 473 university students, the correlates of depressive symptoms could not be more critical for
49
50 474 tackling for the time being. Failure to ameliorate these factors would jeopardize the
51
52 475 qualification and career development of this populace and finally the human capital for nation-
53
54 476 building. Second, these findings warrant an acceleration of on-campus counseling services for
55
56 477 university students throughout the course of studentship. Efforts should be invested in

1
2
3 478 comprehensive screening and intervention programs to diagnose those susceptible students
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5 479 early, offer immediate treatment, and cater appropriate support. Ultimately, the jurisdiction of
6
7 480 refining students' mental state should go beyond universities to families and pertinent
8
9 481 governmental bodies at large, provided we are to assist the young to overcome their academic
10
11 482 challenges and enjoy a prosperous post-graduation life. Further research could delve into
12
13 483 changing lifestyles and their associations with depressive symptoms among a larger sample of
14
15 484 university students. Furthermore, validation studies are required to develop and validate
16
17 485 reliable instruments for use in Cambodian populations.
18
19 486

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25
26 490

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28
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30
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32
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34
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37 496

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44 500

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46
47 502 view of USAID or our respective institutions
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50
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52
53 505

1
2
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6
7
8

9 509
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11 511 Principal Investigator (Dr. Siyan Yi) at siyan@doctor.com. The data cannot be made publicly
12 512 available due to ethical restriction.
13
14
15

16 513

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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.

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

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3 1 **Social and behavioral factors associated with depressive symptoms among university**
4 **students in Cambodia: A cross-sectional study**
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30 ABSTRACT

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

33 **Design** Cross-sectional study.

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

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

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

41 **Results** The proportion of students with depressive symptoms and severe depressive symptoms
42 were 50.6% and 19.6%, respectively. After adjustment in multivariate logistic regression
43 analysis, depressive symptoms remained significantly associated with poor academic
44 performance (AOR= 7.31, 95% CI= 2.24-23.86), higher consumption of unhealthy food (AOR=
45 1.72, 95% CI= 1.08-2.76), a negative self-perception about body shape (AOR= 0.54, 95% CI=
46 0.29-0.99) and general health status (AOR= 2.99, 95% CI= 1.28-7.00), and limited physical
47 activeness (AOR= 0.30, 95% CI= 0.16-0.58). Depressive symptoms also remained significantly
48 associated with adverse childhood experiences including physical violence (AOR= 1.39, 95% CI=
49 1.04-1.86), psychological abuse (AOR= 1.82, 95% CI= 1.37-2.42), and lack of general and medical
50 care (AOR= 0.51, 95% CI= 0.30-0.86) by family during childhood.

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

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56 **Strengths and limitations of this study**

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

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3 59 • It included a large sample of students randomly selected from all departments in two
4 public universities – one in the capital city and the other in a provincial town – using a
5 60 multi-stage cluster sampling method.
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9 62 • Limitations of the study, however, included the representativeness of the study sample,
10 the cross-sectional nature of the data that limits causation inferences, unknown validity
11 63 of the scales used to measure important constructs in Cambodian contexts, and
12 64 potential bias of self-reported measures.
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18 67 INTRODUCTION

19
20 68 Several studies have suggested that the aspects of mental health among university students are
21 69 considerably poorer than that of their peers in the general population.¹⁻⁵ Depression is one of
22 the most prevalent mental health problems among university students, and the prevalence is
23 70 rising.⁶⁻⁷ There are varied prevalence estimates of depressive symptoms among university
24 71 students, ranging from in the area of 10%⁸⁻¹¹ to in the region of 20%¹² and up to 40% and
25 72 80%.¹³⁻¹⁵ However, the mean prevalence of depression in university students stands at 30.6%.⁶
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27 73
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29 74 University students are in a critical period of life since they transition from adolescence to
30 75 adulthood, which requires them to make many major decisions. During this period, they
31 76 encounter tremendous pressures, chiefly from economic stress, academic demands,
32 77 interpersonal relationships, and struggles with making crucial decisions.¹⁶
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38 78 Depression manifests in a wide range of symptoms, encompassing sleep and eating
39 79 disturbances, lack of self-care, poor concentration, anxiety, and disinterest in everyday
40 80 activities.¹⁷ For university students, depression is correlated with poor academic
41 81 achievements,¹⁸ drop-out,¹⁹⁻²⁰ relationship instability,²¹ suicidal ideation and attempts,¹⁸⁻²²⁻²³
42 82 poor work performance,²⁴ substance abuse,²⁵⁻²⁶ acute infectious illnesses,²⁷ and poor physical
43 83 and mental health in general.²⁸⁻²⁹ Moreover, depression in this early period can build up
44 84 negative consequences in adult life through its impacts on career prospects and social
45 85 relationships.³⁰⁻³¹
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53 86 Thus, tackling depression among university students is vital since most lifetime mental
54 87 disorders commence during the university age,³² and their mental health has essential
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3 88 ramifications for campus health services in particular and mental health policy-making in
4 general.^{33 34} Put another way, from a public health standpoint, early detection and prevention
5 89 of mental health problems among young adults in higher education is paramount.
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7 90 Comprehension of their salient psychological distress, namely depression, and its correlates
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9 91 would enable tailor-made and early screening and intervention programs to reduce mental
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11 92 health problems in this population. This is integral for their educational performance and
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13 93 triumph in their prospective profession as well as for the national advancement since they are
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15 94 future leaders.
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18 96 The prevalence of depression is induced by many factors, including study populations,
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20 97 socio-demographics,^{16 35} study sites,^{16 36} diagnostic tools and sampling methods,^{36 37} and socio-
21
22 98 cultural environments.¹⁶ Contextualization of facets linked with depression thus is significant
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24 99 for mitigation measures.

25 100 In Cambodia, little is known about social and behavioral determinants of depressive
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27 101 symptoms among student populations. In 2012, a study on 1,943 students at 11 junior high and
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29 102 high schools found that exposure to violence among community members, peers, or family was
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31 103 a predictor for depressive symptoms in the students.^{38 39} A 2013 qualitative study on a sample
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33 104 of 28 students at a Cambodian university found that life events, problems of everyday life, and
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35 105 availability of social support were the main stress factors affecting university students' life
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37 106 satisfaction.⁴⁰ Moreover, exposure to daily hassles was a stress factor having a strong impact on
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39 107 students' psychological and somatic responses. Nonetheless, no research has been conducted
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41 108 to examine social and behavioral determinants of depression among Cambodian university
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43 109 students. This study therefore intends to identify factors associated with depressive symptoms
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45 110 among university students in Cambodia.

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47 112 **METHODS**

48 113 **Study sites and population**

49 114 This cross-sectional study was conducted with students at the University of Battambang (UB) in
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51 115 Battambang province and the Royal University of Phnom Penh (RUPP) in the capital city of
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53 116 Cambodia in June and July 2015. Epi Info (Centers for Disease Control and Prevention, Atlanta,
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3 117 GA) was used to calculate the sample size from the university student population of
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5 118 approximately 168,000.⁴¹ The anticipated percentage frequency was not known, so 50% was
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7 119 put for the calculation to prevent any underestimated prevalence. Based on a 95% confidence
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9 120 interval (CI) and a +5% margin of error, the minimum sample size required for this study was
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11 121 767 students. Adjusted for 10% of incomplete responses, missing data, and rejection rate, the
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13 122 final minimum required sample size was 850 students.
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16 124 **Patient and public involvement**

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18 125 The development of the research questions and outcome measures was informed by university
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20 126 students' priorities, experience, and preferences gathered through consultative meetings with
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22 127 representatives of students, faculty members, and school administrators. The workshops aimed
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24 128 to collect inputs from the representatives for designing the study and developing the study
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26 129 protocol and materials. The representatives were also invited to participate in the study finding
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28 130 dissemination workshops in each participating university.
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31 132 **Sampling and data collection procedure**

32 133 A multi-stage cluster sampling method was used to select the participants. First, the two
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34 134 universities were purposively selected, considering administration and logistic limitations. All
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36 135 departments of the selected universities were included in the study. In each department, a non-
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38 136 proportionate quota sampling method was used to select the sample from a name list provided
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40 137 by the department administrator to meet the required sample size. On the designated date of
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42 138 data collection, all selected students were approached by trained data collectors with support
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44 139 from a school administrator. Questionnaires and instructions were then distributed to them in a
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46 140 classroom for self-administration, which took approximately 30min to complete.
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49 142 **Questionnaire development and training**

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51 143 We first developed a structured questionnaire in English and translated it into Khmer, the
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53 144 national language of Cambodia. Then, the Khmer questionnaire was back-translated into
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55 145 English by a local expert to check its accuracy. The Khmer questionnaire was pretested with a
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3 146 sample of 20 students at RUPP to ensure that the wording and contents were culturally suitable
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5 147 and clearly understandable. We also received comments on the questionnaire from experts
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7 148 working on health and education in Cambodia. The questionnaire was finalized based on their
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9 149 feedback and findings from the pretest. The questionnaire is available on request from the
10
11 150 corresponding author.

12 151 A two-day training on the study protocol and data collection methods was provided to
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14 152 the data enumerators and supervisors. The training focused on building familiarity with the
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16 153 study protocol and questionnaire, interview techniques, privacy assurance, and confidentiality.
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18 154 It also addressed quality control strategies, such as rechecking and reviewing the
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20 155 questionnaires after administration, and resolving issues that might arise during the fieldwork.
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22 156 The data collection supervisors were instructed to perform regular reviews with the data
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24 157 enumerators to monitor progress and settle any issues occurring during the process.

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27 159 **Variables and measurements**

29 160 *Depressive symptoms*

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31 161 Depressive symptoms were assessed by using the Center for Epidemiologic Studies Depression
32
33 162 scale (CES-D).⁴² This scale consists of 20 questions addressing six symptoms of depression,
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35 163 including depressed mood, guilt or worthlessness, helplessness or hopelessness, psychomotor
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37 164 retardation, loss of appetite, and sleep disturbance experienced during the preceding week.
38
39 165 Each question is scored on a scale of 0 to 3 according to the frequency of the symptoms, and
40
41 166 the total CES-D score ranges from 0 to 60. To calculate the total score, four items (I felt I was
42
43 167 just as good as other people, I felt hopeful about the future, I was happy, and I enjoyed life)
44
45 168 were reverse coded. The criterion validity of the CES-D scale has been well established in
46
47 169 Western⁴² and Asian⁴³ populations. We defined depressive symptoms as present when a
48
49 170 subject had a CES-D score of ≥ 16 . A cutoff value of ≥ 23 was also used to define severe
50
51 171 depressive state.⁴⁴

52 172

53 173 *Socio-demographic characteristics, substance use, and sexual behaviors*

1
2
3 174 We adapted standardized tools from the most recent Cambodia Demographic and Health
4
5 175 Survey⁴⁵ as well as from our previous student and young people health surveys in Cambodia^{38 39}
6
7 176 ⁴⁶⁻⁴⁸ to measure socioeconomic characteristics, sexual behaviors with different partners, and
8
9 177 substance use (alcohol, tobacco, and illicit drugs). Socio-demographic characteristics of the
10
11 178 respondents included study site, gender, age, marital status, academic year, living situations,
12
13 179 perceived family economic status, and perceived academic performance.
14
15

16 181 *Health related behaviors*

17
18 182 We used the Health Behavior Survey,⁴⁹ which was designed as a broad survey of health-related
19
20 183 behaviors and beliefs, components of the “National College Health Risk Behavior Survey”
21
22 184 (1997),⁵⁰ and the Global School-based Student Health Survey.⁵¹ Each health behavior area was
23
24 185 addressed by only a limited number of items. For example, frequency of consumption of fast
25
26 186 food in an average week was assessed by a question, “On average, how many times do you eat
27
28 187 fast food per week?” with response options of 0 time, 1-2 times a week, and 3 or more times a
29
30 188 week. Similar questions and response options were used to assess consumption of several
31
32 189 other kinds of healthy and unhealthy food, such as high-fat snack or fruits/vegetables. Self-
33
34 190 ratings were also used for some questions, such as perceived body size (rated from very
35
36 191 overweight to very underweight) and general health status (rated from very good to very poor).
37

38 193 *Adverse childhood experiences (ACEs)*

39
40 194 Five questions were adapted from the brief screening version of the Childhood Trauma
41
42 195 Questionnaire to measure ACEs.⁵² The five yes/no questions asked about the experiences of
43
44 196 physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect during
45
46 197 childhood.
47

48 49 199 *Self-rated health*

50
51 200 SF-12 Health Survey (SF-12) was used to measure self-rated health.^{53 54} The SF-12 is a
52
53 201 multipurpose short-form generic measure of health status. It is a subset of the larger SF-36 and
54
55 202 monitors health in general and in specific populations. The SF-12 measures eight health
56
57
58
59
60

1
2
3 203 aspects, namely physical functioning, role limitations due to physical health problems, bodily
4
5 204 pain, general health, vitality (energy/fatigue), social functioning, role limitations due to
6
7 205 emotional problems, and mental health (psychological distress and psychological well-being).
8
9 206

10 207 **Data analyses**

11
12 208 Double data entry was performed using EpiData version 3 (Odense, Denmark). χ^2 test, or
13
14 209 Fisher's exact test when a sample size was smaller than five in one cell, was used for categorical
15
16 210 variables, and Student's *t*-test was used for continuous variables to compare socio-
17
18 211 demographic characteristics, health risk behaviors (sexual behaviors, substance use, and eating
19
20 212 behaviors), self-rated health (SF-12), and ACEs among students with depressive symptoms,
21
22 213 defined by a CES-D score of ≥ 16 , to those among students without depressive symptoms. The
23
24 214 same comparisons were also made among students with and without severe depressive
25
26 215 symptoms, defined by a CES-D score of ≥ 23 .

27 216 In multivariate models, we first included all variables significantly associated with
28
29 217 depressive symptoms in the bivariate analyses at a level of *p*-value < 0.05 simultaneously in the
30
31 218 models. Variables with a *p*-value > 0.05 were then removed, and the models were refitted. The
32
33 219 steps were repeated until all *p*-values of the remaining variables were < 0.05 in the final models.
34
35 220 Adjusted odds ratios (AOR) were obtained and presented with CI and *p*-values. SPSS version 22
36
37 221 (IBM Corporation, New York) was used for all statistical analyses.
38
39 222

40 223 **Ethical considerations**

41
42 224 The National Ethics Committee for Health Research of the Ministry of Health, Cambodia,
43
44 225 approved the study protocol and materials (No. 191NECHR). Participation in this study was
45
46 226 voluntary. In the process of obtaining a written informed consent, students were made clear
47
48 227 that they could refuse or discontinue their participation at any time and for any reason. The
49
50 228 confidentiality and privacy of the respondents were protected by administering the
51
52 229 questionnaires in a private premise and by excluding personal identifiers from the data and
53
54 230 field notes. After completing the survey, each participant received a small gift (costing
55
56 231 approximately \$US 2.0) for their time compensation.
57
58
59
60

232

233 **RESULTS**234 **Socio-demographic characteristics**

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

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

249

250 **Table 1** Comparisons of socio-demographic characteristics of university students with and without
 251 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 \pm SD)	21.3 \pm 2.4	21.4 \pm 2.3	0.82	21.4 \pm 2.3	21.1 \pm 2.4	0.12
Marital status			0.34			0.08

1					
2					
3	Unmarried	655 (49.2)	675 (50.8)	1066 (80.2)	264 (19.8)
4					
5	Married	17 (58.6)	12 (41.4)	27 (93.1)	2 (6.9)
6					
7	Academic year			0.59	0.66
8	1	240 (48.4)	256 (51.6)	394 (79.4)	102 (20.6)
9					
10	2	145 (51.6)	136 (48.4)	224 (79.7)	57 (20.3)
11					
12	3	123 (49.0)	128 (51.0)	201 (80.1)	50 (19.9)
13					
14	4	164 (49.5)	167 (50.5)	274 (82.8)	57 (17.2)
15	Currently living with			0.35	0.70
16	Parents	297 (49.9)	298 (50.1)	486 (81.7)	109 (18.3)
17					
18	Relatives	81 (45.0)	99 (55.0)	139 (77.2)	41 (22.8)
19					
20	Sibling	87 (56.1)	68 (43.9)	124 (80.0)	31 (20.0)
21					
22	Friend	162 (50.2)	161 (49.8)	258 (79.9)	65 (20.1)
23					
24	Spouse/partners	10 (47.6)	11 (52.4)	19 (90.5)	2 (9.5)
25					
26	Alone	26 (41.9)	36 (58.1)	50 (80.6)	12 (19.4)
27					
28	Other	9 (39.1)	14 (60.9)	17 (73.9)	6 (26.1)
29	Perceived family economic status			0.002	0.04
30	Well-off/quite	248 (55.7)	197 (44.3)	374 (84.0)	71 (16.0)
31					
32	well-off				
33	Neither poor nor	398 (47.0)	448 (53.0)	669 (71.1)	177 (20.9)
34					
35	well-off				
36	Poor	26 (38.2)	42 (61.8)	50 (73.5)	18 (26.5)
37					
38	Perceived academic performance			<0.001	<0.001
39					
40	Very good	44 (77.2)	13 (22.8)	52 (91.2)	5 (5.8)
41					
42	Good	180 (59.0)	123 (40.6)	263 (86.8)	40 (13.2)
43					
44	Fairly good	301 (50.5)	295 (49.5)	484 (81.2)	112 (18.8)
45					
46	Fair	138 (37.7)	228 (62.3)	275 (75.1)	91 (24.9)
47					
48	Poor	9 (24.3)	28 (75.7)	19 (51.4)	18 (48.6)

252 Abbreviation: SD, standard deviation.

253 Values are numbers of subjects (%) for categorical variables and means \pm standard deviation (SD) for
254 continuous variables.

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

256 † Defined by a CES-D score of ≥ 23 .

257 ‡ Chi-square test was used for categorical variables; independent Student's t-test was used for continuous
258 variables.

259

260 **Health risk behaviors**

261 As shown in Table 2, a significantly higher proportion of students with depressive symptoms
 262 reported consuming unhealthy food frequently, such as high-fat snack ($p= 0.001$ for depressive
 263 symptoms; $p< 0.001$ for severe depressive symptoms), margarine, butter, or meat fat ($p= 0.02$
 264 for depressive symptoms; $p< 0.001$ for severe depressive symptoms). A significantly lower
 265 proportion of students with depressive symptoms reported consuming of healthy food
 266 frequently, such as fruits and vegetables ($p= 0.009$ for depressive symptoms; $p= 0.007$ for
 267 severe depressive symptoms), or lean protein ($p< 0.001$ for depressive symptoms; $p= 0.03$ for
 268 severe depressive symptoms). A significantly higher proportion of students with depressive
 269 symptoms reported not having desert over the past week ($p= 0.003$ for depressive symptoms;
 270 $p= 0.008$ for severe depressive symptoms). Moreover, a significantly higher proportion of
 271 students with depressive symptoms perceived that their body size was very overweight or very
 272 underweight ($p< 0.001$ for both depressive symptoms and severe depressive symptoms).

273

274 **Table 2** Comparisons of health risk behaviors among university students with and without depressive
 275 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)

276 *Abbreviations: STI, sexually transmitted infections.*

277 *Values are numbers of subjects (%).*

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

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

280 *‡Chi-square test was used or Fisher's exact test was used as appropriate.*

281

282 **Self-rated health (SF-12)**

283 Table 3 shows that significantly higher proportion of students with depressive symptoms
 284 perceived that their general health status was poor ($p < 0.001$ for both depressive symptoms
 285 and severe depressive symptoms). A significantly higher proportion of students with depressive
 286 symptoms reported higher levels of limitation in several daily activities, such as limitation in
 287 moderate activities ($p < 0.001$ for depressive symptoms; $p = 0.02$ for severe depressive
 288 symptoms), climbing several flights of stairs ($p < 0.001$ for depressive symptoms), or other kinds
 289 of activities in the past four weeks as a result of their physical or emotional health problems ($p <$
 290 0.001 for both depressive symptoms and severe depressive symptoms). Further, they reported
 291 higher levels of problems in several other physical and emotional health aspects in the past four
 292 weeks, such as a feeling that they had accomplished less than they would like ($p < 0.001$ for
 293 both depressive symptoms and severe depressive symptoms), pain interferes with their normal
 294 work ($p < 0.001$ for both depressive symptoms and severe depressive symptoms), having less
 295 energy ($p < 0.001$ for both depressive symptoms and severe depressive symptoms), down-
 296 hearted and blue ($p < 0.001$ for both depressive symptoms and severe depressive symptoms),
 297 and that their physical health interferes with their social acts ($p < 0.001$ for both depressive
 298 symptoms and severe depressive symptoms).

299

300 **Table 3** Comparisons of self-rated health (SF-12) among university students with and without depressive
 301 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)

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

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

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

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

306

307 **Adverse childhood experiences (ACEs)**

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

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

319

320 **Table 4** Comparisons of adverse childhood experiences among university students with and without
 321 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

322 *Values are numbers of subjects (%).*

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

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

325 *[‡]Chi-square test was used.*

326

327 Risk factors of depressive symptoms

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

337 Regarding self-rated health, the odds of depressive symptoms increased significantly
338 with the perception that their general health status was poor (depressive symptoms: AOR=
339 2.99, 95% CI=1.28-7.00; severe depressive symptoms: AOR=5.43, 95% CI=2.19-13.46) and the
340 report of higher level of limitation in moderate activities (depressive symptoms: AOR= 0.30
341 (95% CI= 0.16-0.58), higher level of pain interference with their normal work (depressive
342 symptoms: AOR= 10.43, 95% CI= 1.05-10.94; severe depressive symptoms: AOR= 10.02, 95% CI=
343 1.99-9.28), and higher level of feeling down-hearted and blue (depressive symptoms: AOR=
344 6.69, 95% CI= 1.87-23.90; severe depressive symptoms: AOR= 8.72, 95% CI= 1.69-14.86).

345 For ACEs, the odds of depressive symptoms increased significantly with the report of
346 having been hit, slapped, or kicked by a parent or guardian (depressive symptoms: AOR= 1.39,
347 95% CI= 1.04-1.86) and that people in their family had said hurtful or insulting things to them
348 (depressive symptoms: AOR= 1.82, 95% CI= 1.37-2.42; severe depressive symptoms: AOR= 2.18,
349 95% CI=1.46-3.24) during their childhood. In contrast, the odds of depressive symptoms
350 decreased significantly with the report that there had been someone to take care of them and
351 take them to medical care when they got sick (depressive symptoms: AOR= 0.51, 95% CI= 0.30-
352 0.86; severe depressive symptoms: AOR= 0.26, 95% CI= 0.13-0.52).

353

354 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				

1					
2					
3	Greatly limited	Reference		Reference	
4					
5	Mildly limited	0.39 (0.20-0.74)	0.004	0.64 (0.29-1.34)	0.23
6					
7	Not limited	0.30 (0.16-0.58)	<0.001	0.63 (0.30-1.36)	0.24
8	Pain interferes with your normal work in past 4 weeks				
9					
10	Not at all	Reference		Reference	
11					
12	A little bit	1.68 (1.08-2.61)	0.02	1.01 (0.46-2.22)	0.99
13					
14	Moderately	3.10 (1.89-5.10)	<0.001	3.69 (1.68-7.11)	0.001
15					
16	Quite a bit	4.14 (2.13-8.05)	<0.001	4.68 (2.01-10.92)	<0.001
17					
18	Extremely	10.43 (1.05-10.94)	0.04	10.02 (1.99-9.28)	0.005
19	Feeling down-hearted and blue in past 4 weeks				
20					
21	None of the time	Reference		Reference	
22					
23	A little of the time	0.52 (0.63-3.66)	0.35	1.02 (0.24-4.29)	0.98
24					
25	Some of the time	3.42 (1.42-8.23)	0.006	1.83 (0.45-7.45)	0.40
26					
27	A good bit of the time	7.70 (3.02-19.66)	<0.001	6.01 (1.45-4.85)	0.01
28					
29	Most of the time	20.71 (6.47-66.37)	<0.001	9.04 (2.31-13.71)	0.002
30					
31	A lot of the time	6.69 (1.87-23.90)	0.003	8.72 (1.69-14.86)	0.01
32	Had been hit, slapped, kicked, by a parent/guardian				
33					
34	No	Reference		Reference	
35					
36	Yes	1.39 (1.04-1.86)	0.03	1.11 (0.75-1.65)	0.59
37	People in my family had said hurtful or insulting things to me				
38					
39	No	Reference		Reference	
40					
41	Yes	1.82 (1.37-2.42)	<0.001	2.18 (1.46-3.24)	<0.001
42	There had been someone to take care of me and take me to medical care when I got sick				
43					
44	No	Reference		Reference	
45					
46	Yes	0.51 (0.30-0.86)	0.01	0.26 (0.13-0.52)	<0.001

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

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

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

359 ‡ Defined by a CES-D score of ≥ 23 .

360

361 DISCUSSION

1
2
3 362 This study explored the prevalence of depressive symptoms and unearthed a number of social
4
5 363 and behavioral factors correlated with the symptoms among university students in Cambodia.
6
7 364 The proportion of students with depressive symptoms and severe depressive symptoms was
8
9 365 50.6% and 19.6%, respectively. The salient factors comprised cultural and socio-economic
10
11 366 dimensions (socio-economic background and lack of general and medical care by family during
12
13 367 their childhood), individual behaviors and attitudes (poor academic accomplishment,
14
15 368 consumption of unhealthy food, negative perception about their body and their general health
16
17 369 status, and limited physical activeness), and nurture-related facets (physical violence and
18
19 370 psychological abuse by family during their childhood).

20 371 The bivariate outcomes display that students from the provincial university (UB) and a
21
22 372 poorer family were more susceptible to depressive symptoms. Albeit not manifesting in the
23
24 373 multivariate model, these factors are corroborated by the existing scholarship. Various studies
25
26 374 revealed that university students from rural areas and low socio-economic backgrounds were
27
28 375 predisposed to higher depression.^{1 16 28 55 56} This could be explained by an economic situation
29
30 376 where students with a rural background tended to stipulate a poorer family status. Plus,
31
32 377 financial vulnerability could further exacerbate depression in students from low-income
33
34 378 families. A meta-analysis of 60 studies unveiled that people in the lowest socio-economic
35
36 379 quintile had 1.81 the probability of depression compared with those in the highest socio-
37
38 380 economic quintile.⁵⁷ A global study on 17,348 university students from 23 high-, middle-, and
39
40 381 low-income countries also uncovered that higher depressive symptoms were recorded among
41
42 382 students in low-income countries and economies with greater income inequality.¹⁶ The
43
44 383 Cambodian economy has been growing rapidly in terms of income per capita; yet, income gaps
45
46 384 between the rich and the poor and between rural and urban areas remain large.⁵⁸ The gaps in
47
48 385 income and material growth, which typify economic conditions, may induce people's mental
49
50 386 health problems. In another word, poor economic status may bring about low self-esteem and
51
52 387 self-confidence, which would lead to depression.

53 388 Our multivariate results depict that students with depressive symptoms, regardless of
54
55 389 severity, tended to report poor academic performance and higher consumption of unhealthy
56
57 390 food. These findings conform to a systematic review of 24 studies⁶ and studies in Asia, such as

1
2
3 391 China,⁷ which pinpoint low scholastic merit and suicidal ideation as consistent correlates of
4
5 392 depression in university students probably as a culmination of poor concentration and solitude.
6
7 393 On the consumption of unhealthy food, the transition from adolescence to adulthood, and thus
8
9 394 the changes in lifestyle such as living arrangements and independence, might have rendered
10
11 395 university students to indulge in unhealthy food, as pinpointed by a meta-analysis of 39 studies
12
13 396 in China.⁷ As afore-mentioned, more than half of our sample were not living with their parents;
14
15 397 therefore, it might have been hard for them to maintain healthy daily food. Conversely,
16
17 398 depression might have made students care-free about themselves and consequently eat
18
19 399 unhealthily.¹⁷ This implies that nutrition education for both physical and mental health,
20
400 stressing healthy food for the body and mind, is imperative for university students.

21
401 Students with depressive symptoms, regardless of magnitude, also tended to have a
22
23 402 negative perception about their body and their general health status. These findings confirms
24
25 403 the general perception among depressed people who are not gratified with their body and
26
27 404 health,¹⁷ although these relationships require a cautious interpretation given that CES-D also
28
29 405 measures some aspects of negative self-perception. Further, depressed students were more
30
31 406 likely to have limited physical activeness, more pain interference with their normal work, and
32
33 407 more dismay or sorrow. These findings are consistent with findings from previous studies in
34
35 408 different populations and settings.^{59 60} However, the interpretation of these complex
36
37 409 relationships must be made with caution given that the nature of the data does not allow
38
39 410 causal relationship to be established.

40
411 Finally, students with depressive symptoms, disregard of severity, were more likely to
41
42 412 encounter physical violence by their parent or guardian, psychological abuse by their family
43
44 413 members, and lack of general and medical care by their family when they were growing up. As
45
46 414 for the physical violence and psychological abuse, this finding tends to acquiesce with a study in
47
48 415 Cambodia that postulates that exposure to violence within family is associated with depression
49
50 416 in high school students.^{38 39} On the lack of general and medical care by family, a Chinese study
51
52 417 on 5,245 students at six universities found that students who had a poor parental relationship
53
54 418 were more vulnerable to depression.⁶¹ Also, a global study on 17,348 university students from
55
56 419 23 high, middle-, and low-income countries iterated that university students with less

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3 420 individualistic cultures, particularly in Asia, reported higher extents of depressive symptoms.¹⁶
4
5 421 Students of these cultures longed for more familial and societal ties and assistance, and thus
6
7 422 felt depressed once this social capital was unavailable.¹⁶ This highlights a significant role of
8
9 423 family bonds and scaffolding in association with depression among university students. The lack
10
11 424 of social support from the family presumably would only be a factor for students living
12
13 425 independently. But, for those living with relatives, friends, or spouse, they would still have such
14
15 426 support.

16 427 A study on a sample of 2,671 respondents in nine provinces and a capital city in 2012
17
18 428 revealed that Cambodia greatly needs more and better counseling and mental health services.⁶²
19
20 429 The study also pointed out the shortage of skilled professionals in the field of mental health,
21
22 430 particularly those with high clinical and counseling skills to treat mental disorders. In 2012,
23
24 431 Cambodia had only 49 trained psychiatrists and 45 psychiatric nurses working in mental health
25
26 432 facilities and private practices for a population of approximately 15 million.^{62 63} This number
27
28 433 equates to approximately 0.2 psychiatrists per 100,000 population, which is similar to the
29
30 434 average in Southeast Asia.⁶³ Many health staff lack training, supervision, and experience in
31
32 435 these areas. Only about 300 doctors completed basic mental healthcare training.⁶⁴ At university
33
34 436 level, the 2012 study called for more awareness raising for self-care and burnout prevention
35
36 437 and mental health counseling services for staff and students.⁶² Given the paucity of mental
37
38 438 health services in general, let alone at universities, our findings fuel the needs for more and
39
40 439 better mental healthcare in Cambodia. Further to medical care, universities should provide
41
42 440 measures, such as student loans and healthy canteens, to mitigate some key predictors of
43
44 441 depression among students, such as financial hardship and poor diets.

45 442 This study contains certain limitations. First, it examined students at only two public
46
47 443 universities, one in the capital city and the other in a province. Hence, its findings cannot be
48
49 444 generalized at a national level. Second, the cross-sectional design did not enable an
50
51 445 establishment of the causal linkages between depressive symptoms and the related factors.
52
53 446 Given the temporal order and the cross-sectional nature of the data, causal relationships
54
55 447 between the variables could not be derived. Potential bi-directionality of the associations could
56
57 448 occur either way. For instance, physical inactivity could cause depression. Nonetheless, the

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3 449 reverse could also be true—that depression could lead to inactivity, and of course both could
4
5 450 be true simultaneously, where depressive symptoms worsen with physical inactivity, making
6
7 451 physical activity less likely. Third, this study employed self-reported data, which might have
8
9 452 been subject to over-reporting and under-reporting caused by the negative cognitive biases
10
11 453 associated with depression as well as possible recall bias. Future studies should attempt to use
12
13 454 more objective data (e.g., linking participants' responses to university records of academic
14
15 455 performance) to increase validity of the information. Nonetheless, the quality of the data was
16
17 456 ensured by thorough training of the enumerators and field supervisors on the study protocols
18
19 457 and data collection method. Finally, the main outcome measure (CES-D) and some other
20
21 458 measures, such as ACEs and SF-12, were modified from other research and have not been
22
23 459 validated in the Cambodian settings. Therefore, the interpretation of the findings must be
24
25 460 made with caution. Notwithstanding these malfeasances, the findings of this study offer first
26
27 461 and foremost implications for policy development and future research in the Cambodian
28
29 462 context.

30 463

31 464 **CONCLUSIONS**

32 465 This study identified social and behavioral factors associated with depressive symptoms among
33
34 466 Cambodian students at two universities. While causation could not be drawn between these
35
36 467 factors and depression, we surmise that these factors were inter-twined, and thus need to be
37
38 468 addressed in an integrated and holistic fashion.

39
40 469 These findings render three major implications. First, given the current educational
41
42 470 reform and labor market that demand better quality and ergo more competition among
43
44 471 university students, the correlates of depressive symptoms could not be more critical for
45
46 472 tackling for the time being. Failure to ameliorate these factors would jeopardize the
47
48 473 qualification and career development of this populace and finally the human capital for nation-
49
50 474 building. Second, these findings warrant an acceleration of on-campus counseling services for
51
52 475 university students throughout the course of studentship. Efforts should be invested in
53
54 476 comprehensive screening and intervention programs to diagnose those susceptible students
55
56 477 early, offer immediate treatment, and cater appropriate support. Universities could play very

1
2
3 478 important roles in taking this research forwards by providing future research outputs to
4
5 479 improve mental health of the students that would in turn improve their academic outcomes.
6
7 480 Ultimately, the jurisdiction of refining students' mental state should go beyond universities to
8
9 481 families and pertinent governmental bodies at large, provided we are to assist the young to
10
11 482 overcome their academic challenges and enjoy a prosperous post-graduation life. Further
12
13 483 research could delve into changing lifestyles and their associations with depressive symptoms
14
15 484 among a larger sample of university students. Furthermore, validation studies are required to
16
17 485 develop and validate reliable instruments for use in Cambodian populations.
18
19 486

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30
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32
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53 505

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2
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6
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8

9 509
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13
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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.