Depression, Self-Esteem, and Lifestyle Factors Among University Students in Singapore and Malaysia

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ABSTRACT

Depression is one of the leading mental health disorders that occurs frequently among university students. Self-esteem and lifestyle factors are modifiable factors that have the potential of preventing depression. The study aimed to explore the relationship for depression, self-esteem, and lifestyle factors among university students in Singapore and Malaysia, and whether individual lifestyle factors mediate the relationship. Participants completed an online questionnaire that consisted of socio-demographic, Beck Depression Inventory-ll. Rosenberg Self-Esteem Scale, and Simple Lifestyle Indicator Questionnaire. Data analyses showed that low self-esteem, diet, high smoking, and stress predicted an increase in the level of depression. Stress was a significant mediator for self-esteem and depression. Findings suggested that those with low self-esteem perceived stress as unmanageable, thereby increasing the level of depression scores.

KEYWORDS

Alcohol, Depression, Diet, Mental Health, Physical Activity, Psychology, Self-Esteem, Smoking, Stress, University Students

INTRODUCTION

Depression is one of the leading causes of disability worldwide and also one of the most common mental disorders among university students (Paolucci et al., 2018). It is characterised by loss of mood, symptoms of sadness, lack of interest in routine, negative thoughts and high rates of comorbidity with other mental disorders and cardiovascular disease (Lattie et al., 2019). Depression affects individuals of all ages and it was reported that the typical age of onset for depression is early to mid-20s (Kessler & Bromet, 2013). According to World Health Organization (WHO), the prevalence rate for depression

is at 10.4% and affects more than 300 million people globally; nearly half of these people live in the Southeast Asia region (SEA; WHO, 2018). Research evidence has shown that Southeast Asia has the highest rate of depression, with a lifetime risk of 12% for males and 25% for females (Maddock et al., 2021). Along with a high prevalence rate, depression is associated with high economic costs. The total cost for depression in 2010 was $210.5 billion USD and has risen to $326.2 billion USD in 2018 (Greenberg et al., 2021).

Depression Among University Students

Young adults in university have been found to be more prone to depression because of their stressful academic lifestyles, transition from adolescence to adulthood, and occasionally part-time employment to ease their financial burdens (Dessauvagie et al., 2022). The prevalence rate of depression for university students is alarming, estimated at 10.2% (Sokratous et al., 2014). Moreover, Dessauvagie et al. (2022), through systematic review has found that the prevalence rate of depression for SEA countries was 29.4% and 7.6% for severe depression. Singapore, a multi-ethnicity country with a total population of 4.03 million, comprises 74.4% Chinese, 13.4% Malays, 9.0% Indians and 3.2% other ethnicities (Singapore Department of Statistics, 2019). According to the Ministry of Education Singapore (2020), approximately 111,600 students were enrolled in a local university in 2019 (excluding private universities). Singapore Mental Health Study (SMHS; 2018) data in 2016 reported that the lifetime prevalence rate for depression in Singapore residents aged 18-34 was as high as 9.2%.

Singapore's neighbouring country, Malaysia, with a total population of 32.7 million, comprises 22.6% Chinese, 69.6% Malay, 6.8% Indian and 1.0% other ethnicities (Department of Statistics Malaysia, 2020). According to Malaysia Educational Statistics (2019), approximately 552,702 students were enrolled in a public university (excluding private universities) and the prevalence rate of depression for Malaysian students was 20% in 2016 (Fauzi et al., 2021). Unfortunately, 73% of Singaporeans and 76% of Malaysian university students did not seek treatments for their mental health issues (Ibrahim et al., 2019; Ong et al., 2021). Reluctant to seek help from mental health professionals is not uncommon in Singapore and Malaysia (Nahas et al., 2019; Tan et al., 2021). Picco et al. (2016) reported that individuals recommended non-professionals sources of help such as friends or family for people with mental health issues. However, family and friends are not mental health professionals who can recognize the signs and symptoms, which may lead to a delay in treatments (Tan et al., 2021).

Therefore, timely detection and management of depression and its correlate among young adults in university are essential to safeguard public health (Fauzi et al., 2021). This is vital for their educational achievement, intended growth and development in life, as today's youth are tomorrow's leaders (Shamsuddin et al.,2013).

BACKGROUND

Depression and Self-Esteem

For the past decade, researchers have postulated that self-esteem constituted a central role in the development of depression (Abramson et al., 1978; Beck, 1967) and empirically, depression and self-esteem are related (Orth & Robins, 2013). In university settings, students with higher self-esteem tend to exert a more substantial need to prove their competence and maximum effort in university to feel worthy (Schraml et al., 2011). Failure to do so, the experience of setbacks and failure are detrimental to their self-esteem (Ebert et al., 2019). This creates a vulnerability triggered when adverse events occur and develop a negative conceptualisation of themselves, lowering their self-esteem (Gittins & Hunt, 2020) and influencing the onset of depression (Martinsen et al., 2021). As such, low self-esteem is a critical feature of depression.

The vulnerability model has received empirical support in the population of university students (Bang et al., 2020; Orchard & Reynolds, 2018). Abela and D'Alessandro (2002) study using upper-level students found that negative attitudes about oneself predicted an increase in depression after a negative outcome of daily life stressors in university. Moreover, students with a negative view of their future play a significant key role in the process of dysfunctional attitudes which influence the increase in depression (Abela & D'Alessandro, 2002). Similarly, Abela and colleagues (2011) support the vulnerability model that low self-esteem is a predictor of depression. Students who are vulnerable to depression are indistinguishable from others (Zheng et al., 2014). When faced with the adverse interpretation of daily life stressors such as peer rejection, exam pressures and societal changes in university could place vulnerable students at a higher risk of depression (Xu et al., 2016). Hence, self-esteem may be part of depression, but it does not imply a causal relationship (Uba et al., 2012) and low self-esteem on its own does not predict future depression. However, self-esteem may be mediated by other factors such as lifestyle factors in predicting future depression (Simpson et al., 2010).

Although the vulnerability model has received empirical studies to support the relationship between self-esteem and depression in university students (Masselink et al., 2018; Steiger et al., 2014), however, there is still a lack of research explaining the underlying mechanism between depression and self-esteem (Park & Yang, 2017). Indeed, self-esteem plays an essential role for university students (Cao et al., 2020). However, the extent to which variables mediate the relationship between depression and self-esteem is relatively less studied (Wu et al., 2016). A review of literature using other variables with depression (e.g., locus of control, socioeconomic status, etc) instead of self-esteem has identified one promising mediator which is lifestyle factors (Fazeli et al., 2020; Park & Young, 2017; Sarfan et al., 2019; Xue et al., 2021) that has the potential to serve as a preventive measure against depression.

Lifestyle Factors as a Mediator for Depression and Self-Esteem

It is well known that adhering to a healthy lifestyle leads to better mental health and reduces the risk of cardiovascular and various somatic diseases (Velten et al., 2018). In addition, engaging in a healthy lifestyle is also associated with positive self-esteem (Knox & Muros, 2017). Diet quality is a lifestyle behvioural risk associated with self-esteem and depression (Winpenny et al., 2018). Research has shown that students in university often gain weight in their first year (Gropper et al., 2012a; Gropper et al., 2012b). This is partly due to young adults having the autonomy to make more living choices, including unhealthy diet patterns (Skinner et al., 2021). Often, these unhealthy diets turn into negative body-focused thoughts and these thoughts could potentially lead to poor self-esteem (Sarfan et al., 2019) and contribute to the incidence of depression (Kheiroui & Alizadeh, 2019; Murakami & Latner, 2015).

Participation in physical activity is negatively correlated with depression (Edman et al., 2012). Encouraging evidence from systematic reviews and meta-analyses has indicated that even low physical activity can produce a protective effect against depression and improve an individual self-esteem (Dale et al., 2019; Kvam et al., 2016). Students who engage in daily physical activity are also less likely to suffer from depression (Tao et al., 2020). Grasdalsmoen and colleagues (2021) explained that physical activity could generate several physiological changes and mechanisms in the body and the plasma level of endorphins was elevated immediately, which has been linked to the feelings of euphoria. Furthermore, physical activity is linked to several neurotransmitters in the brain, such as serotonin, dopamine and noradrenaline, suggesting that physical activity may act the same way as Selective Serotonin Reuptake Inhibitors (SSRIs; Wipfli et al., 2011).

Previous research has shown that low self-esteem is a determinant of substance abuse, such as smoking (Han & Lee, 2020; Szinay et al., 2019). Low self-esteem has also been suggested as an important motivational factor that drives behaviours and influences health risk behaviours because students need to adapt or change their behaviours in order for them to either maintain or enhance

their self-esteem (Wu et al., 2016). Moreover, students with low self-esteem students are more likely to be persuaded to smoke to cope with the negative inferential about themselves (Hale et al., 2015). Wootton et al. (2020) further explained that students believe that smoking has beneficial effects on depression and that the chemical properties of tobacco alleviate the symptoms of depression). Smokers' experiences irritability, depressed moods and stress when they have not smoked for a duration. These feelings are relieved by smoking, thus creating the perception that smoking helps to alleviate depression (Taylor et al., 2014).

Similarly, low self-esteem increases the likelihood of an individual turning to alcohol to manage their negative feelings (Zhai et al., 2015). Excessive use of alcohol is strongly associated with depression and a higher risk of somatic conditions (Skogen et al., 2009). Moreover, students with low self-esteem turn to alcohol to manage their negative perception of themselves and adopt alcohol consumption to build a new social network with their peers (Masselink et al., 2018). Unable to integrate into new social networks may have adverse consequences such as peer rejection and negative dysfunctional beliefs about their perceptions, resulting in depression (Martin et al., 2021).

Notably, a time is considered one of the most stressful periods for university students as they transition from adolescence to young adults, societal changes in the university, and academic pressure (Xu et al., 2016). University students face these daily life stressors and unsurprisingly, these daily life stressors are strongly associated with depression and self-esteem (Slavich & Irwin, 2014). Students with low self-esteem may perceive these stressors as unmanageable or highly disturbing and could not cope with these stressful life events (Lee et al., 2012). Ling et al. (2016) explained that these daily life stressors accumulate and posit as chronic stress. The impact of chronic stress could lead to more negative events and the more occurrence of adverse events, the greater the likelihood of developing depression (Ramón-Arbués et al., 2020). Academics are an integral part of a university students' life, while academics can be perceived as a positive challenge (Beiter et al., 2015). However, without a healthy attitude toward academic goals and positive challenges, students can be pressured by academic stress. This stress can potentially be a risk factor for self-esteem and depression (Wu et al., 2020).

CURRENT STUDY

The prevalence rate for depression in Singapore and Malaysia is rising at an alarming rate and both of these countries are leading countries in higher education (Dessauvagie et al., 2022; Ong et al., 2021). Considering the gaps in previous literature where most of the studies are conducted in Western culture (Ebert et al., 2019; Knox & Muros, 2017), there is relatively little research in Singapore and Malaysia due to social and cultural factors where Asian individuals have been considered to denied depression and reluctant to admit because of stigmatisation and misconceptions of mental illness (Goh et al., 2021). Therefore, relatively few studies have been conducted.

Secondly, most past research examining lifestyle factors and their association with depression focused on one or two lifestyle factors (Martin et al., 2021; Park & Young, 2017). Given the multiple lifestyle behaviours simultaneously impacts depression, there is a need to examine a greater number of lifestyle factors that are associated with depression and self-esteem (Gao et al., 2021), and because these lifestyle factors are modifiable and have the potential to prevent depression (Xu et al., 2016). It is essential to grasp a better understanding of their roles in the development of depression in university students.

Lastly, it is essential to target the issues of depression among university students as depression often occurs during university years (Xu et al., 2016)). University students experience a critical transition period from adolescence to adulthood; a time often considered as one of most stressful periods (Awadalla et al., 2020), spending maximum of time in schools with multiple sources of stress such as academic performance and job seeking opportunities and living a monotonous daily

life routine (Xu et al., 2016). Understanding the contributory factors of depression would enable the tailor-made preventive measures that targets the population of university students (Ngin et al., 2018). Hence, the aim of this research was to examine the relationship for depression, self-esteem and lifestyle behaviours among university students in Singapore and Malaysia, as well as the role of lifestyle as a mediator in the relationship between depression and self-esteem.

Hypotheses

Hypothesis 1: It is predicted that lower self-esteem scores and lower diet scores will be associated with higher depression score among university students.
Hypothesis 2: It is predicted that higher physical activity scores will be associated wither lower depression scores among university students.
Hypothesis 3: It is predicted that higher smoking, alcohol and stress scores will be associated with higher depression scores among university students.
Hypothesis 4: It is predicted that lifestyle factors will mediate the relationship between self-esteem and depression scores.

METHOD

Ethical Statement

This research was approved by the Monash University Human Research Ethics Committee (MUHREC), approval project ID: 28413.

Power Analysis

G*Power (v 3.1.9.7; Erdfelder et al., 1996) analysis suggested that this study required a minimum participant of 146 to achieved statistical power of .95 with a significance level of 0.05 and medium effect size of 0.15. The sample size in the current study was sufficient to carry out the data analysis.

Participants

An initial sample of 222 participants completed the survey. Participants were university students and non-students from Singapore and Malaysia Inclusion criteria for this study were: a) Currently studying in a university in Singapore or Malaysia; b) Aged 18 and above; c) Singaporean or Malaysia. 55 participants were excluded in this study due to either not studying in an university in Singapore or Malaysia or did not completely filled up the questionnaires, resulting to a sample size of 167 university students aged 18-39. Out of these 167 participants, another 7 participants were removed as they were either univariate or multivariate outliers, resulting in a final sample of 156 participants, age 18-39 ($M = 23.30$, $SD = 2.85$), including 33 males (21.2%) and 123 females (78.8%). Table 1 provides other socio-demographic information of the participants.

Materials

Beck Depression Inventory – ll (BDI-ll; Beck et al., 1996) was used to assess the level of depression scores for the participants. The BDI-ll consist of 21 items and uses a 4-point Likert scale ranging from 0 to 3, except for question 16 (Changes in Sleeping Pattern) and 18 (Changes in Appetite) which have a Likert scale of 0 to 7. A minimal clinical cut-off score of 20 is required to detect clinical depression in university student populations (Dozois et al., 1998). BDI-ll showed a high construct validity of 0.93 and an internal consistency of 0.91 and strongly correlates with Hamilton Depressing Rate Scale of 0.71 (Beck et al., 1996). Cronbach's Alpha in the current study was .92.

The Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965) is a 10-item measurement tool that measures the level of self-esteem of an individual. RSES is commonly scored as Likert scale and was

Table 1. Sociodemographic Characteristic of Participants

Variables	n	%
Gender		
Male	33	21.2%
Female	123	78.8%
Nationality		
Singaporean	46	29.5%
Malaysian	110	70.5%
Ethnicity		
Chinese	118	75.6%
Malay	34	21.8%
Indian	3	1.9%
Others	1	0.6%
Education		
College/Diploma	41	26.3%
Bachelor's Degree	96	61.5%
Master's Degree	17	10.9%
PhD	2	1.3%

answered on a 4-point scale ranging from strongly agree to strongly disagree. The scale ranges from 1 to 40 with 40 indicating the highest score possible. The higher the score indicates higher self-esteem. RSES has a high reliability of 0.77 and coefficient reproducibility of at least .90 (Rosenberg, 1965; Tinakon & Nahathai, 2012). Cronbach's Alpha in the current study was .87.

The Simple Lifestyle Indicator Questionnaires (SLIQ; Godwin et al., 2008) is a 12-item instrument that measures an individual lifestyle. The SLIQ consists of five components diet, physical activity, alcohol consumption, smoking and stress. For each component, there are 2 types of scores - a raw score and a category score. The category score of each component is 0, 1 or 2 and raw scores can range from 0 to 15. For the purpose of this study, only the raw score instead the overall score from SLIQ will be utilised for data analysis because an overall score limits the perspective of which predictors is the strongest in predicting depression. Hence, examining five individual lifestyles would be more appropriate in understanding each of their roles in depression. The SLIQ has a high test-retest reliability from .63 to .77 and correlation coefficient of 0.77 between participants (Godwin et al., 2008). Cronbach's Alpha in the current study was .59.

Procedures

Data collection was conducted from May to July 2021. Participants were recruited online via social networking sites (e.g., Facebook & WhatsApp) and word-of-mouth through the researchers' family and friends. Explanatory statement and consent were obtained electronically. Participants filled out online questionnaires regarding demographics information, depression, self-esteem and lifestyles through Google Form, and thereafter data were collated. These questionnaires were obtained online for free. Upon completion of the questionnaires, participants were redirected to the last page of the survey to acknowledge and appreciate their time to take part in this research.

RESULTS

Relationship Among Socio-Demographics and Depression

Pearson's bivariate correlation was used to examine the relationship among socio-demographics on depression and self-esteem. Correlation matrix showed that all socio-demographics variables were not significantly correlated with depression (refer to Table 2). Hence, no socio-demographics variables will be included as covariates in further analysis.

Relationship Among Depression, Self-Esteem and Lifestyle

Results showed a significant negative relationship between depression and self-esteem, $r(156) = -.70$, $p < .001$, depression and diet, $r(156) = -.23$, $p = .004$, indicating that students who have lower level of self-esteem and unhealthy diet have higher level of depression scores. Significant positive results showed depression and stress, $r(156) = .49$, $p < .001$. Correlation matrix indicated that there was no significant relationship with depression, physical activity, smoking and alcohol (refer to Table 3).

Multiple Linear Regression Analysis for Depression, Self-Esteem and Lifestyle

Multiple linear regression was conducted to examine the effect of self-esteem, diet, Physical activity, smoking, alcohol and stress on depression. All independent variables accounted for 59.0% of variance in depression scores, $F(6, 149) = 35.78$, $p < .001$ (Refer to Table 4). Regression coefficient showed that self-esteem, $\beta = -.61$, p <.001, 95% CI [-1.76, -1.20], diet, $\beta = -.16$, p = .005, 95% CI [-.96, -.18], smoke, $\beta = .12$, p = .037, 95% CI [-4.24, -.14] and stress, $\beta = .25$, p <.001, 95% CI [-1.72,

Table 2. Covariates for Depression

Variables	n	1	2	3	4	5	6
1. Depression	156	—					
2. Age	156	.05	—				
3. Gender	156	.13	-.02	—			
4. Nationality	156	-.11	-.26**	.04	—		
5. Ethnicity	156	.14	.09	-.03	.15	—	
6. Education	156	.02	.26**	.02	.49**	.24**	—

Note. *p < .05, **p < .01

Table 3. Descriptive Statistics and Correlation Among Depression, Self-esteem and Lifestyles

Variables	n	M	SD	1	2	3	4	5	6	7
1. Depression	156	17.37	11.42	—						
2. Self-esteem	156	26.12	4.62	-.70**	—					
3. Diet	156	6.66	3.20	-.23**	.08	—				
4. PA	156	7.45	6.12	-.12	.07	.25**	—			
5. Smoke	156	1.69	.65	-.07	-.10	.04	-.06	—		
6. Alcohol	156	.61	2.04	.11	-.17*	.04	.31**	-.35**	—	
7. Stress	156	4.18	.90	.49**	-.37**	-.05	-.01	-.07	.14	—

Note. *p < .05, **p < .01.

4.57] were significant predictors of depression. Physical activity and alcohol were not significant predictors of depression.

MEDIATION ANALYSIS

To investigate whether lifestyle factors mediate the relationship between depression and self-esteem, a simple mediation was performed using PROCESS macro model number 4 (Hayes, 2013). A total of three different mediation analyses was conducted with diet (Model 1), smoke (Model 2) and stress (Model 3) as different mediators for each analysis. Results indicated that only stress partially mediated the relationship between self-esteem and depression, b = -.23, SE = .07, 95% CI [-.39, -.10], partially standardized β = -.02. (refer to Table 5 and Figures 1 and 2). Self-esteem and stress accounted for 54.8% of variance in depression scores. Diet and smoke were not significant mediators of depression.

DISCUSSION

The aim of the present study was to explore the relationship between depression, self-esteem and lifestyle (diet, physical activity, smoking, alcohol and stress) factors among university students in Singapore and Malaysia and examine whether individual lifestyle factors mediate the relationship between self-esteem and depression.

In line with the first hypothesis, students with a lower level of self-esteem scores predicted an increase in depression scores. Current findings were consistent with past studies that depression and self-esteem are related (Abela et al., 2011; Masselink et al., 2018; Rieger et al., 2016; Steiger et al., 2014). Current study also supported those lower level of diet scores predicted an increase in depression scores. This finding was consistent with past findings that lower diet quality is associated with higher depression scores (Kheiroui & Alizadeh, 2019; Murakami & Latner, 2015; Sarfan et al., 2019). However, hypothesis two was not supported and hypothesis three was partially supported. Smoking was not correlated with depression but is a predictor of depression. Moreover, students with a higher level of stress scores predicted an increase in the level of depression scores. Current result of stress was consistent with past studies findings and stress was a significant predictor of depression (Lee et al., 2012; Ling et al., 2016; Slavich & Irwin, 2014; Wu et al., 2020). Hypothesis four was partially supported, where only stress mediates the relationship between self-esteem and depression.

Consistent with Beck's vulnerability model of depression (Beck, 1967), negative evaluation such as low self-esteem is a significant predictor for depression. Students with lower level of self-esteem have a greater risk of developing depression symptoms. However, Beck's vulnerability model

Table 4. Summary of Multiple Linear Regression for Self-esteem and Lifestyles of Depression

Predictors	B	SE	β	95% CI		R^2	F	p
				LL	UL			
						.590	35.78	<.001
Self-esteem	-1.48	.14	-.61	-1.76	-1.20			<.001
Diet	-.57	.20	-.16	-.96	-.18			.005
Physical Activity	-.04	.11	-.02	-.25	.17			.709
Smoke	2.19	1.04	-.12	-4.24	-.14			.037
Alcohol	-.50	-.56	-.06	-1.59	.60			.371
Stress	3.15	.72	.25	1.72	4.57			<.001

Note: CI = Confidence Interval; *LL* = lower limit; *UL* = upper limit

Table 5. Summary of Mediation Analysis

| Model	β	SE	95% CI		R^2	F	p
			LL	UL			
Total effect (c) without mediator Self-Esteem → Depression	-1.68	.14	-1.96	-1.41	.49	147	<.001
Model 1 (Diet as mediator)							
Direct effect (c') with mediator Self-Esteem → Depression	-1.65	.14	-1.92	-1.38	.52	82.71	<.001
Indirect effect (a) Self-Esteem → Diet	-05	.05	-.05	1.60			.324
Indirect effect (b) Diet → Depression	.64	.20	-1.04	-.24			.002
Total indirect effect of Diet on Self-Esteem and Depression	-.03	.04	-.12	.04			>.05
Model 2 (Smoke as mediator)							
Direct effect (c') with mediator Self-Esteem → Depression	-1.72	.14	-1.99	-1.44	.51	78.56	<.001
Indirect effect (a) Self-Esteem → Smoke	.01	.01	-.01	.03			.215
Indirect effect (b) Smoke → Depression	2.46	1.03	.42	4.50			.019
Total indirect effect of Smoke on Self-Esteem and Depression	.03	.04	-.03	.13			>.05
Model 3 (Stress as mediator)							
Direct effect (c') with mediator Self-Esteem → Depression	-1.45	.14	-1.73	-1.17	.55	92.8	<.001
Indirect effect (a) Self-Esteem → Stress	-.07	.14	-.09	-.04			<.001
Indirect effect (b) Stress → Depression	3.33	.74	1.87	4.81			<.001
Total indirect effect of Stress on Self-Esteem and Depression	-.23	.03	-.38	-.10			<.05

Note: CI = Confidence Interval; *LL* = lower limit; *UL* = upper limit

Figure 1. Total Effect of Self-Esteem on Depression (Note: Path *c*: total effect = -1.68, *p* < .001. ****p* < .001)
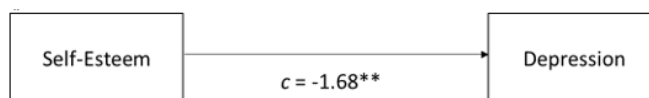
of depression failed to consider other environmental factors such as an unhealthy lifestyle. These unhealthy lifestyle factors should be included in the vulnerability model as mediators because self-esteem is an important motivational factor that drives unhealthy behaviours to cope with the negative evaluations they are currently facing. Correlational results indicated that students with low self-esteem was negatively correlated with alcohol consumption and alcohol was positively correlated with smoking, indicating that students with low self-esteem tended to consume more alcohol. Consequently, students who consume alcohol are more likely to smoke. Hence, this finding showed that self-esteem is an important motivational factor that drives unhealthy behaviours. Identifying mediators is not only crucial for theoretical implications, but also provides direction for preventive measures.

Figure 2. Direct and Indirect Effect of Self-Esteem and Stress on Depression (Note: Path *a*: effect of self-esteem on stress, *b* = -.07, *p* < .001. Path *b*: effect of stress on depression controlling for self-esteem, *b* = 3.33, *p* < .001. Path *c'*: effect of self-esteem on depression, controlling for stress, *b* = -1.45, *p* < .001. *a**b: Total indirect effect, *b* = -.23, *p* < .05. **p < .001.)
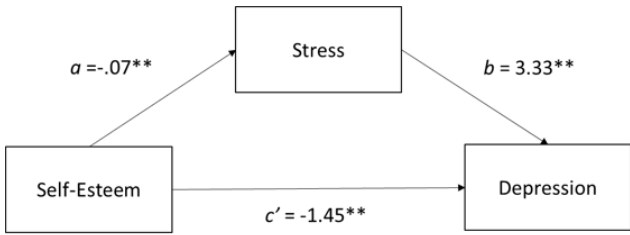
The association between diet and depression is likely to be explained via pro-inflammatory markers (Hart et al., 2021). It is also possible that poor diet quality is an outcome rather than a predictor of depression. It is also possible that a higher level of depression scores may be a precursor of poor diet quality. Collins et al. (2021) suggested that students with depressive symptoms seek emotional comfort through appetite changes. Although the current study did not collect information on the types of vegetables and fruit intake, future study could conduct an experimental design to look further into the specific types of dietary consumption on depression to draw causal inference.

A surprising finding for stress was that both countries' students exhibited high levels of stress scores. However, current study could not conclude on what types of stress would predict the level of depression. It may be due to academic stress, financial stress, occupational stress and pandemic stress that is associated with the level of depression scores. All live classes in Singapore and Malaysia were conducted online during Phase 2 Heighten Alert (P2HA) and lockdown (Ministry of Education, 2021) and all campuses were closed until further notice. Student movements and social gatherings were restricted and limited. The pandemic stressor could be a significant contributor for students' stress that predicts the level of depression. The most important finding of this study was that stress partially mediates the relationship between self-esteem and depression, and self-esteem negatively affects depression directly and indirectly through stress. In other words, students who have lower levels of self-esteem and higher levels of stress, which thereby increase the symptoms of depression scores. These findings were consistent with past research (Fazeli et al., 2020; Slavich & Irwin, 2014) and highlighted the important contribution of self-esteem and stress to the relationship for depression. Students with lower levels of self-esteem may have fewer coping mechanisms to cope with stress. In turn, students may view these stressors as disturbing, which could lead to more negative events. The occurrence of more negative events could contribute to higher levels of depression scores.

IMPLICATIONS

Current study has several important practical implications. University students are more vulnerable in developing depression because of the unique characteristic and monotonous lifestyle they are living. It may be more effective in changing student's lifestyle behaviours earlier than in later periods. Moreover, the mental health team in university should advocate the importance of healthy diet and the risks of unhealthy diet to students. Mental health team may collaborate with lecturers or professors in conveying the importance of a healthy diet and students may be more accepting to learn from their lecturers or professors. In addition, universities could also tailor smoking cessation programs to students who want to quit smoking. Alongside diet and smoking cessation programs, it is important for universities to design programs that enhance the level of self-esteem and teach students coping mechanisms such as mindfulness-based techniques in coping with stress-related problems. This coping

mechanism not only can assist students with academic stress and daily life stressors they are currently facing, these coping mechanisms may assist them in their future career prospects.

Limitations and Recommendation for Future Study

There are several limitations in the current study that need to be addressed. Firstly, current study was a cross-sectional study design and which does not allow for temporal causal inferences and it is difficult to draw any causal relationship. In addition, findings from cross-sectional designs can only suggest and could not established any cause and effects or causal associations between depression, self-esteem and lifestyle behaviours. Therefore, findings should be interpreted cautiously. It is suggested that future study should adopt qualitative study in order to gain a more in-depth understanding of the existing results.

Secondly, although depression and self-esteem scales were measured using well-known scales. However, it is unclear whether using different measurements will lead to different outcomes. Furthermore, BDI-II and RSES was widely used in assessing depression in clinical and general population. Students might be able to recognise that the questionnaires were from BDI-II and RSES and potentially may have some respondent bias, particularly the social desirability bias, which may influence students to deny undesirable traits (Latkin et al., 2017). As a result, students may have overreported both positive and negative behaviours. Similarly, the measurement for stress only had one question which was not comprehensive in measuring the level and types of stress that could contribute in predicting depression. SLIQ might not be reliable in measuring stress as it was not to designed in specifically measuring stress. Hence, future studies could utilise another measurement such as Perceived Stress Scale (PSS; Cohen et al., 1983) as PSS was explicitly designed to measure stress.

Thirdly, data collection was collected online and participants were not screened prior to data collection. It is possible that through the word-of-mouth of family and friends or social media, some participants that were not university students participated in the study. Future study should screen participants to ensure that they fit the study's criteria. Current study sample was not a clinical sample and the mean score for depression in the current study does not reach the clinical level of depression. Current study depression mean score was 17.02, which was below the clinical cut off score for detecting clinical depression and the sample of university students may not be generalised to the community or clinical populations. Hence, additional research is needed to determine whether the results in the current study are applicable to the community or clinical populations.

Lastly, current study did not control for any confounding variables. Despite correlation results indicated that all socio-demographics were not significantly correlated with depression. Besides, current study did not collect other socio-demographics information such as types of stressors that contribute to their level of stress, occupational stress and financial stress. In view of COVID-19 stressors, the aforementioned stress may add-on to their current level of stress and could possibly contribute to the incidence of depression. Hence, it is important to control for such confounding variables in future study that may have an effect on depression and results of the study could be made more accurate.

CONCLUSION

In conclusion, current study provides evidence that low self-esteem, unhealthy diet, smoking and stress are significant predictors of depression. These daily lifestyle factors and self-esteem are modifiable and have the potential as a preventive measure against depression. However, physical activity and alcohol are not significant predictors of depression. It may be due to the restrictions of COVID-19 that restricted students from going out to exercise and non-alcoholics in the current study sample that resulted in these two variables as non-predictors of depression. Nevertheless, it is still noteworthy in examining these two variables for future studies without the effects of COVID-19. In addition, stress partially mediates the relationship between self-esteem and depression. This finding suggested

that more emphasis is needed on intervention programs that target self-esteem as high levels of self-esteem may serve as a protective factor against depression and stress. Whereas, low self-esteem students have lesser coping mechanisms for stress, which may be unmanageable, thereby increasing the level of depression.

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AUTHORS CONTRIBUTION

Gary Kwok Kum Hoe: Investigation; writing – original draft, review and editing; administrative task; methodology; data collection. Tam Cai Lian: Investigation; writing – original draft, review and editing.

CONFLICT OF INTEREST

The authors of this publication declare there is no conflict of interest.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the first author upon reasonable request.

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