Does emotion and its daily fluctuation correlate with depression? A cross-cultural analysis among six developing countries

Derwin K.C. Chan, Xin Zhang, Helene H. Fung, Martin S. Hagger

Does emotion and its daily fluctuation correlate with depression? A cross-cultural analysis among six developing countries

Derwin K.C. Chan [a], Xin Zhang [b,*], Helene H. Fung [c], Martin S. Hagger [a]

[a] School of Psychology and Speech Pathology, Curtin University, Perth, Australia
[b] Department of Psychology, Peking University, Beijing, China
[c] Department of Psychology, Chinese University of Hong Kong, Hong Kong, China

Abstract Utilizing a World Health Organization (WHO) multi-national dataset, the present study examined the relationships between emotion, affective variability (i.e., the fluctuation of emotional status), and depression across six developing countries, including China ($N = 15{,}050$); Ghana ($N = 5{,}573$); India ($N = 12{,}198$); Mexico ($N = 5{,}448$); South Africa ($N = 4{,}227$); and Russia ($N = 4{,}947$). Using moderated logistic regression and hierarchical multiple regression, the effects of emotion, affective variability, culture, and their interactions on depression and depressive symptoms were examined when statistically controlling for a number of external factors (i.e., age, gender, marital status, education level, income, smoking, alcohol drinking, physical activity, sedentary behavior, and diet). The results revealed that negative emotion was a statistically significant predictor of depressive symptoms, but the strength of association was smaller in countries with a lower incidence of depression (i.e., China and Ghana). The association between negative affective variability and the risk of depression was higher in India and lower in Ghana. Findings suggested that culture not only was associated with the incidence of depression, but it could also moderate the effects of emotion and affective variability on depression or the experience of depressive symptoms.
© 2014 Ministry of Health, Saudi Arabia. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Depression is a major mental disorder that affects over 350 million people worldwide [1]. Symptoms of depression include sadness, low self-esteem, a

* Corresponding author at: Room 228, Philosophy Building, Department of Psychology, Peking University, Beijing 100871, China. Tel.: +86 10 62751830; fax: +86 10 62761081.
  E-mail address: zhang.x@pku.edu.cn (X. Zhang).

sense of meaninglessness, and the 'vegetative' substratum [2]. Among all the known potential causes of depression, chronically low levels of positive emotion and high levels of negative emotion have been frequently identified as the influential factors associated with this mental disorder [3,4]. More recently, affective variability (i.e., the fluctuation of emotional status) has also been identified to be closely related to depression [5,6]. However, most studies in this respect were conducted in developed nations in Northern America, Western Europe, and Australia [5–7]. Very few studies have used samples from developing nations to examine the relationship between emotion and depression. In the present study, we used the population-based datasets from the World Health Organization to examine the relationship between emotion, affective variability and depression across six developing countries, including China, Ghana, India, Mexico, South Africa, and Russia.

Depressive disorders are common forms of mental disorders, which have been reported frequently among people of all age groups from the teenage years upwards across the globe [8]. They are identified as one of the leading causes of the burden of disease in the Northern America, European, and Western Pacific regions [1]. Affect is regarded as one of the major causes of clinical depression, and the relationship between emotion and depression has been extensively researched [3,4]. In particular, the findings suggested that chronic experience of negative emotion was a risk factor for the onset of depression, while consistently-felt positive affect could buffer against stress [9] and reduce the risk of such mental health problems [10,11]. The influence of positive and negative emotion on mental health might not only be direct, but could also be indirect through the mediation of other psychological factors. Social scientists identified indirect influences of positive and negative emotion on mental health through improved persuasion [12], risk perception [13], and adaptive decision-making [14].

Recent research has proposed that understanding the situational status of emotion does not provide a complete explanation of how emotion could be related to mental health problems, and a growing amount of attention has now been placed on the dynamics or the fluctuations of emotion over time [11,12]. The term *affective variability*, defined as fluctuation of emotional experience across time, is regarded as a key construct for social scientists in understanding the impact of emotion on physical and mental health [15]. Research evidence has shown that affective variability is associated with impaired mental health. For example, the

variability of negative affect was shown to be a positive predictor of depressive symptoms [13], borderline personality disorder [16], and even suicidal ideation [17]. Similarly, the variability of positive affect was positively associated with a lower level of life satisfaction [18].

Although studies have shown a consistent association between emotion, affective variability and depression, it is still worth noting that most of the studies have been conducted in the developed nations, predominately North America and Western European countries [19]. Therefore, it could not be assumed that the existing findings could be generalized to all nations. To illustrate this, Jenkins, Kleinman, and Good [20] argue that ''models of depression based on studies of patients in Western psychiatric settings cannot be unquestioningly generalized to non-Western societies'' (p. 67). A recent investigation by Ferrari and colleagues [8] indeed found that there was a significant difference in terms of incidence and severity of depression between different world regions. Hence, investigating the relationship between emotion, affective variability, and depression among the unexplored regions such as developing countries is highly relevant and important because it may test the cross-cultural generalizability of the evidence [15,20,21].

In the present study, the aim was to investigate the association between emotion, affective variability and depression in six developing countries: China, Ghana, India, Mexico, South Africa, and Russia, which have been shown to have a distinct incidence and severity of depression in recent research [8]. Moreover, cross-cultural differences in the corresponding relationships between these different nations were examined to evaluate the generalizability of the findings within these developing countries.

2. Method

2.1. Data sources

The multi-national dataset was obtained from the World Health Organization (WHO). Data were collected by the Multi-Country unit of the WHO for a study on adult health and ageing (i.e., global AGEing and adult health (SAGE)). This was the first wave of data collection of the whole project carried out from 2007 to 2010 among six countries, including China, Ghana, India, Mexico, South Africa, and Russia. Using a stratified, multi-stage cluster sampling strategy, the data were collected from a number of regions and major cities of each

country in order to ensure that samples were representative to national populations of adults, aged between 18 and above. The responses were recorded through face-to-face paper and pencil interview or face-to-face computer-assisted personal interview by trained interviewers. As a result, a total of 47,443 individuals from China ($N = 15,050$; response rate = 58.98%); Ghana ($N = 5,573$; response rate = 5.31%); India ($N = 12,198$; response rate = 53.04%); Mexico ($N = 5,448$; response rate = 52.30%); South Africa ($N = 4,227$; response rate = 48.83%); and Russia ($N = 4,947$; response rate = 5.79%) participated in the study. The demographic details of the participants in each country are shown in Table 1.

2.2. Measures

2.2.1. Demographic information
Participants reported their gender, age, marital status, level of education, household income, cigarette consumption, alcohol consumption, diet (the number of servings of fruit and vegetables consumed in a typical day), and amount of physical activity and sedentary behavior as control variables of the study. Their weight and height were measured and used to compute participants' Body Mass Index (BMI). Participants reported the average number of cigarettes they smoked in a day, and the number of months (and years) they had been smoking. Based on this information, cigarette consumption was calculated based on the total number of cigarettes participants consumed since they started smoking. Similarly, participants reported the frequency of alcohol consumption occasions on a 5-point Likert scale from ''None per week'' (0) to ''more than 5 times per week'' (4) and the amount of alcoholic beverages consumed per session. Total alcohol consumption was computed by multiplying the drinking frequency by the drinking amount.

2.2.2. Depression
Participants reported whether they had been clinically diagnosed with depression (0 = ''no'',

Table 1 Participant Characteristics.

Mean (SD)	China	Ghana	India	Mexico	South Africa	Russia
Gender (% Male)	46.59%	50.60%	38.60%	38.29%	42.53%	35.59%
Age	60.53 (11.91)	60.19 (14.06)	49.97 (16.76)	63.67 (14.30)	60.29 (12.36)	62.36 (13.03)
Marital status (% Married)	83.31%	59.82%	77.58%	58.63%	47.37%	53.80%
Educational level (% high school or above)	6.88%	7.40%	1.80%	1.94%	7.26%	2.32%
Years of education	7.62 (3.71)	9.17 (3.98)	7.92 (4.08)	6.22 (4.14)	8.03 (3.84)	11.23 (3.66)
Permanent income quintile	3.04 (1.41)	3.03 (1.42)	3.13 (1.42)	2.99 (1.42)	3.05 (1.42)	3.12 (1.41)
BMI	23.94 (9.20)	23.43 (6.33)	20.82 (5.99)	28.39 (5.40)	3.53 (12.05)	28.61 (6.34)
Smoker (%)	26.34%	1.93%	35.45%	8.99%	25.36%	16.88%
Drinking alcohol (%)	25.22%	4.59%	8.91%	12.67%	21.15%	5.72%
Dieting	9.20 (5.05)	4.38 (2.28)	3.16 (1.73)	4.54 (1.70)	3.78 (2.25)	4.11 (2.24)
Physical activity time (hour/day)	5.42 (3.98)	5.57 (2.81)	5.09 (3.64)	5.76 (4.18)	4.16 (4.14)	5.80 (3.36)
Sedentary behavior (hour/day)	3.76 (2.32)	3.62 (2.45)	3.07 (2.53)	2.60 (2.57)	3.13 (2.34)	5.00 (3.31)
Depression (%)	.30%	1.24%	3.35%	5.89%	3.03%	3.76%
Depressive symptoms (N)	.15 (1.13)	.73 (2.63)	.97 (2.75)	.40 (1.78)	.39 (1.98)	.52 (2.07)
Positive emotion	2.43 (.57)	2.60 (.42)	2.24 (.52)	2.32 (.53)	2.76 (.37)	2.37 (.45)
Negative emotion	1.04 (.15)	1.08 (.19)	1.20 (.27)	1.20 (.31)	1.08 (.21)	1.19 (.26)
Positive affective variability	.20 (.27)	.25 (.26)	.32 (.27)	.31 (.33)	.19 (.27)	.28 (.26)
Negative affective variability	.04 (.11)	.07 (.13)	.14 (.16)	.12 (.18)	.07 (.14)	.13 (.16)
Activities reported	3.68 (1.56)	3.75 (2.15)	4.09 (1.85)	1.08 (1.28)	3.96 (2.16)	2.79 (1.65)

Note. Smoker refers to those who smoked daily or occasionally. Drinking alcohol refers to those who drank alcoholic beverages at least once every month. Dieting refers to the number of servings of fruit or vegetables participants had in a typical day. Physical activity time refers to the total duration of physical activity of any intensity during work, transportation, or leisure time participants did on average in a typical day. Sedentary behavior refers to the number of hours participants spend in sitting or reclining in a typical day.

1 = ''yes''), and they were further asked about whether they experienced the symptoms of depression based on DSM-IV (e.g., loss of appetite, difficulties of concentrating, thinking of death or suicide, etc.) [2] for more than two weeks and during most of the day. The number of depressive symptoms participants reported was then counted.

2.2.3. Emotional status

A daily reconstruction method was used to assess participants' emotion experienced in their daily activity [22]. Participants were given a list of 23 different categories of activities (e.g., working, shopping, chatting with someone), and were asked to recall the emotions they experienced during these activities (if they had) in the previous day. For each activity, participants evaluated the extent to which they experienced positive emotions (i.e., calmness and enjoyment), and negative emotions (i.e., worried, rushed, irritated, depressed, and stressed) on three-point Likert scales ranging from 1 (not at all) to 3 (very much). The score of each item was averaged across all activities reported, and then the mean score of all positive emotions was taken as the overall positive emotion, and that of all negative emotions as the overall negative emotion. The internal score reliability of the averaged scores of positive emotion ($\alpha = .88$) and negative emotion ($\alpha = .88$) was acceptable.

2.2.4. Affective variability

Affective variability scores were computed based on previous literature [16,23]. Specifically, overall positive emotion and negative emotion indexes were computed by taking the averaged scores of the corresponding items for each activity. The affective variability scores were computed by the standard deviation of overall positive emotion, or overall negative emotion across different activities. As it was not possible to compute affective variability for participants who reported emotions for fewer than two daily activities (3.02% for negative emotion; 2.93% for positive emotion), these values were input as missing data, which were replaced by the mean value of affective variability for each country.

2.3. Analysis

Hierarchical regression analyses were conducted to investigate whether emotional status and affective variability were predictive of depression across cultures. In the baseline model (Step 1), all the demographic variables, such as gender, age, marital status, level of education, household income, cigarette consumption, alcohol consumption, diet, and physical activity and sedentary behavior, were included as independent variables. In Step 2, positive emotional status, negative emotional status, positive affective variability, and negative affective variability were included as independent variables together with the variables in Step 1. In Step 3, the effect of culture on depression was examined by adding six dummy-coded variables as independent variables on top of Step 2, including China (0 = not China; 1 = China); Ghana (0 = not Ghana; 1 = Ghana); India (0 = not India; 1 = India); Mexico (0 = not Mexico; 1 = Mexico); South Africa (0 = not South Africa; 1 = South Africa); and Russia (0 = not Russia; 1 = Russia). In Step 4, the interaction terms between culture and emotional status or affective variability were added to Step 3 as additional independent variables. The interaction terms were the cross products of the dummy variables for culture and the z-scores of each emotional status or affective variability variable. For the dichotomous dependent variable (i.e., whether or not the participant had received a diagnosis of depression), the hierarchical logistic regression model was used for Step 1 to Step 4. For the continuous dependent variable, that is depressive symptoms, hierarchical linear regression was employed. Post-hoc regression analyses further tested the effect of emotional status and affective variability on the dependent variables when controlling for the demographic variables (Step 2) independently for each country.

3. Results

3.1. Preliminary analysis

Table 1 presents the descriptive analysis of the major variables for each country. Zero-order correlations between the study variables, including the emotional-related variables, depression-related variables, and the demographic variables are also presented in Table 2. Results indicated that all demographic variables formed significant associations with either one or more of depression-related variables and the emotional-related variables. Even though the strength of associations was relatively weak, some interesting relationships emerged. Depression and depressive symptoms formed significant positive relationships with (female) gender, age, BMI (the negative correlation with depressive symptoms excepted), and sedentary behavior (depression excepted). These variables also formed negative associations with dieting, and physical activity. Positive emotion was positively associated with education level, income quintile, BMI, and dieting. Negative emotion and both types of affective

Table 2 Correlation matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 Pos Emotion	1																	
2 Neg Emotion	−.38**	1																
3 Pos Affective-V	−.26**	.20**	1															
4 Neg Affective-V	−.29**	.65**	.35**	1														
5 Depression	−.08**	.16**	.02**	.11**	1													
6 Depression-sym	−.10**	.29**	.07**	.20**	.23**	1												
7 Country	.17**	−.02**	.00	.00	.01**	.03**	1											
8 Gender	−.05**	.06**	.03**	.06**	.04**	.05**	−.04**	1										
9 Age	.06**	−.07**	−.07**	−.11	.02**	.04**	.11**	−.09**	1									
10 Marital Status	−.01	.04**	.00	.02**	.04**	.08**	.16**	.23**	.37**	1								
11 Education Level	.08**	.00	−.01*	.01	−.01	−.04**	.07**	−.04**	−.14**	−.06**	1							
12 Income quintile	.10**	−.05**	−.04**	−.04**	.01*	−.02**	−.01*	−.02**	−.09**	−.12**	.23**	1						
13 BMI	.10**	−.03**	−.04**	−.04**	.03**	−.05**	.12**	.08**	.10**	.05**	.05**	.08**	1					
14 Cigarette-Consum	−.02**	.02**	.00	.02**	.00	.03**	−.08**	−.19**	.04**	−.03**	−.04**	−.01*	−.07**	1				
15 Alcohol-Consum	.02**	−.03**	−.02**	−.03**	−.01	−.02**	.02**	−.20**	.00	−.04**	−.02**	−.01**	−.01**	.09**	1			
16 Dieting	.10**	−.18**	−.13**	−.19**	−.06**	−.12**	−.23**	−.05**	.05**	−.10**	.01	.08**	.03**	−.02**	.06**	1		
17 Physical Activity	.04**	.01	.03**	.00	−.02*	−.03**	.04**	−.13**	−.09**	−.05**	.00	−.04**	−.01	.04**	.05**	.02*	1	
18 Seden-Behavior	.06**	.02	−.01	−.01*	−.03**	.03**	.03**	.00	.19**	.11**	.09**	.00	.04**	.02**	−.01	.05**	.01	1

Note. Pos = positive; Neg = negative; Affective-V = affective variability; Depression = clinically diagnosed with depression; Depression-sym = number of depressive symptoms; Gender = 1 (male), 2 (female); Cigarette-Consum = cigarette consumption; Alcohol-Consum = alcohol consumption; Dieting = number of servings of fruit or vegetables consumed in a typical day; Seden-Behavior = sedentary behavior.

* *p* < .5 at 2 tailed.

** *p* < .01 at 2 tailed.

variability were negatively associated with income quintile, BMI, alcohol consumption, and dieting. Therefore, the effects of all of these demographic variables were controlled when conducting the regression analyses.

3.2. Hierarchical logistic regression

In Step 1, a few demographic variables, such as gender, age, income quintile, and dieting, formed significant associations with depression. When emotional-related variables were regressed on the dependent variables in Step 2, depression was positively linked to negative emotion, and was negatively related to positive emotion and positive affective variability. When the dummy variables representing each country were inserted into the model in Step 3, depression was negatively predicted by China national membership, suggesting that Chinese participants tended to report a lower rate of depression. When the interaction terms between country and emotional-related variables were entered in Step 4, India had significant interaction with negative affective variability on the prediction of depression. In summary, the full logistic regression models in Step 4 explained a small to moderate proportion of variance of depression (19.90%).

3.3. Hierarchical linear regression

In Step 1 of the hierarchical linear regression analysis, gender, age, marital status, BMI, and dieting predicted depressive symptoms significantly. In Step 2, negative emotion formed a positive association with depressive symptoms as expected. In Step 3, when the dummy variables representing the countries were inserted as independent variables, China, India, and South Africa national membership were significant negative predictors of depressive symptoms. In Step 4, a number of significant interactions between the emotional-related variables and the dummy variables of the country were established. China and Russia national membership interacted significantly with negative emotion on their prediction of depressive symptoms. Mexico national membership interacted significantly with positive affective variability. Finally, Ghana national membership significantly interacted with all the emotional-related variables in the prediction of depressive symptoms. The full linear regression model in Step 4 explained 8.70% of variance of depressive symptoms. Table 3 displays the parameter estimates and the effect sizes of the regression models.

3.4. Post-hoc regression analyses

The significant interaction terms indicated that the pattern of relationships between the emotional-related variables and the depression-related variables was different across the countries. Negative emotion was a positive predictor of depressive symptoms in all countries except in the sample from Ghana, and the strength of prediction was smaller in the sample from China than in the samples from other countries with significant regression coefficients. Negative affective variability was positively related to depression in India, but not in other countries.

Other significant parameter estimates in the post hoc regression analyses were of interest, even though their related interaction terms were not significant in the hierarchical regression model. For instance, depression was associated with negative emotion in the samples from India, Mexico, and Russia, but the corresponding associations in other countries were not significant. See Table 4 for the full statistics of the post hoc parameter estimates.

4. Discussion

The present investigation was the first to examine the effects of emotion and affective variability on depression in samples from six developing countries. The findings provided additional evidence on the relationships between emotional-related variables and depression when controlling for the effects of other health-related variables (e.g., BMI, physical activity, cigarette smoking, and alcohol consumption), and might provide additional evidence to compare with data from Western countries [8,17,18,20]. In general, results were in line with previous studies that negative emotion was associated with a higher risk of depression while positive emotion was associated with a lower risk of depression, and, moreover, negative and positive affective variability were negative predictors of depression [5,6,11,17]. In addition, cross-cultural differences were observed in which participants in the China and Ghana samples were less likely to report depression as compared with other regions. Cross-cultural difference was observed in the relationships between emotion, affective variability, and depression, which confirmed the argument that the findings from Western countries about depression could not be generalized to people from other countries [8,20,21,24]. These findings clearly showed that the predictive power of

Table 3 Parameter estimates in the hierarchical regression model.

		Depression Exp (B)	Depression-sym β
Step 1	Gender	1.62**	.06**
	Age	1.01*	.08**
	Marital Status	1.14	.04**
	Education Level	1.03	−.02
	Income quintile	1.17**	.00
	BMI	1.00	−.05**
	Cigarette-Consum	1.00	−.01
	Alcohol-Consum	1.00	−.01
	Dieting	.83**	−.09**
	Physical Activity	1.00	.02
	Sedentary Behavior	1.00	.00
Step 2	Pos Emotion	.48**	.03
	Neg Emotion	5.00**	.22**
	Pos Affective-V	.51*	.00
	Neg Affective-V	1.87	.00
Step 3	China	.06**	−.09**
	Ghana	.54	.01
	India	1.05	−.04*
	Mexico	1.98	.00
	South Africa	.81	−.01
	Russia	1.27	−.07**
Step 4	China X Pos Emotion	1.98	−.01
	China X Neg Emotion	1.16	−.08**
	China X Pos Affective-V	1.74	.02
	China X Neg Affective-V	1.30	.03
	Ghana X Pos Emotion	4.00	.07**
	Ghana X Neg Emotion	.60	−.06**
	Ghana X Pos Affective-V	1.77	.04*
	Ghana X Neg Affective-V	2.24	.05*
	India X Pos Emotion	.86	−.01
	India X Neg Emotion	1.00	.00
	India X Pos Affective-V	1.04	−.02
	India X Neg Affective-V	1.56*	.00
	Mexico X Pos Emotion	1.05	.01
	Mexico X Neg Emotion	1.22	.02
	Mexico X Pos Affective-V	1.36	.03*
	Mexico X Neg Affective-V	1.15	.01
	South Africa X Pos Emotion	1.01	.00
	South Africa X Neg Emotion	1.06	.05
	South Africa X Pos Affective-V	1.66	.02
	South Africa X Neg Affective-V	1.48	−.03
	Russia X Pos Emotion	.96	−.02
	Russia X Neg Emotion	.90	.04*
	Russia X Pos Affective-V	.89	−.01
	Russia X Neg Affective-V	.68	−.02
		Chi-Squares	F-value
Step 1		88.51**	12.78**
(df = 11)	R^2	.06	.02
Step 2		211.21**	30.29**
(df = 15)	R^2	.15	.06
Step 3		256.31**	26.12**

Table 3 (*continued*)

		Depression Exp (B)	Depression-sym β
(df = 21)	R^2	.18	.07
Step 4		284.53[**]	15.91[**]
df = 45	R^2	.20	.09

Note. Pos = positive; Neg = negative; Affective-V = affective variability; Cigarette-Consum = cigarette consumption; Alcohol-Consum = alcohol consumption; Dieting = number of servings of fruit or vegetables consumed in a typical day. Nagelkerke R^2 Square was used to reflect the explained variance of the logistic regression models. The parameter estimates for the variables presented in the previous model were omitted for clarity.

* $p < .5$ at 2 tailed.
** $p < .01$ at 2 tailed.

emotion and affective variability on depression varied across the countries.

4.1. Emotion and culture

Negative emotion was generally a significant positive predictor of depression and depressive symptoms, but there were some variations in the corresponding association between the six countries. Specifically, depression was associated with negative emotions in India, Mexico, and Russia, but the corresponding associations in other countries (China, Ghana, and South Africa) were not significant. Indeed, the odds ratios of China and Africa were high, so the non-significant findings might be due to the higher measurement error resulting from relative fewer proportion of people that reported a history of depression in these countries in comparison with the other countries (also see the limitation section). However, the result patterns were more consistent with the prediction for depressive symptoms. For example, negative emotion predicted depressive symptoms in all countries except Ghana, and the corresponding parameter estimate was also small in China. This might be due to the fact that Ghana has one of the lowest proportions of people afflicted with depression, with the lowest proportion being found in China [25]. A lower risk of depression might have attenuated the association between negative emotion and depression. Similarly, previous studies showed that Russia had a notably higher incidence of depression [8], and indeed it was found that the strength of the relationship between negative emotion and depressive symptoms in China and Russia was respectively the lowest and the highest among all countries. Taken together, these findings illustrate that negative emotion tends to form a weak link with depressive symptoms in countries with a lower incidence of depression, but the link might be stronger in other countries with a higher incidence of depression. It appeared that culture might not only be related to the proportion of

people afflicted with depression, but could also moderate the strength of association between emotion and depression.

4.2. Affective variability and culture

Positive affective variability was a negative predictor of depression, which was in agreement with this hypothesis and the findings of a previous study [18]. Similarly, it was consistently found that negative affective variability was a positive correlate of depressive symptoms in all countries, which again supported the literature on the detrimental effects of negative affective variability on health and well-being [4,5]. Negative affective variability significantly interacted with India national membership in the prediction of depression, and it significantly interacted with Ghana national membership in the prediction of depressive symptoms. These interactions, as indicated from the post hoc tests, revealed that the association of negative affective variability and the risk of depression was higher in India and lower in Ghana compared with the samples from other countries. Participants in the sample from India appeared to be more likely to have depression when they experienced negative affective variability, and participants from the sample from Ghana appeared to be less likely to report depressive symptoms when they experienced negative affective variability.

4.3. Limitations

This study has numerous strengths including a large sample size from multiple national groups with appropriate measures of emotional status, depression, and demographic variables fit for the purpose of testing their hypotheses of emotional variability. The study is not, however, without limitations and a few are highlighted so that the value of the findings can be put into context. This was a cross-sectional study with a correlational design, so it was not possible to make an inference of causal relationships

Table 4 Post-hoc parameter estimates by country.

		China	Ghana	India	Mexico	South Africa	Russia
Depression	Positive Emotion (OR)	2.95	5.47	.32**	.20	.48	.42*
	Negative Emotion (OR)	14.65	.26	4.75**	33.09**	57.38	3.14*
	Positive Affective Variability (OR)	1.46	.87	1.12	1.06	.96	1.14
	Negative Affective Variability (OR)	.67	102.45	2.78*	.05	3.84	.15
	R-Squared	.20	.26	.19	.67	.45	.11
Depression-sym	Positive Emotion (β)	-.06*	.08**	-.07**	-.06	-.21**	-.20**
	Negative Emotion (β)	.12**	.01	.21**	.27**	.34**	.36**
	Positive Affective Variability (β)	.08**	.02	.01	.08	.17**	-.02
	Negative Affective Variability (β)	.15**	.07*	.13**	.15*	.25**	.17**
	R-Squared	.04	.07	.06	.21	.20	.16

Note. Depression = clinically diagnosed with depression; Depression-sym = number of depressive symptoms. The parameter estimates for the demographic variables are omitted from this table for clarity. The parameter estimates where significant interactions terms between the emotional-related variables and the country were present in the hierarchical regression model were bold.

* $p < .5$ at 2 tailed.
** $p < .01$ at 2 tailed.

between depression and emotion-related variables [26,27]. Also, responses on the self-reported measures of depressive symptoms could be subject to social desirability and memory bias. This might be one of the reasons why the depression rate reported in China in the present study was lower than previous studies using other clinical measures of depression [25]. The single item about depression only reflected participants' medical history of depression, but it did not include any information on the time of diagnosis, duration, severity of the disease, or current ongoing treatment. This measure should, therefore, only be regarded as a retrospective assessment of depression, and its measurement error could be heightened due to the individuals' variation of the treatment or recovery status [28].

In addition, when cross-cultural differences were evaluated in the relationships between emotion or affective variability and depression, dummy-coded variables and interaction terms were used. Although this method simultaneously and parsimoniously carried out the analysis for the central research questions of the study while controlling for an appropriate number of important demographic variables, the analysis that was employed did not specifically make a pairwise comparison of the effects of emotion or affective variability between each pair of countries, so the results were only able to reflect how the effects of one country differed from those of all other countries. Similarly, there were no data from a developed country for a direct comparison between developing countries and developed countries. Therefore, it is important for future studies to use a nationally representative sample of a developed country (e.g., the United Kingdom or the United States) to make a comparison against

these developing countries in terms of the effects of emotion and affective variability on depression. Finally, the samples in this study were generally older adults with a low educational level, and there existed some variations in terms of personal characteristics (e.g., age, marital status, BMI) and lifestyle factors (e.g., smoking and drinking, physical activity, and sedentary behavior) between the six countries. Although the effects of these potentially confounding variables were statistically controlled, the generalizability of the study findings could be restricted as a consequence, so results should be interpreted with this advisory in mind.

5. Conclusion

In this cross-cultural investigation of the effects of emotion and affective variability on depression among six developing countries (China, Ghana, India, Mexico, South Africa, Russia), it was found that culture was not only a factor associated with the incidence of depression, but it could also be related to the degree to which emotion and affective variability were linked to the experience of depression or depressive symptoms.

Conflict of interest

None declared.

References

[1] World Health Organization. The global burden of disease: 2004 update. Geneva: WHO Press; 2008.
[2] American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed., text rev. ed. Washington, DC, 2000.

[3] Brown TA, Chorpita BF, Barlow DH. Structural relationships among dimensions of the DSM-IV anxiety and mood disorders and dimensions of negative affect, positive affect, and autonomic arousal. J Abnorm Psychol 1998;107:179—92.

[4] Bylsma LM, Morris BH, Rottenberg J. A meta-analysis of emotional reactivity in major depressive disorder. Clin Psychol Rev 2008;28:676—91.

[5] Peeters F, Berkhof J, Delespaul P, Rottenberg J, Nicolson NA. Diurnal mood variation in major depressive disorder. Emotion 2006;6:383—91.

[6] Peeters F, Berkhof J, Rottenberg J, Nicolson NA. Ambulatory emotional reactivity to negative daily life events predicts remission from major depressive disorder. Behav Res Ther 2010;48:754—60.

[7] Wichers M, Lothmann C, Simons CJP, Nicolson NA, Peeters F. The dynamic interplay between negative and positive emotions in daily life predicts response to treatment in depression: a momentary assessment study. Br J Clin Psycho. 2012;51:206—22.

[8] Ferrari AJ, Charlson FJ, Norman RE, et al. Burden of depressive disorders by country, sex, age, and year: findings from the global burden of disease study 2010. PLoS Med 2013; 10.

[9] Zautra AJ, Affleck GG, Tennen H, Reich JW, Davis MC. Dynamic approaches to emotions and stress in everyday life: Bolger and Zuckerman reloaded with positive as well as negative affects. J Pers 2005;73:1511—38.

[10] Davidson KW, Mostofsky E, Whang W. Don't worry, be happy: positive affect and reduced 10-year incident coronary heart disease: the Canadian Nova Scotia Health Survey. Eur Heart J 2010;31:1065—70.

[11] Pressman SD, Cohen S. Does positive affect influence health? Psychol Bull 2005;131:925—71.

[12] Zhang X, Fung H, Ching BHH. Age differences in goals: implications for health promotion. Aging Ment Health 2009;13:336—48.

[13] Lerner JS, Keltner D. Fear, anger, and risk. J Pers Soc Psychol 2001;81:146—59.

[14] Lerner JS, Tiedens LZ. Portrait of the angry decision maker: how appraisal tendencies shape anger's influence on cognition. J Behav Decis Making 2006;19:115—37.

[15] Davidson RJ. Anterior electrophysiological asymmetries, emotion, and depression: conceptual and methodological conundrums. Psychophysiology 1998;35:607—14.

[16] Trull TJ, Solhan MB, Tragesser SL, et al. Affective instability: measuring a core feature of borderline personality disorder with ecological momentary assessment. J Abnorm Psychol 2008;117:647—61.

[17] Palmier-Claus JE, Taylor PJ, Gooding P, Dunn G, Lewis SW. Affective variability predicts suicidal ideation in individuals at ultra-high risk of developing psychosis: an experience sampling study. Br J Clin Psychol 2012;51:72—83.

[18] Gruber J, Kogan A, Quoidbach J, Mauss IB. Happiness is best kept stable: positive emotion variability is associated with poorer psychological health. Emotion 2013;13:1—6.

[19] Brandt ME, Boucher JD. Concepts of depression in emotion lexicons of eight cultures. Int J Intercultural Relat 1986;10:321—46.

[20] Jenkins JH, Kleinman A, Good BJ. Cross-cultural studies of depression. In: Becker J, Kleinman A, editors. Psychosocial aspects of depression. New York: Erlbaum Press; 1991. p. 67—99.

[21] Kirmayer LJ. Cultural variations in the clinical presentation of depression and anxiety: implications for diagnosis and treatment. J Clin Psychiatry 2001;62:22—30.

[22] Kahneman D, Krueger AB, Schkade DA, Schwarz N, Stone AA. A survey method for characterizing daily life experience: the day reconstruction method. Science 2004;306:1776—80.

[23] Eid M, Diener E. Intra individual variability in affect: reliability, validity, and personality correlates. J Pers Soc Psychol 1999;76:662—76.

[24] Tsai JL, Knutson B, Fung HH. Cultural variation in affect valuation. J Pers Soc Psychol 2006;90:288—307.

[25] Shao J, Li D, Zhang D, Zhang L, Zhang Q, Qi X. Birth cohort changes in the depressive symptoms of Chinese older adults: a cross-temporal meta-analysis. J Geriatr Psychiatry 2013;28:1101—8.

[26] Chan DKC, Hagger MS. Theoretical integration and the psychology of sport injury prevention. Sports Med 2012;42:725—32.

[27] Hagger MS, Chatzisarantis NLD. Assumptions in research in sport and exercise psychology. Psychol Sport Exerc 2009;10:511—9.

[28] Chan DKC, Lonsdale C, Ho PY, Yung PSH, Chan KM. Patient motivation and adherence to post-surgery rehabilitation exercise recommendations: the influence of physiotherapists' autonomy supportive behaviors. Arch Phys Med Rehabil 2009;90:1977—82