Asian Journal of Humanities and Social Sciences (AJHSS)
Volume 3, Issue—1, February, 2015
ISSN: 2320-9720

The Association between Perceived Stress, Life Satisfaction, Optimism, and Physical Health in the Singapore Asian context

San-Ho Yew*[1], Keane Ming-Jie Lim[1,2], Yu-Xuan Haw[2] and Samuel Ken-En Gan[1,2,3]
[1]James Cook University, Singapore
[2]Bioinformatics Institute, Agency for Science, Technology, and Research, Singapore
[3]p53 Laboratory, Agency for Science, Technology, and Research, Singapore (A*STAR)
*Corresponding author: San-Ho Yew. Email: yewsanho[at]gmail.com

ABSTRACT

Stress levels, satisfaction, and outlook in life, interact with physiological health indicators such as Body Mass Index (BMI), heart rate and blood pressure. However, various theories offer conflicting opinions on the direction of such effect. Since cultural differences can influence these interactions, we investigated the association of these factors and the direction of the relationship in a sample of 112 Singapore Asians, utilizing the psychological measures of optimism, life satisfaction, perceived stress, and physiological parameters: blood pressure, heart rate, and BMI. Our analysis showed that both physiological parameters and mental health were associated with the stress levels, and that statistical tests supported the direction of influence proposed by the controversial James-Lange theory that body physiology elicited emotions.

Keywords: Blood pressure, Body mass index, Stress, Optimism, Life satisfaction, James-Lange theory.

1. INTRODUCTION

Stress impacts every one in every aspect of life and is present in all ages, and across all cultures. While acute stress does not have an immediate effect on the health of modern societies, chronic stress is associated with burnout, and with higher occurrences of coronary cardiovascular disease (Kendall-Tackett, 2007; Kop & Gottdiener, 2005), cancer (Schleifer, 2007) and impaired physical growth (Deltondo et al., 2008). Stress occurs when an individual is generally unable to adapt to circumstantial demands (Cohen, Janicki-Deverts, & Miller, 2007; Lazarus, 1993), and despite demonstrating that cultural differences do affect the management of stress (Chang, 2002), there remains limited literature after year 2002. Given that most studies were carried out in the western world, there remains much to study on the association of stress and both physiological and psychological health in the highly populated Asian world. In western world studies, Asian Americans were found to score higher on depression and social anxiety measures than Caucasian American college students (Okazaki, 1997). Furthermore, Asian Americans tend to attribute their success to external factors and circumstances, and were more pessimistic than the Caucasian Americans (Chang, 2002).

Optimism and life satisfaction may mitigate the detrimental effect of stress via stress perception. Optimism, the extent of a favourable view of a person's own future (Carver, Scheier, & Segerstrom, 2010; Scheier & Carver, 1992), is often accompanied by active coping and better problem-solving skills (Bedi & Brown, 2005; Brenes, Rapp, Rejeski, & Miller, 2002; Scheier & Carver, 1992). Higher optimism have been found to negatively correlate with stress, job burnouts

(Hayes & Weathington, 2007), stroke (Kim, Park, & Peterson, 2011), and cardiovascular diseases (Kubzansky, Sparrow, Vokonas, & Kawachi, 2001). Further analyses identify optimism as a key factor to better well-being and resilience during stressful events (Kim et al., 2011; Kubzansky et al., 2001; Schwarzer, 1994). Different from optimism, life satisfaction is a subjective assessment (Diener, 1984) of inner well-being (Hayes & Weathington, 2007) implying contentment, fulfilment, and acceptance of circumstances (Sousa & Lyubomirsky, 2001). It correlates positively with optimism, but negatively with perceived stress (Hayes & Weathington, 2007). Although there is evidence where emotional expression remained the same in a dog with a central nervous system separated viscera (Cannon ,1927), we did not rule out testing the direction of physiological to psychology effect as in the controversial James-Lange theory (James, 1984) where the elicitation of emotions may also arise from physical parameters.

Given that Singapore is a globalized city state with numerous immigrants from other Asia regions (South East Asia and China) joining the local populations, it provides a good geographical location for the testing of the effects of Asian culture (Department of Statistics Singapore, 2014) on psychological measures that affect stress (optimism and life satisfaction).In our study, we aim to investigate: 1) the associations between stress psychological modulators (life satisfaction and optimism) and physiological health indicators (BMI, heart rate and blood pressures); 2) statistically test the validity of physiological parameters as factors for the psychological factors; and 3) whether the findings of this study were in agreement with those in the western context.

2. METHOD

2.1 Participants

A total of 112 Singapore citizens (39 males and 73 females) aged between 19 and 57 years (M = 33.96, SD = 11.79, *Mode* = 21), completed the survey measures of perceived optimism, life satisfaction and perceived stress, and had their blood pressure, heart rate and BMI (Body Mass Index) measured. Demographic data: ethnicity, marital status, occupation, and religious affiliation were also collected. Out of 112 participants, 89.3% were Chinese, 1.8% were Malay, 3.6% were Indian, and 2.7% each were "Chindian" and "others". In term of marital status, 58.9% were single, 38.4% were married or attached, 1.8% were divorced or separated, and 0.9% was widowed. With regards tooccupation, 7.1% were unemployed, 32.1% were students, 12.5% were public or civil servants, 10.7% were technical or admin staff, 17% were in the middle management level, 8.9% were in the senior management level, and 11.6% were Chief Executive Office level or equivalent. For religious affiliation, 2.7% did not have any religious affiliation, 68.8% were Christians, 12.5% were Buddhist or Taoist, 1.8% were Hindu, 3.6% each were Muslim and atheist, and 7.1% were agnostics.

2.2 Materials

Perceived optimism was assessed using the "Life Orientation Test-Revised" (LOT-R); (Scheier, Carver, & Bridges, 1994) and reported to have a Cronbach's $\alpha = 0.78$, and a test-retest correlation of 0.68 after 4 months and 0.6 after 12 months (Scheier et al., 1994).. The LOT-R (Life Orientation Test-Revised) contained ten items with each consisting of four filler items rated using a 5-point Likert scale (0 = *strongly disagree* to 4 = *strongly agree*). The total possible

scores ranged from 0 to 24, whereby a higher score indicated greater optimism. Of the six scored items, three items were scored in reverse order(i.e., items 3, 7, 9).

Life satisfaction was measured using the "Satisfaction with Life Scale" (SWLS); (Diener, Emmons, Larsen, & Griffin, 1985). SWLS was reported to have a Cronbach's α = .79 to .89 (Pavot & Diener, 1993), and the results were grouped (extremely dissatisfied: 5-9, dissatisfied: 10-14, slightly dissatisfied: 15-19, neutral: 20, slightly satisfied: 21-25, satisfied: 26-30, and extremely satisfied: 31-35) according to the previously used cutoff scores (Pavot & Diener, 2008). SWLS was rated using a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). The total possible scores ranged from 5 to 35 whereby higher scores indicated a greater degree of satisfaction with life and have also been shown to be predictive of better psychological well-being (Pavot & Diener, 2008).

Perceived stress was measured using the "Perceived Stress Scale" (PSS); (Cohen, Kamarck, & Mermelstein, 1983). The PSS was reported to have a Cronbach's α = .78 to .91 (Cohen & Janicki-Deverts, 2012) and contained ten items rated using a 5-point Likert scale (0 = *never* to 4 = *very often*). Items 4, 5, 7, and 8 were scored in reverse order before the total sum of the scores was calculated. The total possible scores ranged from 0 to 40 with higher scores indicating a greater degree of perceived stress experienced by participants over the past one month.

Body Mass Index (BMI) was collected as an indirect measurement of obesity, which is a factor to blood pressure (Gan, Loh and Seet ,2003) and general health. It is classified into different groups: Low as ≤ 18.4, healthy as 18.5-22.9, moderate as 23.0-27.4, and high as ≥ 27.5 (Singapore Health Promotion Board, 2012).

2.3 Procedure

Participants were briefed on the aims of the study and informed consent was sought prior to the study. The participants were volunteer and they acknowledged that they could withdraw anytime without prejudice. Physiological parameters: height and weight, resting heart rate, systolic and diastolic blood pressures were measured in the same manner as performed previously by Gan, Loh and Seet (2003) using an automated oscillometric sphygmomanometer Omron SEM1 digital blood pressure monitor according to the manufacturer's specifications (Omron, n.d.). Briefly, three separate blood pressure and resting heart rate readings were taken from the participant's non-dominant arm before and after the mental health scales of LOT-R, SWLS and PSS were completed. Blood pressure readings that differed by more than 5mm/Hg, were supplemented by two additional readings, and the mean of all five readings (obtained before and after the completion of mental health scales) were recorded.

2.4 Statistical analysis

The data were analyzed using IBM SPSS Version 20 (IBM Corporation, 2011). The assumption of normality was tested on all the parameters (blood pressure, heart rate, LOT-R, SWLS and PSS) using the Shapiro-Wilk test as recommended (Ghasemi & Zahediasl, 2012) prior to further analysis. Non-parametric tests were used for parameters that violated the assumptions of normality. Kruskal-Wallis test was used to rank the means of systolic and diastolic blood pressures based on different groups of BMI and SWLS. Pearson's correlation and Spearman's rho were used to determine the correlation between three mental health measures

(PSS, SWLS and LOT-R). Mann-Whitney U test was used to assess the difference between the BMI groups on the blood pressure parameters. To analyze the relationships between the physiological and psychological parameters, stepwise multiple linear regressions were used for LOT-R and PSS. One-way between-groups ANOVA were used to determine the relationship between SWLS and the physiological and psychological measures. Levene's test of homogeneity of variance was used to assess the difference in variances for PSS based on different groups of SWLS. As the physiological measures did violated the assumptions of normality, we were not able to test the other direction of psychology affecting physiology.

2.5 Ethical considerations

Ethical approval was given by James Cook University Human Research Ethics Committee. The experiment was deemed as a low risk study.

3. RESULTS

Heart rate (*S-W* = .979, *p* = .072), LOT-R (*S-W* = .987, *p* = .336) and PSS (*S-W* = .986, *p* = .278) adhered to assumptions of normality. The remaining parameters: Systolic (*S-W* = .911, *p* < .001) and diastolic (*S-W* = .973, *p* = .024) blood pressures and SWLS (*S-W* = .974, *p* = .030), violated the assumptions of normality.

3.1 Correlation between mental health measures

Pearson's correlation (for variables that adhered to normality) and Spearman's rho (for variables that violated normality) between the mental health scales (LOT-R, SWLS, PSS) revealed significant associations for the following: Firstly, PSS and LOTR (*r* = -.384, *p* < .001); 2); secondly, PSS and SWLS (*rho* = -.423, *p* < .001); and finally, LOT-R and SWLS (*rho* = .447, *p* < .001).

3.2 Validation of physiological data collection

Physiological parameters were consistent with previous reports (Gan et al., 2003),. Kruskal-Wallis tests (with the systolic and diastolic blood pressures as dependent variables, and BMI as independent variable) confirmed significant differences in the BMI groups on the measures of systolic blood pressure, $x^2(3, n = 112) = 26.37$, $p < .001$, and diastolic blood pressure, $x^2(3, n = 112) = 22.60$, $p < .001$. The Mann-Whitney U test (with a Bonferonni adjustment of .05/6 = .008 α level, post-hoc test) revealed significant differences for systolic blood pressure in the following groups: low BMI group (*Md* = 103) and healthy BMI group (*U* = 175.0, *p* = .007, *Md* = 113); moderate BMI group (*U* = 62.5, *p* < .001, *Md* = 121) and high BMI group (*U* = 16.5, *p* < .001, *Md* = 120); and healthy BMI and moderate BMI groups (*U* = 482.0, *p* = .007).

Diastolic blood pressure was also significantly different between low BMI group (*Md* = 64) and moderate BMI group (*U* = 93.5, *p* < .001, *Md* = 74); low BMI group and high BMI group (*U* = 41.0, *p* < .001, *Md* = 77); healthy BMI group (*Md* = 67.5) and the moderate BMI group (*U* = 440.5, *p* = .002); and healthy BMI group and the high BMI group (*U* = 213.5, *p* = .002). The systolic (*U* = 317.5.0, *p* = .919) and diastolic blood pressures (*U* = 305.0, *p* = .738) were not significantly different between the moderate and high BMI groups.

3.3 Relation between PSS, LOT-R with physiological and mental health measures

Predictors of PSS (M = 17.68, SD = 5.79) were analyzed using multiple linear regression (no recommended cutoff score for PSS categorization), revealing BMI, diastolic blood pressure, heart rate, LOT-R and SWLS, $F(9, 102) = 6.27$, $p < .001$ as significant contributors (see Table 1). All other factor, including demographics parameters did not show statistical significance ($p > 0.05$).

Similarly, on the analysis of predictors of LOT-R (as scaled data, with no cutoff score for categorization), multiple linear regression revealed that only two parameters, SWLS ($\beta = .398$, $p < .001$) and PSS ($\beta = -.248$, $p = .014$) were statistically significant $F(9, 102) = 5.23$, $p < .001$.

Table 1
Analysis of statistically significant predictors of PSS using multiple linear regression

	M	*SD*	*B*	Standard error *B*	β	*t*	*p*
Age (years)	33.96	11.79	-.065	.047	-.133	-1.40	.165
Weight (Kg)	62.84	18.61	-.116	.062	-.374	-1.88	.064
Height (m)	1.61	.234	3.921	3.052	.160	1.29	.202
BMI (kg/m^2)	23.69	6.60	.330	.161	.377	2.05	.043
Systolic blood pressure (mm/Hg)	118.61	18.08	.063	.043	.196	1.45	.149
Diastolic blood pressure (mm/Hg)	71.65	11.41	-.140	.066	-.276	-2.11	.037
Heart rate (pulse/min)	78.96	12.24	.142	.041	.301	3.45	.001
LOT-R	15.49	3.33	-.405	.162	-.234	-2.51	.014
SWLS	16.55	3.53	-.522	.156	-.318	-3.35	.001

Note. *Adjusted* R^2 at .275. Body Mass Index (BMI) is classified into different groups as recommended by Singapore Health Promotion Board (2012); LOT-R = Life Orientation Test-Revised; SWLS =Satisfaction with Life Scale. Factors that were not significant were not shown.

3.4 Relation between SWLS with physiological and mental health measures

One-way between-groups ANOVA (SWLS as the independent variable; LOT-R, PSS and heart rate as dependent variables) showed a statistically significant difference in the LOT-R score for the SWLS groups, $F(4, 107) = 9.72$, $p < .001$. Since PSS violated the Levene's test of homogeneity of variance (when grouped according to SWLS), an adjusted Welch's $F(4, 21.07) = 13.0$, $p < .001$ was reported for the between-subjects ANOVA (Analysis of Variance). This was in contrast to the insignificant association between heart rate and SWLS, $F(4, 107) = .68$, $p = .606$.

Kruskal-Wallis tests between blood pressures and the SWLS groups showed a statistically insignificant difference in the systolic $x^2(4, n = 112) = 2.47$, $p = .650$ and diastolic $x^2(4, n = 112) = .69$, $p = .952$.

4. DISCUSSION

Our investigations to the associations between stress psychological modulators (life satisfaction and optimism) and physiological health indicators (BMI, heart rate and blood pressures) were similar to most reports in the western context (Chang, Maydeu-Olivares, & D'Zurilla, 1997; Extremera, Durán, & Rey, 2009; Paschali & Tsitsas, 2010). On the validity of using physiological parameters as predictors for the psychological factors, our statistical analysis supported the direction of effect suggested by the James-Lange theory. On the whole, the findings of this study were in agreement with those in the western context.

On our analysis within the psychological parameters in our Asian sample, optimism and life satisfaction were positively correlated with each other, but both had a negative relationship with perceived stress levels, supporting the western context studies that optimistic people were more satisfied with their lives, regardless of culture. However, unlike other studies on the western population (Brenes et al., 2002; Matthews, Räikkönen, Sutton-Tyrrell, & Kuller, 2004; Schwarzer, 1994), we did not find an association between optimism and physical health; instead, our findings supported Begley, Lee, & Czajka (2000)'s observation that optimism, blood pressure and heart rates were independent parameters. This phenomenon may be explained in that optimism was not substantial enough to affect blood pressure (Raikkonen & Matthews, 2008; Raikkonen, Matthews, Flory, Owens, & Gump, 1999)as they are regulated by different parts of the brain. Optimism is controlled by left hemisphere of the brain (Hecht, 2013); blood pressure is regulated by networks consisting of Rostral Ventrolateral Medulla (RVLM), hypothalamus, spinal cord and the nucleus of the solitary tract (NTS), which affect the sympathetic tone essential for long-term blood pressure control (Guyenet, 2006).

Similarly, life satisfaction, which is predicted by optimism (Leung, Moneta, & McBride-Chang, 2005) was not associated with heart rate and blood. However, this was validated by the findings where optimism was also not correlated with the physiological measures.

As our physiological findings did not pass tests for assumptions of normality, we were unable to test if the psychological parameters could be predictors of BMI and heart rate, thus limiting our study to analyzing the direction of relation as proposed in the James-Lange theory. Nonetheless, our physiological findings (blood pressure and BMI) were similar to previous reports (Faheem et al., 2010; Gan et al., 2003; Pucarin-Cvetkovic et al., 2006), hence validating our data collection.

Other than optimism and life satisfaction, our physiological measures (heart rate, BMI, diastolic blood pressure) were found to correlate with PSS, an observation that supports the controversial James-Lange theory - where physiological arousal formed the basis of emotions (James, 1884). This finding of physiological arousal associating with stress perception can be explained as both stress and emotions share similar physiological basis, and have the same neuro anatomy: prefrontal cortex, amygdala, and anterior cingulated cortex (Wang & Saudino, 2011).

PSS is positively predicted by heart rate and BMI (independent risk factors of acute coronary events), and is in agreement with finding that higher stress are linked with the risk of developing obesity, insulin resistance, diabetes mellitus (Shigetoh et al., 2009), and cardiovascular mortality (Hjalmarson, 2007). This finding allows individuals to gauge their risks of developing chronic diseases based on their perceived stress levels, and shows stress as a warning sign for chronic diseases.

Contradicting some previous studies (Morimoto et al., 2008; Reims et al., 2004), we found a negative relationship between PSS and diastolic blood pressure that paralleled other studies (Lim & Gan, 2014; Suter, Maire, Holtz, & Vetter, 1997; Winkleby, Ragland, & Syme, 1988). This finding is likely to be explained by: 1) poor stress management in Asian populations in which prolonged stress exposure led to the habituation or the suppression of stress perception (Suter et al., 1997); 2) the early phase of the baroreflex (DiCarlo & Bishop, 2001; Fadel & Raven, 2012), where the stressors first raised the heart rate, and the blood pressure compensated by decreasing; 3) the denial of stress resulted in lower perceived stress, despite higher blood pressure (Barnes, Johnson, Williams, & Williams, 2012; Mills & Dimsdale, 1993); and 4) Asians tend to ignore stress (Fernando, 2012) and are less vocal about their health conditions (Kandula, Lauderdale, & Baker, 2007; Meredith & Siu, 1995). This helps us to gain insights that cultural differences could affect the ways of individuals perceive and deal with stress and that Asians may be generally poor at stress management.

The major limitations of our study include testing the effect of perceived stress on the physiological measures due to violations of normality. Future studies may assess this relationship by obtaining blood pressure readings from a sample population of a smaller age range as systolic blood pressure increased with age while diastolic blood pressure decreased with age (Port, Demer, Jennrich, Walter, & Garfinkel, 2000; Wright, Hughes, Ostchega, Yoon, & Nwankwo, 2011).

5. CONCLUSION

Our study in the Singapore Asian context showed that perceived stress levels were correlated with physiological health parameters such as heart rate, BMI and blood pressure; this observation found support for the James-Lange theory where physiological parameters could affect perceived stress. Higher perceived stress levels could serve as a warning sign and help us to identify the potential individuals who are susceptible to chronic diseases such as obesity, diabetes and cardiovascular mortality. We found that optimism and life satisfaction were not associated with physical health, suggesting that optimistic behaviour was not substantial enough to affect physiological measures such as blood pressure. Cultural differences could affect how people perceive and manage stress. Asian populations may be weaker at managing stress, leading to the contradictory results (negative correlation between perceived stress levels and diastolic blood pressure) as compared with those studies conducted in western context.

Competing interest

The authors declare that they have no competing interests.

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ACKNOWLEDGEMENTS

We would like to thank James Cook University, Singapore for the provision of the facilities and funding of this work.