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Perceived Stress Scale

Reliability and Validity Study in Brazil

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Abstract

The perceived stress scale (PSS-10) reliability and validity were evaluated in Brazilian adults. A two-stage translation procedure was employed to achieve a Portuguese version. Participants were 793 Brazilian university teachers. The exploratory factor analysis showed two factors with eigenvalues greater than 1.0 (56.8% of variance). The Cronbach's alpha coefficients were 0.83 (Factor 1), 0.77 (Factor 2) and 0.87 (Total Score). The test–retest reliability scores were 0.83 (Factor 1), 0.68 (Factor 2) and 0.86 (Total Score). PSS-10 and perceived health correlations ranged from –0.22 to –0.35. The PSS-10 showed an adequate reliability and validity supporting its use in this population.

Keywords

- *health psychology*
- *psychological distress*
- *quantitative methods*
- *reliability*
- *validation*

COMPETING INTERESTS: None declared.

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Introduction

In the last few decades, researchers and practitioners have shown a growing interest in understanding stress. There is substantial evidence linking stress with several health outcomes(Cohen, Tyrrell, & Smith, 1993; Dougall & Baum, 2001; Otto et al., 2004; Song et al., 1999), leading to a consensus that stress has an important role in health.

Despite this agreement, the 'diversity of opinion surrounding the definition of stress has created disagreements among stress researchers, preventing stress from becoming a universally accepted construct'(Martin & Brantley, 2002). It is argued that the stress concept is too broad and ambiguous to adequately define, which has led to different stress theories.

These theories differ on stress nature, which is considered a stimulus, a response or an interaction (Lazarus & Folkman, 1984; Martin & Brantley, 2002). The transactional model (Lazarus & Folkman, 1984), often described as 'stress and coping' framework, is usually measured as perception of the stressful events experienced within a specific period of time. Several stress scales have been employed in this context, such as the Life Event Scale (Holmes & Rahe, 1967) and the Occupational Stress Indicator (Cooper & Payne, 1988). However, these scales are limited to particular conditions and, therefore, the measurement of stress is often limited to specific groups.

To address this problem, Cohen, Kamarck, and Mermelstein (1983), developed a global stress measure, the Perceived Stress Scale (PSS). The PSS is a self-reported measure designed to deal with the degree to which situations in an individual's life are appraised as stressful. It was originally developed as a 14-item scale that assessed the perception of stressful experiences over the previous month using a five-point Likert scale. Later, the authors reported that the 10-item version (PSS-10) showed stronger psychometric characteristics in comparison to the 14-item scale (Cohen & Williamson, 1988).

The PSS-10 has demonstrated adequate reliability coefficients; Cronbach's alpha ranging from 0.75 to 0.91 (Cohen et al., 1983; Cohen & Williamson, 1988; Cole, 1999; Glaser et al., 1999). At least two studies reported test–retest reliability with correlations ranging from 0.55 (six-week interval) to 0.61 (12 months) (Cohen et al., 1983; Cole, 1999). The PSS-10 has also shown validity evidence compared to health behaviors and perceived health (Cohen et al., 1983) and stressful life events and negative affect (Cohen et al., 1993) as criterion measures.

The psychometric quality and short length of the PSS-10 have contributed to its popularization. Several studies have employed PSS-10 to investigate the association between stress and a variety of health issues, such as depression symptoms (Otto et al., 2004), anti-inflammatory responses (Song et al., 1999), immune function (Stowell, Kiecolt-Glaser, & Glaser, 2001), susceptibility to the common cold (Cohen et al., 1993) and breast feeding (Mezzacappa, Guethlein, Vaz, & Bagiella, 2000). The use of the PSS-10 is not limited to English-speaking countries. In fact, it has been translated into several languages including Japanese (Mimura & Griffiths, 2004), Swedish (Eskin & Parr, 1996), Chinese (Lee & Crockett, 1994), French (Muller & Spitz, 2003) and Spanish (Carrobles & Remor, 2001).

To the best of our knowledge, the PSS-10 has not been translated or employed in Brazilian studies with adults. In fact, conducting a systematic search in the main international medical and psychological databases (Medline and PsycINFO) and also those in Latin America (SciELO and Lilacs), we found no reports of its use either in Brazil or in other Portuguese-speaking countries in the adult population. The purpose of this study was to evaluate the reliability and validity of the Brazilian 10-item version of the PSS-10.

Methods

Translation

The translation and adaptation process was conducted as recommended in the literature review (Vijver & Hambleton, 1996) and consisted of a two-stage procedure. The first stage was an independent translation conducted by one Brazilian-Portuguese native speaker with English skills, who translated the English version into Brazilian-Portuguese, and one American-English native speaker and Brazilian resident, who translated the Brazilian-Portuguese version into English. The two English versions were compared and some semantic discrepancies were identified. After some modifications the first draft was obtained.

During the second stage, an expert committee review verified the coverage of the theoretical construct as well as the instrument format. This committee comprised four former residents of the USA, all of whom had PhDs in health or exercise and were Brazilian-Portuguese native speakers. The committee suggested a few modifications in the questionnaire layout and font size to improve the clarity of the instrument. Finally, the second draft was

administered to a group of five university teachers to verify comprehension on the questions and the response format.

Participants

Participants were part of a cross-sectional study of health risk behaviors conducted with university teachers in southern Brazil. The population ($N = 6829$) was determined through a list provided by seven federal universities located in the three Brazilian southern states, and only full-time teachers were included because they are more likely to be exposed to the same work-related stressors.

A representative self-weighted sample was estimated in two stages. First, a random sample was selected stratified by gender, and then a percentage of teachers in each institution was sampled. To ensure the minimum sample, a total of 3000 questionnaires were mailed out, anticipating a response rate of 30 percent. The response rate was similar to that observed in surveys using regular surface mail and the internet (Grava-Gubins & Scott, 2008).

The response rate was 34.3 percent ($n = 1.029$) and after checking for invalid or incomplete answers and outliers a total of 793 questionnaires (57% male) were included in the preliminary analysis. This final sample was adequate in estimating a sample error of 4.3 percentage points with a confidence interval of 95 percent.

A sub-sample of 24 participants in one university was randomly selected and the Brazilian PSS-10 (BPSS-10) was re-administered seven days later to assess test–retest reliability. The protocol was approved by the institutional review board at the Pontiff Catholic University of Parana, Brazil.

Measures

The BPSS-10 consists of all 10 original PSS items (Cohen et al., 1983) in which the respondents rate the frequency of their feelings and thoughts related to events and situations that occurred in the last month. Six items are negative (1, 2, 3, 6, 9, 10) and the remaining four are positive (4, 5, 7, 8). The response format was the same as the original PSS (Cohen et al., 1983) and each item is rated on a five-point Likert-type scale (1 = *never* to 5 = *very often*). To produce the score, the four positive items are reverse-scored, and then all the items are summed, with scores ranging from 0 to 40. A higher score indicates greater stress.

Basic demographics, lifestyle activities, perception of work effect on physical and mental health and general health perception measures were collected. Work effect perception on physical and mental health consisted of two items in which respondents answered, on a five-point Likert-type scale (1 = *very negative* to 5 = *very positive*), which of the effects work has on their physical and mental health. These questions were previously employed in another stress study (Ettner & Grzywacz, 2001). Health perception was determined by a five-point scale employed in another adult study (Centers for Disease Control and Prevention, 2004). This measure was dichotomized into two categories, *positive health* (excellent, very good, good) and *negative health* (average, poor). Body mass index (BMI) was computed from self-reported weight and height and those with BMI ≥ 30 kg/m^2 were classified as obese. Socioeconomic level (SES) was estimated by the Brazilian Economic Criterion (ANEP, 2002). The original five SES categories were grouped into three levels, A (high), B (medium), and C (low) because we found few cases in the lowest original categories.

Data analysis

To analyze the construct structure of the BPSS-10, the sample was randomly split in two halves. With the first half we conducted an exploratory factor analysis (EFA) and with the second half a confirmatory factor analysis (CFA). An independent *t*-test and chi-square were employed to compare the samples characteristics.

The EFA was performed with the principal component and Varimax rotation. The sample adequacy was assessed by the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. Factors with eigenvalues higher than 1.0 and items with loadings greater than 0.4 were accepted (Pett, Lackey, & Sullivan, 2003). To conduct this analysis we also observed the item/sample ratio of 10:1, which has been suggested as adequate (Pett et al., 2003). We expected that EFA would extract a two-factor solution, as reported in other studies (Cohen & Williamson, 1988; Otto et al., 2004; Song et al., 1999).

The CFA was performed to assess the goodness-of-fit of: (1) the factor structure extracted from the EFA (Model 1); and, (2) a second-order factor solution as described elsewhere (Golden-Kreutz, Browne, Frierson, & Andersen, 2004) (Model 2). According to recommendations in the literature, the following criteria were used to indicate acceptable model fit in the CFA: goodness-of-fit index (GFI) ≥ 0.85, adjusted goodness-of-fit index (AGFI) ≥ 0.80,

root mean square residual (RMR) > 0.10, and comparative fit index (CFI) > 0.90 (Byrne, 2001).

Evidence of the construct validity was assessed by Pearson-product correlation between the BPSS-10 and perceived health and with perceived effect of the work on physical and mental health. In general, we expected that perceived stress would be negatively correlated with perceived health and with workload perception.

Reliability was assessed by internal consistency (Cronbach's alpha) and test–retest (intraclass correlation-R) with seven days test–retest. Data were entered into Epidata v. 2.01 (Epidata Association, n.d.) with automatic checks for range and consistency. The EFA and reliability analyses were performed using SPSS® 11.0 (manufacturer: SPSS Inc.) and the CFA was performed with AMOS 5.0 (manufacturer SPSS Inc.). All analyses employed a significance level of 5 percent.

Results

Basic socio-demographics and lifestyle habits are shown in Table 1. Participants were university teachers (57.5% men) with a mean age of 45.5 years (SD = 8.0). Overall, participants were of high or medium SES, non-smokers and reported being in good health. However, almost half of the participants were overweight. There were no significant differences between the split samples in any of the demographics and lifestyle variables.

Table 1. Characteristics of participants in the study

Variable	*Sample1 (n = 388)*	*Sample 2 (n = 389)*	*Whole sample (n = 793)*
Age – years (*M* and SD)	44.9 (8.0)	46.0 (8.0)	45.5 (8.0)
Men (%)	58.9	56.0	57.5
Socioeconomic level (%)			
A (high)	39.7	38.9	39.4
B (medium)	53.6	58.0	55.8
C (low)	6.7	3.1	4.8
Smokers (%)	9.9	12.0	10.9
Positive health (%)	9.5	10.5	10.2
Overweight or obese (%)	43.3	41.4	42.3

The EFA showed that a rotated factor solution for the BPSS-10 (Table 2) contained two factors with eingenvalues greater than 1.0 and accounting for 56.8 percent of variance. Factor 1 contained six items (30.6% of variance) and Factor 2 contained four items (26.1% of variance). The amount of variance explained was slightly greater in Factor 1. All item loadings were greater than 0.6 with exception of item 6. Factor correlation between Factor 1 and Factor 2 was 0.66. Factors were labeled accordingly

Table 2. Exploratory factor analysis and reliability coefficients of BPSS-10 (*n* = 393)

	BPSS items	*Factor loadings*	
		Factor 1	*Factor 2*
1	… been upset because of something that happened unexpectedly?	**0.77**	0.15
2	… unable to control the important things in your life?	**0.65**	0.38
3	… felt nervous and 'stressed'?	**0.75**	0.21
4	…confident about your ability to handle your personal problems?	0.21	**0.72**
5	… felt that things were going your way?	0.24	**0.70**
6	… found that you could not cope with all the things that you had to do?	**0.51**	0.37
7	… been able to control irritations in your life?	0.19	**0.69**
8	… felt that you were on top of things?	0.29	**0.78**
9	… been angered because of things that were outside of your control?	**0.73**	0.18
10	… felt difficulties were pilling up so high that you could not overcome them?	**0.65**	0.33
Eingenvalue		4.62	1.05
% variance		30.68	26.19
Cronbach's alpha coefficient		0.83	0.77
		0.87	
Intraclass coefficient (CI) (*n* = 24)		0.83	0.68
		0.86	

Table 3. Goodness-of-fit from confirmatory factor analysis

Model	*GFI*	*AGFI*	*RMR*	*CFI*
Model 1	0.91	0.88	0.07	0.88
Model 2	0.94	0.90	0.05	0.92

in accordance with the answers to their questions as 'Positive Statements' (Factor 1) and 'Negative Statements' (Factor 2).

The Cronbach's alpha coefficients (Table 2) were 0.83, 0.77 and 0.87 for Factor 1, Factor 2 and Total Score (Perceived Stress), respectively. The test–retest reliability scores (r) were 0.83 (Factor 1), 0.68 (Factor 2) and 0.86 (Perceived Stress). Factor 2 had the lower intra-class and alpha coefficients.

The CFA goodness-of-fit measures are presented in Table 3. Model 1 (see Figure 1 in the Appendix), which replicate the first order factor structure extracted in EFA, were all adequate with the exception of CFI (0.88), which was slightly lower than the criterion. The standardized regressions ranged from 0.62 to 0.72 for Factor 1 and from 0.56 to 0.70 to Factor 2. Between-factors correlation was 0.68.

Model 2 (see Figure 2 in the Appendix), was designed to test to what extent a single second-order factor (Perceived Stress), influences the two first-order factors. Goodness-of-fit measures (Table 3) were all adequate, according the employed criteria. The standardized regressions for Factor 1 indicators ranged from 0.53 to 0.72 and from 0.63 to 0.75 in Factor 2 indicators. The Perceived Stress standardized regression was 0.89 for Factor 1 and 0.74 for Factor 2.

The correlations between perceived stress and perceived health and with perceived effect of the work on physical and mental health are presented in Table 4. All correlations were negative and significant ($p < 0.005$), ranging from 0.22 to 0.35. However, the correlations for Factor 1 were greater and more significant than those observed for Factor 2. As expected, correlations for the Perceived Stress score were higher than those observed in the two sub-scales.

Table 4. Spearman Correlations of BPSS-10 to health perception (HEALTH), perceived effect of the work on mental health (MENT) and perceived effect of the work on physical health (PHYS)

Scale	*HEALTH*	*MENT*	*PHYS*
Factors 1 (negative stress)	–0.35	–0.30	–0.22
Factor 2 (positive stress)	–0.31	–0.29	–0.22
Perceived stress	–0.37	–0.32	–0.24

[a] $p < 0.05$

Discussion

The understanding of stress in the Brazilian population is limited because of a lack of reliable and practical stress measures. To the authors' knowledge this is the first study to translate the PSS-10 into Portuguese and examine its psychometric characteristics in an adult Brazilian sample. Overall, the results showed adequate psychometric performance, supporting its use in this population.

The results of the EFA showed a two-factor solution with factor loadings similar to those presented in other studies (Cohen & Williamson, 1988; Hewitt, Flett, & Mosher, 1992; Martin, Kazarian, & Breiter, 1995), supporting the findings in the original study (Cohen & Williamson, 1988). Factor 1 was composed of six negative items, whereas Factor 2 was composed of four positive items. This structure was also observed in the original study (Cohen & Williamson, 1988) and another PSS-10 translated version (Mimura & Griffiths, 2004).

The reliability analysis showed alpha coefficients similar to those observed in the original study (Cohen & Williamson, 1988) and even higher than those reported in other studies (Cohen et al., 1983; Cohen & Williamson, 1988; Cole, 1999; Glaser et al., 1999). The test–retest reliability for Perceived Stress was good, according the recommendation elsewhere (Weir, 2005); however, as other studies have reported only Pearson-product correlation (Cohen et al., 1983; Cole, 1999), comparisons are limited. Overall, the reliability scores showed less support for Factor 2 than Factor 1.

The CFA showed that the two correlated solution (Figure 1) had slightly poorer fit compared to the higher-order solution (Figure 2), with similar results to those reported in another study (Golden-Kreutz et al., 2004). Golden-Kreutz et al. (2004) suggested that the two factors provided by the PSS-10 do not share similar content and they express 'negative feelings resulting from stress' and 'emotions/feelings counter to stress'. However, PSS-10 authors suggested that any distinction between these factors is irrelevant (Cohen & Williamson, 1988) and they only reflect the sentence structures of the scale. In fact, reliability analysis and construct validity evidence provided no support for the employment of two separate sub-scales in the present population.

In the present study Perceived Stress seems to reflect a 'mental workload' rather than a 'physical workload', which is compatible with teachers' complaints (Blix, Cruise, & Mitchel, 1994) and also with the teachers' job stress research (Kyriacou, 1997; Smith & Bourke, 1992). These results provide some evidence of construct validity that is also supported by the significant and negative correlation with perceived health measures.

Some methodological aspects of our study should be considered. We have tested the instrument in a highly educated sample and therefore generalization to other audiences is limited. Construct validity was limited to self-reported measures comparisons and the use of more objective stress markers could improve the evidence of this validity. In order to overcome such limitations we suggest testing BPSS-10 in a more educationally diverse sample and also the use of more objective measures to further improve its the psychometric quality. Some strengths of the study should also be noted. We have examined BPSS-10 psychometric quality through a variety of techniques providing more robust evidence for its use. For instance, some studies have reported EFA (Cohen & Williamson, 1988; Hewitt et al., 1992; Martin et al., 1995; Mimura & Griffiths, 2004) and one study reported CFA (Golden-Kreutz et al., 2004) but we have not found any study reporting these two techniques at the same time. We also verified test–retest reliability using intra-class correlation, which has not been reported in other studies that analyzed this reliability evidence.

In conclusion, the Brazilian version of the PSS (BPSS-10) presented the same factor structure observed in other languages. The measure scale showed good reliability, for both internal consistency and test–retest stability indexes, and also acceptable evidence for construct validity. The findings support the use of BPSS-10 in stress-related research conducted with adults.

Appendix

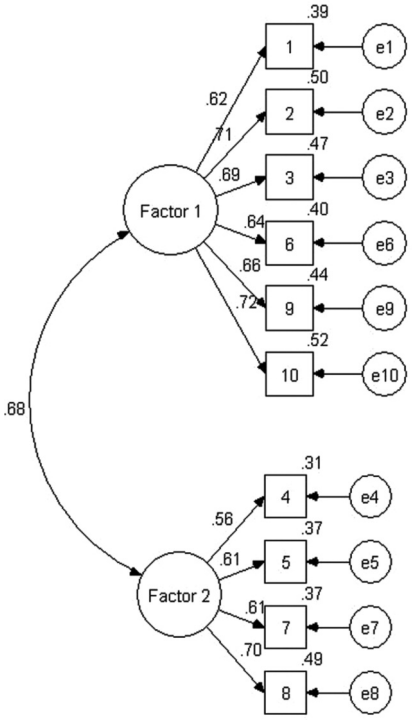

Figure 1.

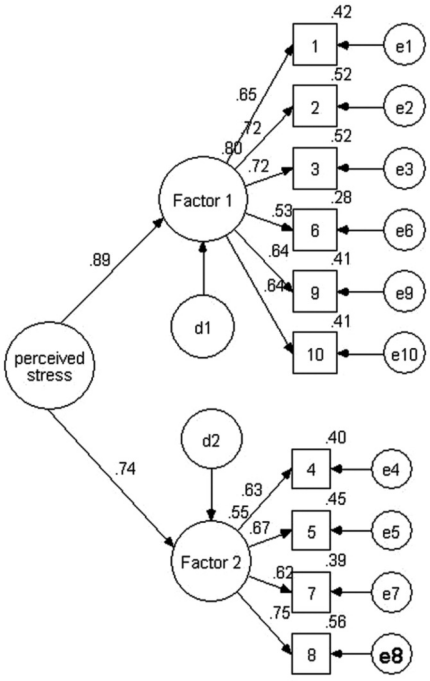

Figure 2.

References

ANEP. (2002). *Brazilian criteria for economic classification*. Retrieved 9 may 2008, from http://www.abep.org.

Blix, A. G., Cruise, R. J., & Mitchel, B. M. (1994). Occupational stress among university teachers. *Educational Research*, *36*(2), 157–169.

Byrne, B. N. (2001). *Structural equation modeling with AMOS*. Rahwah, NJ: Lawrence Erlbaum.

Carrobles, J. A. I., & Remor, E. A. (2001). Version Espanola de la escala de estres percibido (PSS-14): Estudio psicometrico en una muestra VIH+ [Spanish version of the perceived stress scale (PSS-14): Psychometric study in an HIV+ sample]. *Ansiedad y estrés*, *7*(2–3), 195–201.

Centers for Disease Control and Prevention. (2004). *Behavioral Risk Factor Surveillance System Survey Questionnaire*. Retrieved 3 April 2008, from http://www.cdc.gov/BRFSS/

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*(4), 385–396.

Cohen, S., Tyrrell, D. A., & Smith, A. P. (1993). Negative life events, perceived stress, negative affect, and susceptibility to the common cold. *Journal of Personality and Social Psychology*, *64*(1), 131–140.

Cohen, S., & Williamson, G. (1988). Perceived stress in a probability sample of the United States. In S. Spacapan & S. Oskamp (Eds.), *The social psychology of health* (pp. 31–68). Newbury Park, CA: Sage.

Cole, S. R. (1999). Assessment of differential item functioning in the Perceived Stress Scale-10. *Journal of Epidemiology and Community Health*, *53*(5), 319–320.

Cooper, C. L., & Payne, R. (1988). *Causes, coping and consequences of stress at work*. New York, NY: Wiley.

Dougall, A. L., & Baum, A. (2001). Stress, health and illness. In A. Baum, T. A. Revenson, & J. E. Singer (Eds.), *Handbook of health psychology* (pp. 321–337). Manwah, NJ: Lawrence Erlbaum.

EpiData Association. (2000–09) EpiData Software [free computer software]. Retrieved 24 August 2009, from http://www.epidata.dk/index.htm

Eskin, M., & Parr, D. (1996). *Introducing a Swedish version of an instrument measuring mental stress* [report]. Department of Psychology, University of Stockholm.

Ettner, S. L., & Grzywacz, J. G. (2001). Workers' perceptions of how jobs affect health: A social ecological perspective. *Journal of Occupational Health Psychology*, *6*(2), 101–113.

Glaser, R., Kiecolt-Glaser, J. K., Marucha, P. T., MacCallum, R. C., Laskowski, B. F., & Malarkey, W. B. (1999). Stress-related changes in proinflammatory cytokine production in wounds. *Archives of General Psychiatry*, *56*(5), 450–456.

Golden-Kreutz, D. M., Browne, M. W., Frierson, G. M., & Andersen, B. L. (2004). Assessing stress in cancer patients: A second-order factor analysis model for the Perceived Stress Scale. *Assessment*, *11*(3), 216–223.

Grava-Gubins, I., & Scott, S. (2008). Effects of various methodologic strategies: Survey response rates among Canadian physicians and physicians-in-training. *Canadian Family Physician*, *54*(10), 1424–1430.

Hewitt, P. L., Flett, G. L., & Mosher, S. W. (1992). The perceived stress scale: Factor structure and relation to depression symptoms in a psychiatric Sample. *Journal of Psychopathology and Behavioral Assessment*, *14*(3), 247–257.

Holmes, T. H., & Rahe, R. H. (1967). The Social Readjustment Rating Scale. *Journal of Psychosomatic Research*, *11*(2), 213–218.

Kyriacou, C. (1997). Teacher stress and burnout: An international review. *Educational Research*, *29*(2), 146–152.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal and coping*. New York: Springer.

Lee, S., & Crockett, M. S. (1994). Effect of assertiveness training on levels of stress and assertiveness experienced by nurses in Taiwan, Republic of China. *Issues in Mental Health Nursing*, *15*(4), 419–432.

Martin, P. D., & Brantley, P. J. (2002). Stress, coping and social support in health and behavior. In S. B. Johnson, N. W. Perry, & R. H. Rozensky (Eds.), *Handbook of clinical health psychology: Disorders of behavior and health* (1st ed.; pp. 233–268). Washington, DC: American Psychological Association.

Martin, R. A., Kazarian, S. A., & Breiter, H. J. (1995). Perceived stress, life events, dysfunctional attitudes, and depression in adolescent psychiatric inpatients. *Journal of Psychopathology and Behavioral Assessment*, *17*(1), 81–95.

Mezzacappa, E. S., Guethlein, W., Vaz, N., & Bagiella, E. (2000). A preliminary study of breast-feeding and maternal symptomatology. *Annals of Behavioral Medicine*, *22*(1), 71–79.

Mimura, C., & Griffiths, P. (2004). A Japanese version of the perceived stress scale: translation and preliminary test. *International Journal of Nursing Studies*, *41*(4), 379–385.

Muller, L., & Spitz, E. (2003). Multidimensional assessment of coping: Validation of the Brief COPE among French population. *Encephale*, *29*(6), 507–518.

Otto, M. W., Fava, M., Penava, S. J., Bless, E., Muller, R. T., & Rosenbaum, J. F. (2004). Life event, mood, and cognitive predictors of perceived stress before and after treatment for major depression. *Cognitive Therapy and Research*, *21*(4), 409–420.

Pett, M. A., Lackey, N. R., & Sullivan, J. J. (2003). *The use of factor analysis for instrument development in health care research*. Thousand Oaks, CA: Sage.

Smith, M., & Bourke, S. (1992). Teacher stress: Examining a model based on context, workload and satisfaction. *Teacher and Teaching Education*, *8*(1), 31–46.

Song, C., Kenis, G., van Gastel, A., Bosmans, E., Lin, A., de Jong, R., et al. (1999). Influence of psychological stress on immune-inflammatory variables in normal humans. Part II: Altered serum concentrations of natural anti-inflammatory agents and soluble membrane antigens of

monocytes and T lymphocytes. *Psychiatry Research*, *85*(3), 293–303.

Stowell, J. R., Kiecolt-Glaser, J. K., & Glaser, R. (2001). Perceived stress and cellular immunity: When coping counts. *Journal of Behavioral Medicine*, *24*(4), 323–339.

Vijver, F. V. d., & Hambleton, R. K. (1996). Translating tests: Some practical guidelines. *European Psychologist*, *1*(2), 89–99.

Weir, J. P. (2005). Quantifying test–retest reliability using the intraclass correlation coefficient and the SEM. *Journal of Strength & Conditioning Research*, *19*(1), 231–240.

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