

A Japanese version of the perceived stress scale: translation and preliminary test

Chizu Mimura, Peter Griffiths*

*Florence Nightingale School of Nursing and Midwifery, King's College, University of London,
57 Waterloo Road, London SE1 8WA, UK*

Received 5 May 2003; accepted 30 October 2003

Abstract

This paper describes the development of a Japanese version of the Perceived Stress Scale (PSS). Four independent Japanese translations were made and used to develop a single Japanese version. This was back-translated into English. Discrepancies between the original and the back-translation were identified. The Japanese version was altered accordingly, and again back-translated. This forward-backward process was repeated until satisfactory agreement was attained.

The PSS was administered to 38 native English speakers and the Japanese version (PSSJ) to 23 native Japanese. High Cronbach's alpha coefficient was shown for both versions. Factor analysis revealed that the PSS and PSSJ showed an almost identical factor structure. Therefore, the equivalence between the PSS and PSSJ and the validity for each scale was underpinned.

© 2003 Elsevier Ltd. All rights reserved.

Keywords: Stress measurement; Cross-cultural translation; Internal consistency; Construct validity

1. Introduction

This paper describes the development of a Japanese version of a stress measure for use in a cross-cultural study of antecedents of work-related stress amongst nurses. There are a number of models for conceptualising stress which broadly fall into one of the following three categories: those looking at external stressors; those focusing on responses to stress; and those emphasising the interaction between individual appraisals of the demand imposed and of his/her capability (Cox, 1986). However, there is a growing consensus that stress develops from an imbalance between the individual's perception of situational demand and of his/her

own ability to cope with the demand. That is to say the experience of stress is dependent upon the interaction between the individual and the external stressor.

There is a diversity of scales for quantifying the level of stress, and each scale's conceptual and operational definition of stress can also be classified according to the above categorisation. Many attempt to measure the frequency of specific stressful events that the respondent has experienced within a particular environment. One such example is the Nursing Stress Scale (Gray-Toft and Anderson, 1981). Others assess the intensity of stress induced by particular events, such as the Life Event Scale (Holmes and Rahe, 1967) and the Occupational Stress Indicator (Cooper et al., 1988). However, both these stress measurements measure stress purely in terms of external stressors thereby requiring that there is a common perception of that which is potentially stressful. Also, stress caused by specific events cannot be simply separated from stress emanating from other sources, for example, personal stress may increase work-related

*Corresponding author. Primary and Intermediate Care Section, Nightingale School of Nursing and Midwifery, King's College London, 57 Waterloo Road, London SE1 8WA, UK. Tel.: +44-207-848-3012; fax: +44-207-872-3219.

E-mail address: peter.griffiths@kcl.ac.uk (P. Griffiths).

stress (Lewis et al., 1994) because perceived ability to cope may be diminished. Furthermore, a scale that measures stress in relation to specific events runs the risk of being inherently culture bound since that which is perceived as stressful to one group may not be to another.

An ideal stress measurement for a cross-cultural study should, therefore, assess the individual's global perception of stress rather than stress related to specific events. The Perceived Stress Scale (PSS) created by Cohen et al. (1983) is one of the few instruments to measure a global level of perceived stress, dealing with the degree to which situations in one's life are appraised as stressful. It is a 14-item scale that assesses perceived stressful experience or stress responses over the previous month. Each item is on a five-point Likert format which requires scoring of 4=never, 3=almost never, 2=sometimes, 1=fairly often and 0=very often for items stating positive experiences or response. Reverse scoring is required for items stating negative experiences or response. Total possible scores are from 0 to 56. Higher scores represent high stress levels.

There is an abundant literature reporting reliability and validity. The creators reported convergent validity indicated by relationships with depressive ($r = 0.76$, $n = 332$) and physical ($r = 0.70$, $n = 64$) symptomatology scales. Internal consistency reliability was high with Cronbach's alpha coefficient ranging from 0.84 ($n = 332$) to 0.86 ($n = 64$) (Cohen et al., 1983).

The PSS has subsequently been used in a range of settings and has been shown to relate to a number of physiological and psychological responses. Scores on the PSS are associated with depressive symptoms (Chang, 1998; Otto et al., 1997), measures of depression (Band et al., 1998; Treadgold, 1999) and anxiety and psychosomatic complaints (van Eck and Nicolson, 1994). The PSS scores are also related to biochemical responses such as anti-inflammatory response (Song et al., 1999), antibody status (Burns et al., 2002), and use of antidepressant (Fava et al., 1996). The PSS has been utilised not only for measuring levels of stress, but also for evaluating the effect of interventions to reduce stress (Chen et al., 2000) and has been used as a reference standard for examining validity of new stress measures (Levenstein et al., 1993).

A major present gap in cross-cultural research on health outcomes is that most measurements have been developed in English-speaking countries and there are relatively few measurements which have been properly constructed or appropriately translated and evaluated in non-English-speaking cultural settings (Hutchinson et al., 1996). The PSS has been translated into several languages including Spanish (Department of Psychology, 2002), Swedish (Eskin and Parr, 1996) and Chinese (Lee and Crockett, 1994). Thus it has particular value in cross-cultural studies since it has been used in a wider range of cultures than most measures. Nevertheless there

is no evaluated Japanese version. This paper reports the development of a translated Japanese version of the PSS and preliminary testing for reliability and validity. Permission to translate the PSS into Japanese was granted by the developer, Professor Sheldon Cohen. The study was conducted under the aegis of a wider study which had been ethically scrutinised and approved by the author's institutional ethical committee.

2. Translation

The repeated forward-backward translation procedure was adopted as it is most commonly quoted in the adaptation and translation process (Meadows et al., 1996) and was considered to be the best within the strategies which were pragmatically possible. In this procedure a forward translation is made from the source original language to the target new language. The target language version is then translated back into the source language and compared to the original version. Errors in the target language version are identified through changes in meaning that arise in the back translation.

This procedure does however have notable limitations. The most severe of these is the fact that back translation (from target language to source) is just as error prone as forward translation (from source to target). Thus the back translation does not represent a gold standard against which to judge the new translated measurement (Meadows et al., n.d.). Errors in the back translation can be the result of correct translation of an erroneous target version—the purpose of back translation, but can also result from translation errors in the backward translation itself. Alternatively the backward translation can erroneously correct errors in the target version and thus create the impression that the target version is correct.

It is also important to establish that the translation has both semantic and conceptual equivalence. Semantic equivalence refers to the need to avoid literal translation in order to ensure equivalence of meaning. For example the English phrase "I am feeling low" is used to refer to a negative mood state whereas a literal translation into some languages may refer only to a relative vertical position or may refer to different experiences in others. Literal translation into Japanese of item 10 of the PSS "in the last month, how often have you felt that you were on top of things?" is quite unnatural and has connotations of arrogance and conceit (rather than coping) and conveys a relatively bad impression to most Japanese people. Such an item would have gained low scores irrespective of being stressed or relaxed. Therefore, item 10 in the PSSJ is phrased as: "in the last month, how often have you felt that you have well controlled things?" (as literally translated back into English).

Conceptual equivalence is more problematic but relates to the fact that some notions, ideas or experiences may simply not exist in the target language. It is difficult to offer direct examples since those who comprehend a language recognise the concept and struggle to understand how it could be absent as opposed to simply a translation difficulty. Such concepts are most easily illustrated with reference to concepts that have moved across cultures but have retained linguistic expression in a foreign language. In English, the French language phrase “sang-froid” is used to refer to a constellation of qualities such as freedom from agitation or excitement of mind, coolness in trying circumstances, indifference and calmness. None of these single English expressions fully captures the concept. Currently the concept is recognised only through language that remains recognisably “foreign”. One may well imagine that this behavioural disposition or quality was itself unrecognised by English speaking cultures (which rarely suffer from a lack available words) at some point in the past. This particular expression can also be used to illustrate the pitfalls of literal translation. The literal translation of “sang-froid” is “cold blood” which has clear connotations of cruelty not implied by the original.

Meadows et al., n.d. recommend that steps are taken to ensure semantic and conceptual equivalence. They recommend the use of bilingual translators but note that this may induce a bias of representativeness in both cultures since those with such skills may not be typical of the population as a whole and are likely to have a very specific academic training. Translators should be aware of the purpose of the exercise and are recommended to have some prior experience of the process although this too raises questions of the representativeness of any translations. Multiple forward backward translations are recommended in order to identify errors, as is a process whereby difficulties are identified and discussed at all stages. A “multi-disciplinary” committee should review and verify the cross-cultural equivalence before pre-testing of the measurement. This paper reports on the implementation of this process for the PSS.

2.1. Procedures

The procedure was broadly divided into four phases. Phase 1 was to make four Japanese translated versions of the original scale and unify these four. Phase 2 was to produce a back-translated version. Phase 3 was to check the equivalence between the original scale and the back-translated version. Phase 4 was to continue forward and backward translation until satisfactory equivalence was agreed.

In Phase 1, four married couples of a British and a Japanese are separately asked to translate the original scale into Japanese while discussing among the husband and wife about content, semantic and conceptual

equivalence between the original and their translation. All the four couples happened to be of a male British and a female Japanese. They were fully informed of the objectives of their role in the whole procedure.

The four couples were selected in accordance with the following criteria:

1. They are a couple of a native English speaker and a native Japanese speaker.
2. They were reared and educated either in English in an English-speaking country or in Japanese in Japan until at least 18 years old.
3. They have spent more than 5 years together since they married.

These criteria were used for the purpose of the use of translators who are familiar with both their own language and cultural background and that of the alternative language.

The use of married couples was based on the opportunity such couples present for exchanging a native speaker’s insight in ways of expression in different languages among an intimate couple without the bias of representativeness introduced by restricting translators to those with a formal academic training. None of the individuals involved were professional translators. Thus it was hoped that a more equivalent translation would be produced, using language and meaning which would also be more representative of the wider cultures, than by a bilingual person or highly trained translators.

One of the authors (CM whose first language is Japanese) unified the four Japanese translations created by this process into a single translated version. Selection among alternative Japanese translations was based upon perceived “naturalness” of the linguistic expression in the Japanese language version.

In Phase 2, a further couple with a native English speaker and a native Japanese speaker, both blinded to the original scale, was identified. They were asked to back-translate the Japanese version produced in Phase 1. Again, they were not professional translators, and were required to discuss content, semantic and conceptual equivalence and to emphasise meaning rather than word-to-word translation.

In Phase 3, five university lecturers at the authors’ college (native English speakers) compared the original scale and the back-translation brought about by Phase 2, and checked for semantic discrepancies. In Phase 4, the author altered the Japanese expression of the parts found to be problematic in Phase 3 with reference to any alternatives rejected in Phase 1. The couple used in Phase 2 re-translated them into English. One of the panel used in Phase 3 checked discrepancies between the original scale and the re-translation. Detailed discussion of cultural difference and nuance ensured semantic equivalence and aimed to overcome conceptual differences by identifying parallel concepts

that might be perceived as stressful. This process was repeated until problems were resolved.

3. Assessment of equivalence, reliability and validity

3.1. Method

A small-scale investigation was conducted to examine reliability and validity for the PSS Japanese version (PSSJ). The original PSS was administered on native English speakers in London and the PSSJ on native Japanese speakers in a suburb of Tokyo. The data collected were statistically analysed using SPSS 10.1 for Windows in terms of internal consistency reliability and construct validity. This allows the technical performance of scores on the translated measure to be tested and its conceptual equivalence examined through scrutiny of its factor structure.

3.2. Respondents

Nursing students undertaking postgraduate programmes were recruited from a university in each country. For English data, 38 students responded to the PSS, of whom 8 were male (21.1%) and 30 were female (78.9%). Ages ranged from 22 to 53 and the mean age was 34.4 ($SD = 8.0$). As for Japanese data, 23 students responded to the PSSJ, 3 were male (13.0%) and 20 were female (87.0%). Ages ranged from 25 to 50 and the mean was 34.9 ($SD = 7.1$). The response rate in the UK and Japan was 92.7% and 100%, respectively.

3.3. Data collection

After permission for access to the students was granted from the head of department and the course leader, the investigator visited the students in a room before or after a lecture and distributed the questionnaire to them. The students were informed verbally of the research project, procedures and ethical implications involved. The questionnaires were distributed to those who agreed to participate in the study and returned in the envelopes provided immediately after they finished completing the questionnaire in the room. The data collection procedure was exactly same in the UK and Japan.

4. Results

4.1. Internal consistency

In order to examine the extent to which all the items in the PSS and PSSJ represent the same phenomena within the sample, Cronbach's alpha coefficient was calculated.

The analysis showed 0.88 for the PSS and 0.81 for the PSSJ, both are acceptable and very close to the figures identified for the original version which was from 0.84 to 0.86 (Cohen et al., 1983) and 0.80 (Hewitt et al., 1992).

4.2. Construct validity

An exploratory factor analysis was deployed to compare the relationships among the items between the PSS and PSSJ, which is thought to indicate the extent to which the two instruments actually reflect the same construct within the sample. A principal component analysis was performed in which the largest two factors were extracted and rotated by the Varimax method. The two-factor solution was used as this had been identified in the original (Hewitt et al., 1992; Martin et al., 1995) and the prime aim here was to establish equivalence.

The items and their loadings on each factor are presented in Table 1. In terms of the original PSS, the rotated two factors explained 53.2% of the variance. Eight items loaded highly on the first factor which explained 27.3% (Items 1, 2, 3, 7, 8, 11, 12, 14). The second factor accounted for 25.9% of the variance. Six items highly loaded (Items 4, 5, 6, 9, 10, 13). Cronbach's alpha coefficient was calculated for these two factors: 0.84 for the first factor and 0.81 for the second factor.

For the translated PSSJ, the rotated two factors accounted for 49.9% of the variance. On the first largest factor, which accounted for 28.5%, seven items highly loaded, these were Items 1, 2, 3, 8, 11, 12 and 14. The second factor explained 21.4% of the variance and Items 4, 5, 6, 7, 9, 10 and 13 correlated most highly with it. Cronbach's alpha coefficient was 0.73 for the first factor and 0.85 for the second factor.

5. Discussion

Discussion on meanings of words among an intimate couple of a native English speaker and a Japanese native speaker is, as far as we are aware, novel in the formal cross-cultural translation of psychometric scales and may greatly contribute to the equivalence between the original and target language versions. However such couples are likely to differ from the population in general. The translation might, therefore, be biased although professional translators and those who generate the original items on such scales are equally unlikely to represent the general population.

The results of the two-factor solution suggested by Hewitt et al. (1992) showed that the PSS and PSSJ are similar in item loading on factors (Table 1). Hewitt et al. also performed factor analysis of the PSS with the two-factor solution using 96 psychiatric patients. The factor structure and loading in their study are very close to that

Table 1
Loading of each item on factors extracted

Item No.	Statement	Attitude	PSS ^a (present study: <i>n</i> = 38)		PSSJ ^b (present study: <i>n</i> = 23)		PSS ^a (Hewitt et al, 1992: <i>n</i> = 96)	
			Factor I	Factor II	Factor I	Factor II	Factor I	Factor II
1	In the last month, how often have you been upset because of something that happened unexpectedly?	–	0.63	0.27	0.56	–0.21	0.74	0.03
2	In the last month, how often have you felt that you were unable to control the important things in your life?	–	0.66	0.42	0.42	0.42	0.79	0.10
3	In the last month, how often have you felt nervous and/or stressed?	–	0.78	0.15	0.77	0.09	0.80	0.14
4	In the last month, how often have you dealt successfully with irritating life hassles?	+	–0.13	0.81	0.14	0.71	–0.27	0.68
5	In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?	+	0.09	0.78	0.17	0.73	0.16	0.83
6	In the last month, how often have you felt confident about your ability to handle your personal problems?	+	0.31	0.72	0.54	0.58	0.34	0.65
7	In the last month, how often have you felt that things were going your way?	+	0.51	0.47	0.01	0.85	0.49	0.38
8	In the last month, how often have you found that you could not cope with all the things that you had to do?	–	0.56	0.22	0.42	0.11	0.66	–0.02
9	In the last month, how often have you been able to control irritations in your life?	+	0.39	0.65	–0.18	0.70	0.12	0.63
10	In the last month, how often have you felt that you were on top of things?	+	0.41	0.54	0.15	0.61	Not reported	Not reported
11	In the last month, how often have you been angered because of things that happened that were outside of your control?	–	0.60	0.49	0.58	0.39	0.55	–0.24
12	In the last month, how often have you found yourself thinking about things that you have to accomplish?	–	0.56	–0.35	0.59	–0.07	Not reported	Not reported
13	In the last month, how often have you been able to control the way you spend your time?	+	0.33	0.47	–0.07	0.80	Not reported	Not reported
14	In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	–	0.77	0.09	0.81	0.04	0.66	0.33
Factor label			Negative perception	Positive perception	Negative perception	Positive perception	Perceived distress	Perceived coping
			0.84	0.81	0.73	0.85	0.81	0.72
Cronbach's alpha coefficient			0.88		0.81		Not reported	

^aPSS, administered on native English speakers.

^bTranslated Japanese version of the PSS, administered on native Japanese speakers.

in the present study, and correlation of each item to the factor is generally high (Table 1).

Hewitt et al. (1992) labelled the first factor as “perceived distress” since it included items referring directly to negative affective reactions although it also included items tapping general feelings of lack of control. In contrast, the second factor was labelled as “perceived coping” as it consisted of items reflecting a perception of an ability to cope with extant stress. Indeed, the first factor includes items of negative experience except for Item 7, and the second factor consists of items stating positive experience (Table 1). The negative statements in the PSS, in effect, are apt to give an impression of being distressed, and the positive statements tend to give an impression of being able to cope with stressful things.

In the present study, the PSSJ showed that the first factor consists of all items of negative experience and the second factor consists of all items of positive experience. As for the PSS, only Item 7 was different, which was included in the first factor in spite of an item stating positive experience. However, on scrutinising the factor loading, Item 7 has substantial correlation with both the factors. It could be regarded that Item 7 equally loaded on the two factors. Therefore, the factors can be labelled as “negative perception” and “positive perception” respectively although the Hewitt et al.’s (1992) “perceived distress” and “perceived coping” can still work for the factors in the present study even though the additional items that were not reported by them are involved. Cronbach’s alpha of each factor was high in both the PSS and PSSJ. This suggests that all these factors are internally consistent. However, the relatively small samples in the present study mean that the results of the factor analysis should be treated with caution.

As has been discussed, a number of efforts were made to produce a Japanese translation of the PSS as equivalent as possible and high internal consistency reliability and construct validity was obtained. However, influence of cultural differences on the experience of stress cannot be eliminated. What causes stress would differ although this is largely eliminated by the measurement’s focus on the stress response. The expression of the stress response may also differ but since the translation process was based on meaning, it identified concepts that were similar to those identified in the original version and recognised that these concepts were related to stress in the target culture. However it is difficult to ensure that the precise valence of these responses (in terms of the amount of stress experienced) is equivalent.

Additionally, it would be quite natural to find a difference in the level of stress between different cultures no matter how equivalent are the measurements by which stress is measured. Thus, if research aims to compare the level of stress, use of scales like the PSS and

PSSJ would no doubt be a problem. Reference can only be made to population norms within a given culture/language group. However the PSS and PSSJ are suitable tools where it is aimed to explore the concept within a group or compare the inter relationship of concepts between groups.

The subjects used in the preliminary test were convenience samples and sample size was relatively small. Specifically they were nursing postgraduate students and predominantly female. The results may, therefore, be affected by biases resulting from social status, gender or very specific factors relating to the level or subject of study. A larger scale investigation using probability sample would ideally resolve this although in reality scale validation tends to proceed in a somewhat ad hoc manner as evidenced by the limited evidence on the factor structure of the original PSS. It is important that those using this scale in new populations assure themselves of its internal consistency and factor structure.

6. Conclusion

This study has confirmed the internal consistency of scores on the original PSS and identified similar reliability in scores on the translated PSSJ. However reliability is a necessary but not sufficient indicator of successful translation. The equivalence between the PSS and PSSJ is further supported through a near identical factor structure and factor loadings on items. We conclude that the PSSJ is a suitable tool for the study of perceived stress among native Japanese speakers and that there is sufficient evidence of the equivalence of the PSS and PSSJ to consider them as equivalent in cross-cultural studies.

References

- Band, D.A., Edelman, R.J., Avery, S., Brinsden, P.R., 1998. Correlates of psychological distress in relation to male infertility. *British Journal of Health Psychology* 3 (3), 245–256.
- Burns, V.E., Drayson, M., Ring, C., Carroll, D., 2002. Perceived stress and psychological well-being are associated with antibody status after meningitis C conjugate vaccination. *Psychosomatic Medicine* 64 (6), 963–970.
- Chang, E.C., 1998. Does dispositional optimism moderate the relation between perceived stress and psychological well-being?: A preliminary investigation. *Personality and Individual Differences* 25 (2), 233–240.
- Chen, C.H., Tseng, Y.F., Chou, F.H., Wang, S.Y., 2000. Effects of support group intervention in postnatally distressed women: a controlled study in Taiwan. *Journal of Psychosomatic Research* 49 (6), 395–399.

- Cohen, S., Kamarck, T., Mermelstein, R., 1983. A global measure of perceived stress. *Journal of Health and Social Behavior* 24, 385–396.
- Cooper, C.L., Sloane, S.J., Williams, S., 1988. Occupational Stress Indicator Data Supplement. NFER-Nelson, Windsor.
- Cox, T., 1986. *Stress*. Macmillan Education, London.
- Department of Psychology, Carnegie-Mellon University, 2002. Escala de Estres Percibido: Perceived Stress Scale. Online <http://kungfu.psy.cmu.edu/~scohen/pssspanish14item.html>
- Eskin, M., Parr, D., 1996. Introducing a Swedish version of an instrument measuring mental stress. Reports from the Department of Psychology, U Stockholm 813, pp. 1–9
- Fava, M., Davidson, K., Alpert, J.E., Nierenberg, A.A., 1996. Hostility changes following antidepressant treatment: relationship to stress and negative thinking. *Journal of Psychiatric Research* 30 (6), 459–467.
- Gray-Toft, P., Anderson, J.G., 1981. The nursing stress scale: development of an instrument. *Journal of Behavioral Assessment* 3 (1), 11–23.
- 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, 247–257.
- Holmes, T.H., Rahe, R.H., 1967. The social adjustment scale. *Journal of Psychosomatic Medicine* 11, 213–218.
- Hutchinson, A., Bentzen, N., Konig-Zahn, C., 1996. An international approach to ambulatory care health outcome assessment. In: Hutchinson, A., Bentzen, N., Konig-Zahn, C. (Eds.), *Cross Cultural Health Outcome Assessment: A User's Guide*. European Research Group on Health Outcomes, United Kingdom, pp. 9–11.
- 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, 419–432.
- Levenstein, S., Prantera, C., Varvo, V., Scribano, M.L., 1993. Development of the Perceived Stress Questionnaire: a new tool for psychosomatic research. *Journal of Psychosomatic Research* 37 (1), 19–32.
- Lewis, S.L., Bonner, P.N., Campbell, M.A., Cooper, C.L., Willard, A., 1994. Personality, stress, coping, and sense of coherence among nephrology nurses in dialysis settings. *ANNA Journal* 21 (6), 325–335.
- Martin, R.A., Kazarian, S.S., 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.
- Meadows, K., Bentzen, N., Touw-Otten, F., 1996. Cross-cultural issues: an outline of the important principles in establishing cross-cultural validity in health outcome assessment. In: Hutchinson, A., Bentzen, N., Konig-Zahn, C. (Eds.), *Cross Cultural Health Outcome Assessment: A User's Guide*. European Research Group on Health Outcomes, United Kingdom, pp. 34–40.
- Otto, M.W., Fava, M., Penava, S.J., Bless, E., 1997. Life event, mood, and cognitive predictors of perceived stress before and after treatment for major depression. *Cognitive Therapy and Research* 21 (4), 409–420.
- Song, C., Kenis, G., van Gestel, A., Bosmans, E., Lin, A., De Jung, R., Neels, H., Scharpe, S., Janca, A., Yasukawa, K., Maes, M., 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.
- Treadgold, R., 1999. Transcendent vocations: their relationship to stress, depression, and clarity of self-concept. *Journal of Humanistic Psychology* 39 (1), 81–105.
- van Eck, M.M., Nicolson, N.A., 1994. Perceived stress and salivary cortisol in daily life. *Annals of Behavioral Medicine* 16 (3), 221–227.