Is Anatomy Exam Really So Stressful for Dentistry and Medical Students?

Renata Gržić, Sabina Saltović, Ivanka Živčić Bećirević
University of Rijeka, Rijeka, Croatia

Test-taking situation is a stressful situation in which many students experience negative emotions associated with significant neurohormonal (changes in cortisol level) and physiological changes (psychosomatic symptoms). The aim of this study was to explore the relationship between trait anxiety, test anxiety, cortisol level, psychosomatic symptoms, perception of test difficulty, and final grade. The investigation was conducted with 116 first-year dentistry and medical students while taking a very difficult written examination in anatomy course. Just before the exam, they filled in Test Anxiety Inventory, provided saliva samples, assessed the level of difficulty of the exam and the grade they expected. Immediately after the exam, they filled in Subjective Health Complaints Inventory and a week after the exam, they filled in State-Trait Anxiety Inventory and stated the grade they achieved. Exam results had significant effect on the level of trait anxiety and the assessment of exam difficulty, but there was no significant effect of exam difficulty on test anxiety and psychosomatic symptoms. Trait anxiety and test anxiety explained 49% of variance in psychosomatic symptoms. Although there were only five samples of cortisol that were analyzed in the laboratory, the level of salivary cortisol showed significant positive correlation with overall psychosomatic symptoms. Although there is no difference in expressing test anxiety and psychosomatic symptoms between successful and unsuccessful students, there is a significant contribution of test anxiety to discomfort caused by psychosomatic symptoms. There is a need for reorganization of teaching classes and exam in anatomy course.

Keywords: anatomy course, trait anxiety, test anxiety, test difficulty, psychosomatic symptoms

Introduction

Anatomy is a basic course taught in the first year of study of dentistry, using traditional teaching methods and it is a subject of ABSTD (Association of Basic Science Teachers in Dentistry) debate. Even though the courses underwent the process of harmonization with the EU (European Union) directives, a process set out by the EU as a part of accession negotiations, at the School of Medicine in Rijeka, anatomy course is still taught in a classic way and it has not been integrated within clinical courses. It is taught during the first year of dentistry study consisting of 150 teaching hours which are held in rounds over a period of two months. It has 17.5 ECTS (European Credit Transfer and Accumulation System) points. It is also taught in the first year of medicine consisting of 241 teaching hours taught over a period of two trimesters, i.e., 20 weeks of classes. Students

Renata Gržić, Ph.D., professor, Department of Dentistry, School of Medicine, University of Rijeka.

Sabina Saltović, mag.psych., Department of Psychology, Faculty of Humanities and Social Sciences, University of Rijeka.

Ivanka Živčić Bećirević, Ph.D., professor, Department of Psychology, Faculty of Humanities and Social Sciences, University of Rijeka.

obtain points by taking different types of examination. The minimum number of points which allows them to take the final exam is 40%. After reviewing the number of successful candidates who pass the exam, it has been noted that this is an exam with the poorest test performance. Only 50% of students pass the exam. Given the fact that this exam has been regarded among the generations of students as extremely stressful, we wanted to examine additionally the way in which students perceive it.

When taking an exam, many students experience fear, discomfort, restlessness, tension and insecurity caused by the anticipation of possible danger, i.e., they become anxious. Anxiety is usually defined as a displeasing emotional state followed by activation of autonomic nervous system, i.e., physiological changes which include rapid heartbeat, increased blood pressure, and bodily tension (Spielberger & Vagg, 1995). People who are high in trait anxiety perceive greater number of situations as threatening or dangerous. That is why they express more intense state of anxiety compared to people who are low in trait anxiety (Jezova, Makatsori, Duncko, Moncek, & Jakubek, 2004).

Fear of examination or test anxiety comprises of cognitive (negative, underestimating thoughts), emotional (feeling of tension and fear), physiological (perception of autonomous arousal), and behavioral responses (study skills, procrastination) to evaluative situations (Hong, 1998; Putwain, Woods, & Symes, 2010; Sarason, 1980). Students with high test anxiety are always prone to react negatively to an exam in the form of excessive preoccupation, anxiety, and low self-esteem, due to the nature of the exam which they perceive as threatening and which might bring about negative consequences (Keogh & French, 2001).

Given that anxiety occurs as a reaction to an anticipated or real stressful event, it is related to certain changes in organism which occur during stressful period (Jezova et al., 2004). The most important physiological changes happen in the autonomic nervous system and endocrine system (Havelka, 1998) where SAM (sympathetic-adrenal-medullary) axis and HPAC (hypothalamic-pituitary-adrenocortical) axis are being activated. SAM axis releases catecholamines into the bloodstream, adrenalin and noradrenalin being the most prominent ones, and HPAC axis is responsible for the release of glucocorticoids, namely cortisol. Compared to SAM axis which is activated immediately after the stressful situation, HPAC axis controls delayed responses to stressful situation primarily through cortisol (Hudek-Knežević & Kardum, 2006; Takai, Yamaguchi, Aragaki, Eto, Uchihashi, & Nishikawa, 2004) whose level in the organism is the highest 30 minutes after the stressful situation (Hellhammer & Hellhammer, 2008).

Test-taking situation is an example of stressful situation in which significant neurohormonal changes occur and thus, changes in cortisol level should follow accordingly (Al-Ayadhi, 2005; Martinek, Oberascher-Holzinger, Weishuhn, Klimesch, & Kerschbaum, 2003). However, results obtained by examining the relationship between test situation and cortisol response are not consistent, even though test situations are perceived by students as stressful. Some studies show increased cortisol responses to stressful test situations (Allen et al., 1985; Frankenhaeuser et al., 1978; Lacey, Zaharia, Griffiths, Ravindran, Merali, & Anisman, 2000; Lovallo, Pincomb, Edwards, Brackett, & Wilson, 1986; Lucini, Norbiato, Clerici, & Pagani, 2002). For example, Elizabeth, Dayananda, Kusumadevi, Sunil, Sujayasri, and Suhas (Elizabeth, Dayananda, Kusumadevi, Sunil, Sujayasri, & Suhas, 2009) showed increased levels of cortisol in the first-year medical students before the exam compared to post-stressful situation. Al-Ayadhi (2005) obtained similar results, while other studies report decreased cortisol levels during an exam. For example, Vedhara, Hyde, Gilchrist, Tytherleigh, and Plummer (2000) observed that the exam period was associated with an increase in perceived stress levels, but also a reduction in cortisol levels. Some research even revealed no changes in cortisol levels due to stress

(Glaser, Pearl, Kiecolt-Glaser, & Malarkey, 1994).

Apart from physiological changes, such as the change in cortisol level, there are also “visible” physiological changes which students can perceive. Students who experience test situation as extremely stressful are tense and in that emotional state tend to focus more on their internal bodily signs. They can notice different physiological changes, i.e., psychosomatic symptoms (Havelka, 1998) or subjective health problems (Eriksen, Ihlebæk, & Ursin, 1999) as a reaction to stress. Psychosomatic symptoms refer to symptoms experienced by the individual without a defined diagnosis or somatic disease (Haugland, Wold, Stevenson, Aaroe, & Woynarowska, 2001; Torsheim & Wold, 2001). In literature, test anxiety is often stated as characteristic which predisposes individuals to react negatively to an exam (Keogh & French, 2001; Zeidner, 1991). Psychosomatic symptoms are one of the negative outcomes of such predisposition. It has been determined that the test period is associated with an increase in stress experience and also with higher levels of self-reported symptoms (Glaser et al., 1987). A student perceives test situation as threatening and therefore develops emotional reactions such as dissatisfaction, fear, or worry. Such emotions are mediators in relation between academic stressors and psychosomatic symptoms, because they are responsible for physiological and behavioral changes connected with the psychosomatic symptoms (Hjern, Gösta, & Östberg, 2008; Natvig, Alberktzen, Anderssen, & Qvarnstrøm, 1999).

If they continue to occur over a longer period of time, psychosomatic symptoms can develop into various somatic diseases and cause permanent damage to body system and organs (Havelka, 1998). Also, they are often the major symptoms of psychiatric problems such as depression, personality disorders, and anxiety (Haugland et al., 2001).

The aim of this study was to explore the relationship between trait anxiety, test anxiety, level of cortisol, psychosomatic symptoms, perception of test difficulty, and final grade. Additionally, it wanted to investigate the difference between the students who passed the exam from those who did not.

Materials and Methods

Participants

One hundred and sixteen students (70 females and 46 males), ages 18-22 years, who enrolled in the first year at the School of Medicine in Rijeka in the academic year 2010/2011 participated in the study. They were students of integrated undergraduate and graduate university course in medicine ($N = 89$) and students of integrated undergraduate and graduate university course in dental medicine ($N = 27$).

Instruments

Saliva sample was used in the laboratory analysis of cortisol to obtain physiological measurement of students' anxiety level just before taking an exam. Laboratory procedure of determining the level of salivary cortisol was based on the use of monoclonal antibodies to cortisol which are competitively bound to cortisol. Research was based on EIA (enzyme immunoassay), and for that purpose, 96-well microtitration plate with a flat bottom shape which adsorbed specific monoclonal antibodies was used. Reference values of salivary cortisol range between 0.112 to 0.743 $\mu\text{g/dL}$ for men and between 0.272 to 1.348 $\mu\text{g/dL}$ for women who are both 21 to 30 years of age. In this research, only 5 out of 116 samples were processed due to insufficient amount of saliva in other samples.

STAI (State-Trait Anxiety Inventory; Spielberger, 2000) was used to examine relatively stable individual

differences in tendency to anxiety. The level of trait anxiety was assessed using a 5-point Likert-type scale whereby the examinees assess the way they generally feel (0 = "I never feel that way"; 4 = "I almost always feel that way"). Higher score indicates higher level of trait anxiety. The questionnaire shows high reliability on this particular sample (Cronbach's $\alpha = 0.92$).

TAI (Test Anxiety Inventory; Taylor & Deane, 2002) was used to measure the frequency of experiencing specific anxiety symptoms which occur before, during and after different exams. Apart from using the questionnaire to measure general level of test anxiety, it can also be used to measure levels of emotional (physiological) and cognitive test anxiety (worry). However, in this research a single factor inventory was used. The level of test anxiety was assessed using a 4-point Likert-type scale (0 = "Never"; 3 = "Very often, almost always"). Higher score indicates higher level of test anxiety. A high level of reliability of the questionnaire has been determined (Cronbach's $\alpha = 0.94$).

SHC (Subjective Health Complaints Inventory; Eriksen et al., 1999) assess the intensity of subjective psychical and psychological symptoms. In the original version of the inventory the symptoms cluster into five subscales: musculoskeletal (e.g., arm pain, neck pain), pseudoneurological (e.g., anxiety, tiredness), gastrointestinal (e.g., stomach discomfort, diarrhoea), allergic (e.g., breathing difficulties, eczema), and flu-like symptoms (e.g., cough, cold). The examinees had to report to what extent they have been affected by each of these symptoms in the past seven days using a 5-point Likert-type scale (0 = "Not at all"; 4 = "A lot"). It is possible to render the result as a linear sum of examinees' assessment given on a particular subscale and as a sum of answers on all the items of the inventory that provides information on the intensity of all psychosomatic symptoms. Higher score indicates higher intensity of psychosomatic symptoms occurrence. For the purpose of this research, the overall result of the Subjective Health Complaints Inventory was used as a measure of intensity of psychosomatic symptoms occurrence. This questionnaire shows high reliability (Cronbach's $\alpha = 0.92$).

Procedure

The investigation was carried out in groups in a situation of taking a very difficult written examination in anatomy course. It was divided into three phases. Just before the exam scheduled for 9 am, examinees filled in TAI and provided saliva samples that were stored in cups and kept at a -20°C until the laboratory analysis. Examinees were asked to assess the level of difficulty of the exam on 4-point scale and to state the grade they expect to achieve. Out of 108 students that stated their perception of test difficulty, 40 said that the exam was very difficult, 48 considered it as pretty difficult, 24 as somewhat difficult and just one student found the exam not difficult at all. Immediately after the exam, examinees filled in SHC. A week after the exam they filled in STAI and stated the grade they achieved. Out of 91 students who stated their grade, 33 of them failed the exam (36%), while 58 students passed it (64%).

Results

To determine the correlation between examined variables, Pearson correlation coefficient was calculated. Results are shown in Table 1.

As expected, psychosomatic symptoms positively correlate with trait anxiety and test anxiety. Expected grade and final grade show significant positive correlation. Final grade is also negatively correlated with perception of test difficulty as well as with trait anxiety, but not test anxiety. Although there were only five

samples of cortisol that were analyzed in the laboratory, the level of salivary cortisol showed significant positive correlation with overall psychosomatic symptoms.

Table 1

Correlation Between Examined Variables

	1	2	3	4	5	6	7
1. Perception of test difficulty	1						
2. Grade expected	-0.39**	1					
3. Final grade	-0.36**	0.60**	1				
4. Trait anxiety	0.22*	-0.28**	-0.34**	1			
5. Test anxiety	0.25*	-0.24*	-0.20	0.59**	1		
6. Psychosomatic symptoms	0.04	-0.13	0.03	0.55**	0.68**	1	
7. Cortisol	0.20	-0.10	0.30	0.40	0.66	0.97**	1

Note. * $p < 0.05$, ** $p < 0.01$.

In order to determine the difference in the level of trait anxiety, test anxiety, perception of test difficulty, and psychosomatic symptoms between the students who failed the exam and those who passed, a one-way ANOVA (analysis of variance) for independent groups was conducted. Analysis determined that there is a significant effect of exam results on the level of trait anxiety. Students who failed the exam showed higher level of trait anxiety compared to those students who passed it. Furthermore, it has been established that exam results have significant effect on the assessment of exam difficulty. Students who failed the exam assessed it as more difficult than those students who passed the exam. There is no significant effect of exam difficulty on test anxiety and psychosomatic symptoms. Results are shown in Table 2.

Table 2

Difference Between Students Who Passed and Those Who Failed the Exam in Trait Anxiety, Test Anxiety, Perception of Test Difficulty and Psychosomatic Symptoms

	<i>F</i>	Students who failed the exam			Students who passed the exam		
		<i>N</i>	<i>M</i>	<i>Sd</i>	<i>N</i>	<i>M</i>	<i>Sd</i>
Trait anxiety	$F_{(1,79)} = 8.41^{**}$	26	37.69	11.21	55	29.47	12.22
Perception of test difficulty	$F_{(1,83)} = 9.77^{**}$	32	2.47	0.67	53	1.94	0.79
Test anxiety	$F_{(1,79)} = 0.44$	26	31.77	10.4	55	29.99	11.74
Psychosomatic symptoms	$F_{(1,83)} = 0.15$	31	27.39	17.30	54	28.98	18.33

Note. ** $p < 0.01$.

In order to determine contribution of trait anxiety and test anxiety to psychosomatic symptoms, a hierarchical regression analysis was performed. Trait anxiety was introduced first, given that it represents stable and more permanent disposition variable, and then test anxiety as a more specific individual characteristic was introduced. These two predictors explain 49% of variance in psychosomatic symptoms. Trait anxiety proved to be a significant positive predictor of psychosomatic symptoms, explaining 30% of variance in criteria. Contribution of trait anxiety in explaining variance in psychosomatic symptoms although lower, remained significant after introducing test anxiety. Apart from trait anxiety, test anxiety is a significant positive predictor of psychosomatic symptoms, explaining additional 19% of variance in psychosomatic symptoms. Table 3 shows the results of the hierarchical regression analysis.

Table 3

Results of Hierarchical Regression Analysis for the Psychosomatic Symptoms Criteria

Psychosomatic symptoms				
Predictors		Beta	ΔR^2	R^2
1st step	Trait anxiety	0.55**	0.30**	0.30**
2nd step	Trait anxiety	0.22*	0.19**	0.49**
	Test anxiety	0.55**		

Notes. ΔR^2 : contribution of single predictor group to explained variance; R^2 : overall contribution to explained variance; * $p < 0.05$, ** $p < 0.01$.

Discussion

Generations of students of the School of Medicine in Rijeka have regarded the anatomy exam as extremely stressful. In order to verify such claims, we conducted a research with first-year medical students and first-year students of dental medicine.

As expected, students who were more anxious while taking the exam, perceived it as difficult, expected to achieve lower grade and were more affected by psychosomatic symptoms compared to students who were less anxious. In addition, they tend to be more anxious in different situations.

Furthermore, students who tend to be more anxious in different situations and who perceived the exam as difficult were more troubled by psychosomatic symptoms and expected to achieve a lower grade and indeed, their final grade was lower when compared to students who were less anxious.

Cortisol, as a physiological measure of stress, is significantly correlated with the intensity of psychosomatic symptoms in students. Given that only five salivary cortisol samples were analyzed, we can conclude that among those five students those who had higher level of cortisol were more troubled by psychosomatic symptoms. However, more samples should be analyzed in order to reach more reliable conclusion.

Students who achieved lower grade, perceived the exam as difficult and expected their grade to be lower compared to students who achieved a higher final grade.

Results of differences in the level of trait anxiety, test anxiety, perception of test difficulty, and the intensity of psychosomatic symptoms occurrence between students who passed the exam and those who did not, show that students who did not pass the exam are higher in trait anxiety and show more negative perception of test difficulty compared to students who passed the exam. There are no difference in the level of test anxiety and discomfort caused by psychosomatic symptoms that depend on exam results, even though students in this study express relatively higher test anxiety ($M = 31.16$; $SD = 12.02$) compared to students of humanities and social sciences at the University of Rijeka who took a difficult exam ($M = 26.51$; $SD = 10.55$) (Juretić, 2008).

Exam results might be influenced by considerable amount of material that is being examined through both oral and written examination. Written examination is a precondition to take the oral examination and to pass the written examination 50% of questions should be answered correctly.

Although on average, students do not assess to be highly disconcerted by psychosomatic symptoms (average assessment of each questionnaire section is 1.02), the research determined that there is a significant contribution of trait anxiety to the explanation of the psychosomatic symptoms occurrence. Apart from trait anxiety, test anxiety is a significant positive predictor of psychosomatic symptoms. Students who generally tend to be more anxious will experience a higher level of anxiety during the exam, i.e., they will be more

worried and will show a tendency to notice their physiological changes. Students who experience higher test anxiety are more disturbed by different psychosomatic symptoms compared to those who express lower test anxiety. This result is in accordance with findings of previous research on increased likelihood of psychosomatic symptoms occurrence in exam situations in students who express higher test anxiety (Glaser et al., 1987; Greene & Walker, 1997; Poikolainen, Kanerva, & Lonnqvist, 1995). As stated in the introduction, exam period is connected with an increased experience of stress and with higher level of self-evaluated disease symptoms (Glaser et al., 1987).

When interpreting research results and reaching a conclusion, it is necessary to mention certain research limitations. First of all, this type of measuring physiological changes is incomplete because our physiological system is so complex that just one measure of physiological functioning does not reflect the real image of our body when it is in a stressful situation. Moreover, there is a flaw in methodology of cortisol analysis because various factors that affect its level have not been controlled. Also, saliva sample was only taken in a stressful situation so there is no data on referential basic level of cortisol among participants.

Other measurements were conducted in the form of questionnaires and represent measures of self-report so it is inevitable to avoid the attempt of the participants to present themselves in the best possible way thus providing socially desirable answers.

Conclusion

Although there is no difference in expressing test anxiety and discomfort caused of psychosomatic symptoms between successful and unsuccessful students, results indicate that there is a significant contribution of test anxiety to discomfort caused by psychosomatic symptoms. It is possible that the high level of discomfort before the exam does not interfere with test achievement that much, but rather it contributes to subjective student's suffering which manifests through different psychosomatic symptoms.

This data indicates the need to reorganize teaching classes and the examination in anatomy course. It could be divided into smaller parts with smaller number of ECTS points thus reducing the students' workload and subsequent stress.

We propose that further research carries out an experimental verification of effects that different test administration could have on the success and the intensity of psychosomatic symptoms on the generations to come.

References

- Al-Ayadhi, L. (2005). Neurohormonal changes in medical students during academic stress. *Ann Saudi Med*, 25(1), 4-36.
- Allen, P. I., Batty, K. A., Dodd, C. A., et al. (1985). Dissociation between emotional and endocrine responses preceding an academic examination in male medical students. *J. Endocrinol*, 107(2), 163-170.
- Elizabeth, J., Dayananda, G., Kusumadevi, M. S., Sunil, K. C., Sujayasri, S., & Suhas, S. (2009). The response of serum cortisol and leptin levels to academic stress. *Online J. Health Allied Scs.*, 8(3), 7. Retrived March 30th, 2011, from <http://www.ojhas.org/issue31/2009-3-7.htm>
- Eriksen, H. R., Ihlebæk, C., & Ursin, H. (1999). A scoring system for subjective health complaints. *Scand J. Public Health*, 27, 63-72.
- Frankenhaeuser, M., Rauste, von Wright M., Collins, A., Von Wright, J., Sedvall, G., & Swahn, C. G. (1978). Sex differences in psychoneuroendocrine reactions to examination stress. *Psychosomat Med*, 40(4), 334-343.
- Glaser, R., Pearl, D. K., Kiecolt-Glaser, J. K., & Malarkey, M. B. (1994). Plasma cortisol levels and reactivation of latent Epstein-Barr virus in response to examination stress. *Psychoneuroendocrinology*, 19(8), 765-772.

- Glaser, R., Rice, J., Sheridan, J. et al. (1987). Stress-related immune suppression: Health implications. *Brain Behav Immun*, 1(1), 7-20.
- Greene, J. W., & Walker, L. S. (1997). Psychosomatic problems and stress in adolescence. *Pediatr. Clin. North Am.*, 44(6), 1557-1572.
- Haugland, S., Wold, B., Stevenson, J., Aaroe, L. E., & Woynarowska, B. (2001). Subjective health complaints in adolescence: A cross-national comparison of prevalence and dimensionality. *Eur. J. Public Health*, 11(1), 4-10.
- Havelka, M. (1998). *Zdravstvena psihologija*. Jastrebarsko: Naklada Slap.
- Hellhammer, D. H., & Hellhammer, J. (2008). *Stress: The brain-body connection*. Basel: Karger.
- Hjern, A., Gösta, A., & Östberg, V. (2008). School stressors, psychological complaints and psychosomatic pain. *Acta Paediatrica*, 97, 112-117.
- Hong, E. (1998). Differential stability of individual differences in state and trait test anxiety. *Learning and Individual Differences*, 10(1), 51-69.
- Hudek-Knežević, J., & Kardum, I. (2006). *Psihosocijalne odrednice tjelesnog zdravlja: Stres i tjelesno zdravlje*. Jastrebarsko: Naklada Slap.
- Jezova, D., Makatsori, A., Duncko, R., Moncek, F., & Jakubek, M. (2004). High trait anxiety in healthy subjects is associated with low neuroendocrine activity during psychosocial stress. *Prog Neuropsychopharmacol Biol Psychiatry*, 28(8), 1331-1336.
- Juretić, J. (2008). Socijalna i ispitna anksioznost te percepcija samoefikasnosti kao prediktori ishoda ispitne situacije. *Psihologijske teme*, 17(1), 15-36.
- Keogh, E., & French, C. C. (2001). Test anxiety, evaluative stress, and susceptibility to distraction from threat. *Eur. J. Pers.*, 15, 123-141.
- Lacey, K., Zaharia, M. D., Griffiths, J., Ravindran, A. V., Merali, Z., & Anisman, H. (2000). A prospective study of neuroendocrine and immune alterations associated with the stress of an oral academic examination among graduate students. *Psychoneuroendocrinology*, 25(4), 339-356.
- Lovallo, W. R., Pincomb, G. A., Edwards, G. L., Brackett, D. J., & Wilson, M. F. (1986). Work pressure and the type A behavior pattern exam stress in male medical students. *Psychosom Med*, 48(1-2), 125-133.
- Lucini, D., Norbiato, G., Clerici, M., & Pagani, M. (2002). Hemodynamic and autonomic adjustments to real life stress conditions in humans. *Hypertension*, 39(1), 184-188.
- Martinek, L., Oberascher-Holzinger, K., Weishuhn, S., Klimesch, W., & Kerschbaum, H. H. (2003). Anticipated academic examinations induce distinct cortisol responses in adolescent pupils. *Neuroendocrinol Lett*, 4(6), 449-453.
- Natvig, G. K., Albrektsen, G., Anderssen, N., & Qvarnström, U. (1999). School-related stress and psychosomatic symptoms among school adolescents. *Journal of School Health*, 69(9), 362-368.
- Poikolainen, K., Kanerva, R., & Lonnqvist, J. (1995). Life events and other risk factors for somatic symptoms in adolescence. *Pediatrics*, 96(1), 59-63.
- Putwain, D. W., Woods, K. A., & Symes, W. (2010). Personal and situational predictors of test anxiety of students in post-compulsory education. *British Journal of Educational Psychology*, 80, 137-160.
- Sarason, I. G. (1980). *Test anxiety: Theory, research, and applications*. Hillsdale, New Jersey: Lawrence Erlbaum.
- Spielberger, C. D. (2000). *Priručnik za upitnik anksioznosti kao stanja i osobine ličnosti*. Jastrebarsko: Naklada Slap.
- Spielberger, C. D., & Vagg, P. R. (1995). *Test anxiety: Theory, assessment, and treatment*. Washington, D. C.: Taylor & Francis.
- Takai, N., Yamaguchi, M., Aragaki, T., Eto, K., Uchihashi, K., & Nishikawa, Y. (2004). Effect of psychological stress on the salivary cortisol and amylase levels in healthy young adults. *Arch Oral Biol*, 49(12), 963-968.
- Taylor, J., & Deane, F. P. (2002). Development of short form of the Test Anxiety Inventory—TAI—Statistical data included. *Journal of General Psychology*, 129(2), 127-136.
- Torsheim, T., & Wold, B. (2001). School-related stress, school support, and somatic complaints: A general population study. *J. Adolesc Res.*, 16(3), 293-303.
- Vedhara, K., Hyde, J., Gilchrist, I. D., Tytherleigh, M., & Plummer, S. (2000). Acute stress, memory, attention and cortisol. *Psychoneuroendocrinology*, 25(6), 535-549.
- Zeidner, M. (1991). Test anxiety and aptitude test performance in an actual college admissions testing situation: Temporal considerations. *Person Indiv. Diff.*, 12(2), 101-109.