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EDUCATION & TRAINING

Analysis of Psychophysiological Stress Response in Higher Education Students Undergoing Clinical Practice Evaluation

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Abstract

The aim of this study was to analyze the psychophysiological response of Physiotherapy degree students during a complete clinical practice as well as their psychological profile in relation to coping style in stressful situations, and its impact on academic performance. We analysed in 15 students heart rate variability (HRV) to analyse autonomic modulation in three moments during the entire clinical practices of 3 months (4 h per day, 3 days per week), first session, middle session and last session; perceived stress, personality, life engagement, cognitive flexibility before starting the clinical practice the academic performance after the clinical practice. Results based on HRV and related indexes parameters fail to indicate the expected autonomic adaptation during the practice. A complete clinical practice of Physiotherapy degree students did not produce an habituation process since a high sympathetic autonomic nervous system modulation was measured in the beginning, at the middle and at the final of the clinical practice. Below-average scores are presented in a personality factor associated with traditional and non-adaptive coping styles that could explain the non-habituation of the students. Finally, none of the analyzed indexes has been able to relate to academic performance.

Keywords Autonomic modulation · Stress · HRV · Personality · Psychology

Introduction

The application of simulation scenarios in the learning process in health science degrees is extended, especially in Physiotherapy studies, since students must face the professional clinical environment and for this they need to have assimilated valuable theoretical and practical knowledge [1–3]. This academic experience allows students to acquire therapeutic and professional skills that will be essential in their professional future due to the repeated exposure that facilitates the acquisition of the habituation process [4, 5]. This experience tried to offer a real but controllable environment where the students could face a clinical situation as in real future situations with the advantage of not putting a person at risk. This event is stressful, and students must value the demands of the environment and its tools to cope with them, which causes a stress response due to the student's perception of the uncontrollability of the environment. The impact produced by this acute stress response has been studied in other areas such as sport or the military context, showing how the stress response negatively affects the correct neuronal functioning in prefrontal regions, thereby affecting complex processes such as memory, decision-making and the learning process itself [6]. This stress response led to an increase in sympathetic autonomic modulation [7–9], a fact previously associated with the alteration of hippocampal areas related to superior cortical functions [10–13]. It was also found that acute stress produces a reduction in blood flow in the prefrontal cortex, decreasing the

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effectiveness of the executive functions associated with clinical practice [14].

Increased stress response in clinical simulation scenarios may have a negative effect on student academic performance due to the negative impact on communication between neurons in the hippocampus, amygdala, or hypothalamus [14–18]. Therefore, the repetition of the students' exposure to these scenarios would allow them to improve their performance during practice and would facilitate the acquisition of professional skills necessary for future work such as rapid and effective decision making, risk assessment, therapeutic relationship, teamwork, etc. The evaluation of stress response using portable biotechnology devices in simulated clinical scenarios has previously been used to show the efficacy of showing the individual response of the hypothalamic-hypophysis-adrenal axis, specifically by analyzing heart rate (HR) and heart rate variability (HRV) [1, 4–8, 19]. This is a relatively simple, non-invasive methodology and provides an objective measurement tool for the assessor that includes variations in the autonomic modulation of students during the entire clinical trial or simulated scenario [11, 20].

Other crucial factor that could affect the psychophysiological response of student in stressful scenarios as practices, is the psychological profile, since it is known that certain personality traits and specific attitudes could impact directly on the response in these situations [21]. In this line, different construct as resilience and stress coping strategies could have a direct impact in health science practices scenarios. Competence factors such as the ability to solve problems, cognitive flexibility, organization, collaboration or decision making will be significant. The effectiveness to show skills during the development of clinical practice will be determined in part by the competence profile of each student [20, 21]. Then, we proposed the present research with the objective of to analyze the psychological profile and autonomic stress response of Physiotherapy students during a clinical practice and their relationship with academic performance. The initial hypothesis was that students would show a habituation process, decreasing the sympathetic nervous system activity, and that students with higher resilience and stress coping strategies would present the lower sympathetic nervous system activity.

Material and methods

Participants

We analyzed 15 Physiotherapy degree students. 33.3% men and 66.6% women. They were between 21 and 36 years old (M = 24.29; SD = 3.71). All the participants filled an informed consent form in accordance with the Helsinki Declaration guidelines. All students have the same experience in coping with clinical practices, so the acquisition of competencies was done under the same conditions.

Design and procedure

We analyzed student in three moments during the entire clinical practices of 3 months (4 h per day, 3 days per week), first session, middle session and last session. In each single session, autonomous modulation by the HRV and subjective perception of distress strait were analyzed during the first 3 min (basal measure) (M0), the first tenth (M1), the fifth tenth (M2) and the last tenth (M3) of the session, analyzing in addition the delta values for these moments. Finally, we had 11 evaluation moments during the 3 practices session analyzed (Fig. 1). In practices, students had to conduct different manual therapy methodologies to deal with different pathologies.

Measures and procedure

Physiological measures

HRV R-R interval of the heart beat was used as measured of autonomic modulation, as measured with a Polar V800 heart rate monitor (Polar, Kempele, Finland) consistently with previous research [22]. The R-R series was analysed using the Kubios HRV software (version 2.0, Biosignal Analysis and Medical Imaging Group, University of Kuopio, Finland), developed in accordance with the recommendations of the existing scientific literature [23]. This software has demonstrated it is extremely valid, and capable of registering non-linear trends that are often presented in registers of variation in the time interval between beats (R-R) [24].

PNN50 Percentage of differences between normal adjacent R-R intervals greater than 50 ms.

RMSSD The square root of the average of the sum of the differences squared between normal adjacent.

SD1 Sensitivity of the short-term variability of the non-linear spectre of the HRV.

SD2 Long-term variability of the non-linear spectre of the HRV.

Psychological measurements

Subjective scale of distress (SUDS) Ranging from zero (0), which implies "*Completely indifferent and cold; does not affect me*" to one hundred (100), which means "*So distressed and tense that I can't deal with it"* This scale will be applied in the 5 min before the start of the session and provides information based on the level of stress assessed by the

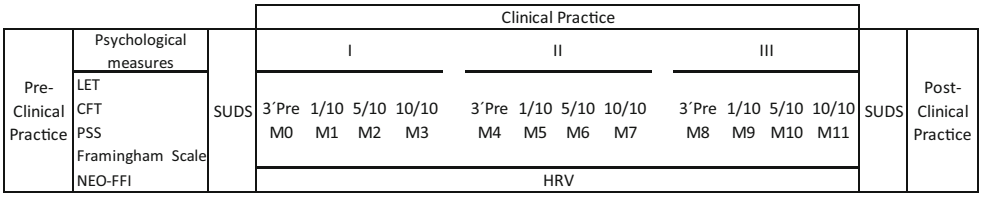

Fig. 1 Research design. Note: Moment (M), Heart rate variability (HRV), Life Engagement Test (LET), The Coping Flexibility Scale (CFS), Perceived Stress Scale (PSS), NEO Five-Factor Inventory (NEO-FFI), SUDS (Subjective units of distress)

individual and which represents the cognitive relationship between the objective event and the emotional response [25].

Life engagement test (LET) This scale consist on 6 items and it was designed to measure the purpose of people in life. In this line, this scale analyzes the degree of involvement of the person in activities that are important within their daily surroundings. An example item is: "*For me, all the things I do deserve the punishment."* Answers on a Likert scale of 1 to 5 where 1 = Strongly disagree and 5 = Strongly agree [26].

The coping flexibility scale (CFS) This scale was designed to measure the flexibility in coping to different situations. Refers to the presence of adaptive coping strategies that are associated with a better psychological health. This test has 10 items and is answered on a Likert scale of 1 to 4, being 1 = Very applicable and 4 = Not applicable. An example item is: "*I am aware of the success or failure of my attempts to deal with stress*" [27].

Perceived stress scale (PSS) This scale assesses the level of perceived stress in a one-month period. Composed of 14 items that are answered in a five-point Likert scale, where 0 = Never and 4 = Very often. An example item is: "*In the last month, how often have you felt that had everything under control*?". High scores are related with a higher perception of stress [28].

Framingham type a behaviour scale This questionnaire consists of 10 items which assess the personality type associated with certain behaviours that differ from conventional patterns, as well as its relationship with different alterations in health. Are responded to in a Likert-type scale of five points, where 1 = never and 4 = very often. An example item is: "*During the student day, do you feel very pressed for time?"* [29].

NEO five-factor inventory (NEO-FFI) This scale assesses the personality, through the analysis of five factors of personality: Neuroticism, Extraversion, Openness, Kindness and Responsibility. Composed of 60 items (condensed version), this scale is answered by a five-point Likert scale, where 0 = Strongly disagree and 4 = Strongly agree. An example item is: "*3. Sometimes, when I read poetry or contemplate a work of art, I feel a deep emotion or excitement*" [30].

Data analysis

All data analyses were done using the Statistical Package for the Social Sciences, version 23 for Windows (IBM Spain, Madrid, Spain). Descriptive were analysed for each variable (M, Md, DT) and a multivariate analysis was carried out to evaluate the effect of the sessions, of moments during the session and of their possible interaction on the physiological and psychological measurements analysed. The Tukey test was used for ad-hoc comparisons. The signification level was 0.05.

Results

We found an increased in parameters PNN50 between M0 vs. M6; SD1 between M0 vs. M6 and M4 vs. M6; SD2 between M0 vs. M6, M1 vs. M6, M1 vs. M7, M1 vs. M10, M1 vs. M11. and a decrease in HF values between M7 vs. M11 (Table 1).

The SUDS decreased their value from 59.3 ± 11.6 to 39.3 ± 10.9 after the clinical practice, and the academic performance of students in this subject was 7.90 ± 3.43 points over 10. There is no correlation between the variables analyzed and the academic performance of the students. The group presents significantly high scores on the Perceived Stress Scale (M = 38,53 ± 6.80) and significantly lower scores on the personality factor Openness (O). The students obtained (27.4 ± 2.50) in Life Engagement Test, (19.6 ± 2.84) in The Coping Flexibility Test, (38.53 ± 6.80) in PSS, (28 ± 7.20) in Framingham Type A Behaviour Scale and (145.8 ± 17.94) in NEO-FFI.

Discussion

The aim of this study was to analyze the psychological profile and autonomic stress response of Physiotherapy students during a clinical practice and their relationship with academic performance. The initial hypothesis was not fulfilled because an increase in the parasympathetic response was not found.

In the first session of the physiotherapy students we found a high anxiety anticipatory response since PNN50, RMSSD, SD1 and SD2 presented low values. This response was similar than athletes before competition or militaries previous combat

Table 1 Differences in the measures through the clinical practice

	SESSION I				SESSION II			
	3 min pre M0	1/10 M1	5/10 M2	10/10 M3	3 min pre M4	1/10 M5	5/10 M6	10/10 M7
PNN50 (No.)	6.61 ± 7.30	6.47 ± 7.17	5.64 ± 6.29	9.51 ± 39.01	6.21 ± 7.98	7.42 ± 10.85	9.29 ± 12.45	10.12 ± 57.82
RMSSD (ms)	25.68 ± 12.27	28.62 ± 11.57	30.72 ± 11.50	34.11 ± 43.83	27.18 ± 21.24	35.28 ± 19.34	38.38 ± 17.83	46.71 ± 49.59
SD1 (ms)	15.97 ± 10.97	20.59 ± 12.95	171.59 ± 222.65	79.31 ± 155.55	18.33 ± 12.46	22.51 ± 14.82	177.85 ± 247.78	79.02 ± 125.67
SD2 (ms)	73.44 ± 18.92	83.41 ± 39.42	24.62 ± 56.15	29.35 ± 57.01	70.78 ± 25.19	77.76 ± 30.82	52.39 ± 66.10	62.60 ± 68.55

	SESSION III						
	3 min pre M8	1/10 M9	5/10 M10	10/10 M11	Chi^2	p	Significant differences between evaluation moment
PNN50 (No.)	4.58 ± 3.69	5.73 ± 10.02	5.73 ± 6.65	9.19 ± 33.35	4.50	.034	6 > 0
RMSSD (ms)	36.88 ± 30.45	36.88 ± 30.45	35.90 ± 24.21	21.90 ± 39.56			
SD1 (ms)	18.67 ± 14.68	19.58 ± 20.61	186.77 ± 447.18	22.98 ± 57.54	4.50	.025	6 > 0;6 > 4
SD2 (ms)	75.56 ± 33.75	84.21 ± 42.81	46.31 ± 58.12	50.21 ± 63.56	4.50	.017	6 < 1;7 < 1;10 < 1;11 < 1;2 < 1

Evaluation Moment (M); the proportion of NN50 divided by total number of NNs (PNN50); Square root of the mean of the sum of the squared differences between adjacent normal R-R intervals (RMSSD); Normalized unit (n.u.); standard deviations of the scattergram 1 (SD1); standard deviations of the scattergram 2 (SD2); SUDS (Subjective units of distress)

manoeuvres [7, 31, 32]. Coping with a situation with high uncontrollability and uncertainty makes the sympathetic system increase its modulation, which prepares the body to face the threat perceived by the subject [33]. This fight-or-flight response is modulated by the participants' subjective perception of threat and stress, being affected by both physiological and psychological factors. In the present case and unlike the high sympathetic response evaluated in extreme ultraendurance runners for example [33], only the psychological load due to the threat perception of the student caused this increase in sympathetic modulation. In this first session (M1 vs. M3) the data showed low values in PNN50, RMSSD, SD1 and SD2 which is associated to the subjective perception of high stress manifested by the students. The perception of insecurity in university students in different types of evaluations has been studied previously and was observed an excess of cortisol in the moments before examination or practical evaluations [34, 35]. This hormonal response interferes with normal communication between neurons responsible for tasks such as working memory, learning or problem solving [36–38].

Analyzing the habituation process during the entire clinical practice, we did not find a habituation process. The absence of an increase in HRV values showed how the autonomic nervous system did not decrease the alert level. In this case, repeated exposure to the clinical practice was not effective in decreasing sympathetic activity. An element that could explain this high sympathetic modulation is the lack of acquired experience since in previous studies with veteran and novel military, a decreased sympathetic modulation was found in experiences compared with novel [39]. Probably a greater accompaniment of the teachers of these practical subjects would be needed to improve the psychophysiological response of students.

The lack of habituation process in the physiotherapy students could be related with other several factors as the personal psychological profile. In the psychological questionnaires we found that PSS scores place the group at a moderate/high perceived stress level. It is known that people who have a high sympathetic modulation as personality trait tend to cope with unfamiliar situations with emotional strategies more frequently than those focused on the question difficulty, influencing the real demands of the context [40]. In practical educational environments, this trait could be a non-adaptive style of coping [41–43], more even taking into account that the use of adequate cognitive, behavioural and emotional adaptive strategies was associated with psychological wellbeing [34, 44, 45]. In this line, students need more teachers support during the immersion in their practical period since the clinical environment itself is a generator of high emotional impact [46–48]. Close and continuous monitoring by the tutor would facilitate the acquisition of the necessary tools increasing the student's confidence.

Regarding personality of students, they presented a low value in the factor *Openness* (O) of the NEO-FII scale. This factor includes measurement of concepts such as fantasy, ideas or intellectual curiosity and actions [30]. Scores below 40 are associated with people who opt for traditional methodologies whose success is already proven. This could explain why the repeated exposure did not work. Throughout the scenarios students are subjected to a large number of different stimuli that will demand dynamic cognitive changes and need resources to adapt properly [49]. This personality trait would determine as the person can face this load of stimuli being able to learn new strategies autonomously.

Finally, none of the psychophysiological variables analyzed were related to academic performance. This may be due to the low differences in the score obtained by the students. In this sense, it would be interesting to make a more objective evaluation design that includes, for example, the use of rubrics based on the same criteria for all evaluators.

Probably a greater accompaniment of the teachers of these practical subjects would be needed to improve the psychophysiological response of students. In this line, it is advisable to use measuring instruments that provide a psychological profile that corresponds to a coping style so that students can learn which are the most appropriate to face a stressful event such as a simulated scenario. To monitor autonomic modulation and manage the entire process, it is also advisable to use HRV measuring instruments. In order to analyze and improve learning processes, it would be interesting to extend this study to other educational levels. Assessing the autonomous response of students in secondary education or early childhood education could provide valuable information on the stressful events they have to face and the strategies they use.

Conclusion

A complete clinical practice of Physiotherapy degree students did not produce a habituation process since a high sympathetic autonomic nervous system modulation was measured in the beginning, at the middle and at the final of the clinical practice. However, both autonomous response and psychological profile were not related to the academic performance of the students.

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Compliance with Ethical Standards

Conflict of Interest None.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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References

1. Munroe, B., Buckley, T., Curtis, K., and Morris, R., Designing and implementing full immersion simulation as a research tool. Australasian Emergency Nursing Journal., 2016. https://doi.org/10.1016/j.aenj.2016.01.001.
2. Borggreve, A., Meijer, J., Schreuder, H., and Ten Cate, O., Simulation-based trauma education for medical students: A review of literature. Medical Teacher 39(6):631–638, 2017. https://doi.org/10.1080/0142159X.2017.1303135.
3. Sobh, A., Izham, M., Diab, M. et al., Qualitative evaluation of a cumulative exit-from degree objetive structured clinical examination in a gulf context. Pharmacy Education 17(1):73–80, 2017.
4. Beltrán-Velasco, A., Bellido-Esteban, A., Ruisoto-Palomera, P., and Clemente-Suárez, V., Use of portable digital devices to analyze autonomic stress response in psychology objective structured clinical examination. Journal of Medical Systems 42(2):35, 2018. https://doi.org/10.1007/s10916-018-0893-x.
5. Clemente-Suárez, V., Beltrán-Velasco, A. I., Bellido-Esteban, A., and Ruisoto, P., Autonomic adaptation to clinical simulation in psychology students: teaching applications. Applied Psychophysiology and Biofeedback., 2018a. https://doi.org/10.1007/s10484-018-9404-6.
6. Delgado-Moreno, R., Robles-Pérez, J., and Clemente-Suárez, V., Combat stress decreases memory of warfighters in action. Journal of Medical Systems 41(8):124, 2017. https://doi.org/10.1007/s10916-017-0772-x.
7. Belinchon-deMiguel, P., and Clemente-Suárez, V., Psychophysiological, body composition, biomechanical and autonomic modulation analysis procedures in an ultraendurance mountain race. Journal of Medical Systems 42(2):32, 2018. https://doi.org/10.1007/s10916-017-0889-y.
8. Mielgo-Ayuso, J., Zourdos, M., Clemente-Suárez, V., Calleja-González, J., and Shipherd, A., Can psychological well-being scales and hormone levels be used to predict acute performance of anaerobic training tasks in elite female volleyball players? Physiology and Behavior 180:31–38, 2017. https://doi.org/10.1016/j.physbeh.2017.08.008.
9. Clemente-Suarez, V., and Robles-Perez, J., Psycho-physiological response of soldiers in urban combat. Anales de Psicología 29(2):598–603, 2013. https://doi.org/10.6018/analesps.29.2.150691.
10. Clemente-Suárez, V., de la Vega, R., Robles-Pérez, J., Lautenschlaeger, M., and Fernández-Lucas, J., Experience modulates the psychophysiological response of airborne warfighters during a tactical combat parachute jump. International Journal of Psychophysiology 110:212–216, 2016. https://doi.org/10.1016/j.ijpsycho.2016.07.502.
11. Mccabe, D., Roediger, H., Mcdaniel, M., Balota, D., and Hambrick, D., The relationship between working memory capacity and executive functioning: Evidence for a common executive attention construct. Neuropsychology 24(2):222–243, 2010. https://doi.org/10.1037/a0017619.

12. Kane, M., and Engle, R., The role of prefrontal cortex in working-memory capacity, executive attention, and general fluid intelligence: An individual-differences perspective. Psychonomic Bulletin and Review 9(4):637–671, 2002. https://doi.org/10.3758/BF03196323.
13. Shields, G., Bonner, J., and Moons, W., Does cortisol influence core executive functions? A meta-analysis of acute cortisol administration effects on working memory, inhibition, and set-shifting. Psychoneuroendocrinology., 2015. https://doi.org/10.1016/j.psyneuen.2015.04.017.
14. Wolf, O., The impact of stress on executive functions in human. Psychoneuroendocrinology 71:13, 2016. https://doi.org/10.1016/j.psyneuen.2016.07.044.
15. Starcke, K., Wiesen, C., Trotzke, P., and Brand, M., Effects of acute laboratory stress on executive functions. Frontiers in Psychology 7:461, 2016. https://doi.org/10.3389/fpsyg.2016.00461.
16. Pabst, S., Schoofs, D., Pawlikowski, M., Brand, M., and Wolf, O., Paradoxical effects of stress and an executive task on decisions under risk. Behavioral Neuroscience 127(3):369–379, 2013. https://doi.org/10.1037/a0032334.
17. Dickerson, S. S., and Kemeny, M. E., Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. Psychological Bulletin 130(3):355–391, 2004. https://doi.org/10.1037/0033-2909.130.3.355.
18. Scult, M., Knodt, A., Radtke, S. et al., Prefrontal executive control rescues risk for anxiety associated with high treat and low reward brain function. Cerebral Cortex, 2017. https://doi.org/10.1093/cercor/bhx304.
19. Bellido, A., Ruisoto, P., Beltran-Velasco, A., and Clemente-Suárez, V., State of the art on the use of portable digital devices to assess stress in humans. Journal of Medical Systems., 2018. https://doi.org/10.1007/s10916-018-0955-0.
20. Nasir, A., Yusuf, A., Abdur-Rahman, L., Babalola, O., Adeyeye, A., Popoola, A., and Adeniran, J., Medical students' perception of objective structured clinical examination: A feedback for process improvement. Journal of Surgical Education 71(5):701–706, 2014. https://doi.org/10.1016/j.jsurg.2014.02.010.
21. Cheng, C., Lau, H., and Chan, M., Coping flexibility and psychological adjustment to stressful life changes: A meta-analytic review. Psychological Bulletin 140(6):1582–1607, 2014. https://doi.org/10.1037/a0037913.
22. Clemente-Suárez, V., Fernandes, R., Arroyo-Toledo, J., Figueiredo, P., González-Ravé, J., and Vilas-Boas, J., Autonomic adaptation after traditional and reverse swimming training periodizations. Acta Physiologica Hungarica 102(1):105–113, 2015. https://doi.org/10.1556/APhysiol.102.2015.1.11.
23. Malik, M., Bigger, J., Camm, A., and Kleiger, R., Heart rate variability. Standards of measurement, physiological interpretation, and clinical use. Task force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. European Heart Journal 17:354–381, 1996.
24. Moya Albiol, L., and Salvador, A., Respuesta cardíaca y electrodérmica ante estresores de laboratorio. Revista Española de Motivación y Emoción 4:5–6, 1997.
25. Tapia, D., Cruz, C., Gallardo, I., and Dasso, M., Adaptación de la Escala de Percepción global de Estrés- (EPGE) en estudiantes adultos de escasos recursos en Santiago. Chile: Revista de Administracion Sanitaria, 2007.
26. Scheier, M., Wrosch, C., Baum, A., Cohen, S., Martire, L., Matthews, K., and Zdaniuk, B., The life engagement test: Assessing purpose in life. Journal of Behavioral Medicine 29(3):291–298, 2006. https://doi.org/10.1007/s10865-005-9044-1.
27. Sinclair, V., and Wallston, K., The development and psychometric evaluation of the brief resilient coping scale. Assessment 11(1):94–101, 2004. https://doi.org/10.1177/1073191103258144.
28. Cohen, S., Kamarck, T., and Mermelstein, R., A global measure of perceived stress. Journal of Health and Social Behavior 24(4):385, 1983. https://doi.org/10.2307/2136404.
29. Houston, B., Smith, T., and Zurawski, R., Principal dimensions of the Framingham type a scale: Differential relationships to cardiovascular reactivity and anxiety. Journal of Human Stress 12(3):105–112, 1986. https://doi.org/10.1080/0097840X.1986.9936774.
30. Costa, P., and McCrae, R., Professional manual: Revised NEO personality inventory (NEO-PI-R) and NEO five-factor inventory (NEO-FFI). Odessa FL Psychological Assessment Resources 3:101, 1992. https://doi.org/10.1037/1040-3590.4.1.5.
31. Edwards, J., Walsh, N., Diment, P., and Roberts, R., Anxiety and perceived psychological stress play an important role in the immune response after exercise. Exercise Immunology Review. 24:26–34, 2018.
32. Sagone, E., and De Caroli, M., A correlational study on dispositional resilience, psychological well-being, and coping strategies in university students. Americal Journal of Educational Research. 2(7):463–471, 2014. https://doi.org/10.12691/education-2-7-5.
33. Clemente-Suárez, V., Palomera, P., and Robles-Pérez, J., Psychophysiological response to acute-high-stress combat situations in professional soldiers. Stress and Health 2:247–252, 2018b.
34. Chan, C., So, W., and Fong, D., Hong Kong baccalaureate nursing students' stress and their coping strategies in clinical practice. Journal of Professional Nursing., 2009. https://doi.org/10.1016/j.profnurs.2009.01.018.
35. Unsworth, N., Fukuda, K., Awh, E., and Vogel, E. K., Working memory and fluid intelligence: Capacity, attention control, and secondary memory retrieval. Cognitive Psychology., 2014. https://doi.org/10.1016/j.cogpsych.2014.01.003.
36. Erazo, M., Moncada, L., Llanos, G. et al., Psychological profile of 1st year nursing students. Preliminary study. Ciencia y Enfermería 15(1):99–108, 2009.
37. Mills, B., Carter, O., Rudd, C., Claxton, L., and O'Brien, R., An experimental investigation into the extent social evaluation anxiety impairs performance in simulation-based learning environments amongst final-year undergraduate nursing students. Nurse Education Today., 2016. https://doi.org/10.1016/j.nedt.2016.06.006.
38. May, R., Seibert, G., Sanchez-Gonzalez, M., and Fincham, F., Physiology of school burnout in medical students: Hemodynamic and autonomic functioning. Burnout Research., 2016. https://doi.org/10.1016/j.burn.2016.05.001.
39. Clemente-Suárez, V., Robles-Pérez, J., and Fernández-Lucas, J., Psycho-physiological response in an automatic parachute jump. Journal of Sports Sciences 35(19):1872–1878, 2017. https://doi.org/10.1080/02640414.2016.1240878.
40. Szabo, A., Ward, C., and Jose, P., Uprooting stress, coping, and anxiety: A longitudinal study of international students. International Journal of Stress Management., 2016. https://doi.org/10.1037/a0039771.
41. Martin, Y., Estres academico y frontamiento en estudiantes de Medicina. Revista Humaninades Medicas., 2010. https://doi.org/10.1989/ejep.v3i1.47.
42. Mushtaq, I., and Khan, S., Factors affecting students' academic performance. Global Journal of Management and Business Research., 2012. https://doi.org/10.1002/tea.3660200906.
43. Myers, S., Sweeney, A., Popick, V., Wesley, K., Bordfeld, A., and Fingerhut, R., Self-care practices and perceived stress levels among psychology graduate students. Training and Education in Professional Psychology., 2012. https://doi.org/10.1037/a0026534.
44. Wolf, L., Stidham, A., and Ross, R., Predictors of stress and coping strategies of US accelerated vs. generic baccalaureate nursing students: An embedded mixed methods study. Nurse Education Today, 2015. https://doi.org/10.1016/j.nedt.2014.07.005.

45. Naqvi, S., Factors affecting Student's Perfomance. Bangladesh e-Journal of Sociology 3(1):10, 2006.
46. Blomberg, K., Bisholt, B., Kullén Engström, A., Ohlsson, U., Sundler Johansso, A., and Gustafsson, M., Swedish nursing students' experience of stress during clinical practice in relation to clinical setting characteristics and the organisation of the clinical education. Journal of Clinical Nursing., 2014. https://doi.org/10.1111/jocn.12506.
47. Thomson, D., Boyle, D., Legg, C., Owen, M., Newman, M., and Cole, M., Clinical placements: The perspectives of UK physiotherapy students on how prepared they were by their university for their first clinical placements: An example of one HEI. International Journal of Practice-Based Learning in Health and Social Care., 2014. https://doi.org/10.11120/pblh.2014.00031.
48. Thomson, D., Patterson, D., Chapman, H., and Toner, M., Exploring the experiences and implementing strategies for physiotherapy students who perceive they have been bullied or harassed on clinical placements: Participatory action research. Physiotherapy 103(1):73–80, 2015. https://doi.org/10.1016/j.physio.2015.12.003.
49. Soliman, M., Perception of stress and coping strategies by medical students at King Saud University, Riyadh, Saudi Arabia. Journal of Taibah University Medical Sciences., 2014. https://doi.org/10.1016/j.jtumed.2013.09.006.