DISCLOSURE

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Consulting fees: None

Other (including employment): EBMA, iCognitus

mef 2019
Medical Education Forum
7–9 May 2019 Kraków, Poland

The role of stress in test performance: the good, the bad and the ugly

José Miguel Pêgo

[1] School of Medicine – University of Minho, Portugal
[2] ICVS/3B's – PT Government Associated Laboratory, Braga/Guimarães, Portugal

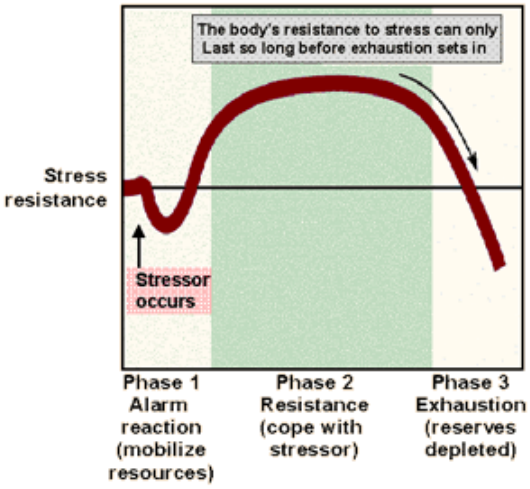
JM Pêgo is supported by iCognitus IT SOLUTIONS, Universidade do Minho SPINOFF, Associado de Member of Health Cluster Portugal Pólo de Competitividade da Saúde

This work was funded by "**EUSTRESS** – Sistema de Informação para a monitorização e avaliação dos níveis do stress e previsão de stress crónico" Nº2015/017832 P2020 SI I&DT, (NUP, NORTE-01-0247-FEDER-017832) in co-promotion between Optimizer-Lda and ICVS/3B's-Uminho.

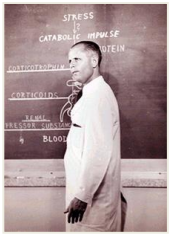
PORTUGAL 2020, UNIÃO EUROPEIA, Fundos Europeus Estruturais e de Investimento

ICVS Life and Health Sciences Research Institute, Instituto de Investigação em Ciências da Vida e Saúde
Universidade do Minho Escola de Medicina
ICVS/3B's Associate Laboratory

Context



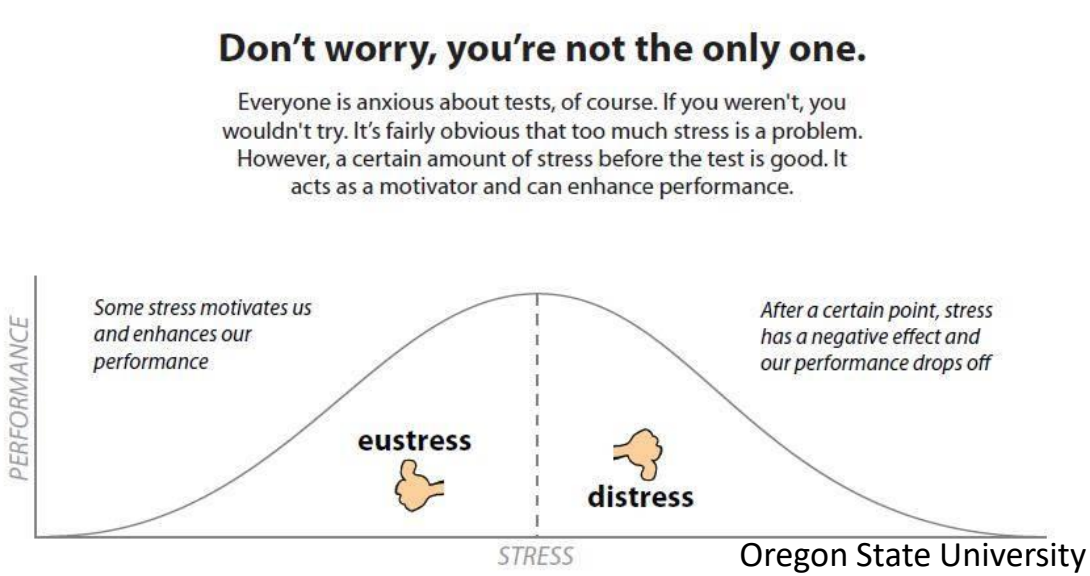
The Stress Response graph developed by Dr. Hans Selye



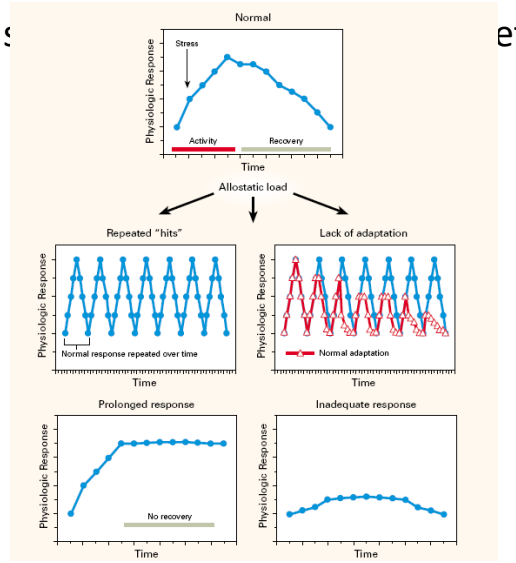
INITIAL ADAPTIVE STRESS RESPONSE	PROLONGED (MALADAPTIVE) STRESS RESPONSE
▲ Adrenalin, Epinephrine, Cortisol	▼ Immune System
Glucose	Memory & Learning
Energy Mobilization & Use	Sexuality: Impotence & Anovulation
Cognition & Performance	Pain Tolerance
Cardiovascular Tone	▲ Insulin Resistance & Weight
Cardiopulmonary tone	Fatigue
Stress Analgesia/Pain Tolerance	Stress Hypertension
▼ Immune System	Respiratory Problems
Digestion	Opportunistic Infections
Sexuality & Reproductive Hormones	Anhedonia & Depression
Growth	Bone Decalcification
	Addictions
	Somatic Syndromes

Context

- Performance anxiety is a common phenomenon affecting students' performance in a test administration.
- It is also known that students' psychological traits, namely anxiety, affect their performance in a test.



Oregon State University



McEwen B, NEJM, 1998

Context

- Stressors that affect academic performance typically are related to major life events
  - Lack of social support (particularly relevant in international and displaced students)
  - Disrupted living arrangements
  - Economical difficulties
  - Natural catastrophes

Wilkinson *et al. BMC Medical Education* (2016) 16:43

Essentials of Educational Measurement by R. L. Ebel, D. A. Frisbie

Context

- Medical school dependent stressors may have an impact as well
  - School workload
  - Performance pressure
  - Medical School structure, administration and faculty
  - Lack of career planning and concerns about the future
  - Grading system (P/F vs tiered)
  - Curriculum revisions

Med Educ Online 2015, **20**: 27706 -
Journal of Medical Education and Curricular Development
Volume 4: 1–8
MEDICAL EDUCATION ONLINE
2018, VOL. 23, 1530558
https://doi.org/10.1080/10872981.2018.1530558

Context

Well-Being of Students

Systematic Review of Depression, Anxiety, and Other Indicators of Psychological Distress Among U.S. and Canadian Medical Students

Liselotte N. Dyrbye, MD, Matthew R. Thomas, MD, and Tait D. Shanafelt, MD

Acad Med. 2006; 81:354–373.

Conclusions

Medical school is a time of significant psychological distress for physicians-in-training. Currently available information is insufficient to draw firm conclusions on the causes and consequences of student distress. Large, prospective, multicenter studies are needed to identify personal and training-related features that influence depression, anxiety, and burnout among students and explore relationships between distress and competency.

Depressive Symptoms in Medical Students and Residents: A Multischool Study

Deborah Goebert, DPH, Diane Thompson, MD, Junji Takeshita, MD, Cheryl Beach, PhD, Philip Bryson, LCSW, Kimberly Ephgrave, MD, Alan Kent, PhD, Monique Kunkel, MD, Joel Schechter, PhD, and Jodi Tate, MD

Conclusions

Depression remains a significant issue for medical trainees. This study highlights the importance of ongoing mental health assessment, treatment, and education for medical trainees.

Acad Med. 2009; 84:236–241.

Context

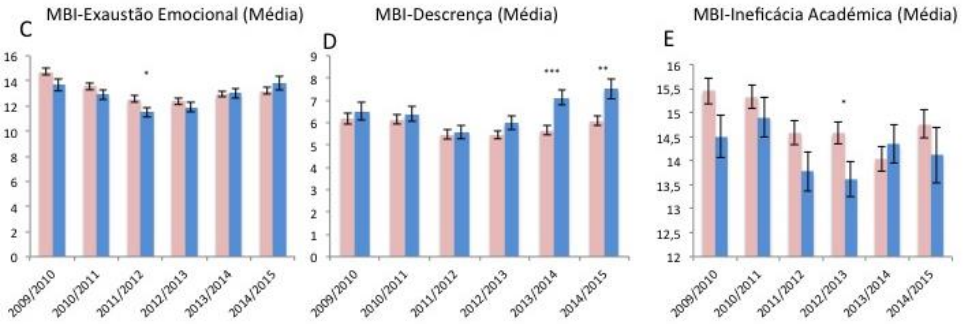
Silva *et al. BMC Medical Education* (2017) 17:184
DOI 10.1186/s12909-017-1006-0

BMC Medical Education

RESEARCH ARTICLE Open Access

Depression in medical students: insights from a longitudinal study

Vanessa Silva[1,2*], Patrício Costa[1,2], Inês Pereira[1], Ricardo Faria[1], Ana P. Salgueira[1,2], Manuel J. Costa[1,2], Nuno Sousa[1,2], João J. Cerqueira[1,2] and Pedro Morgado[1,2]



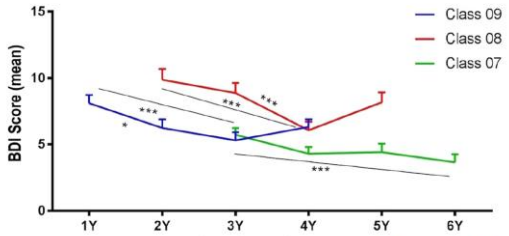


Fig. 2 BDI score for class and school year with representation of significant differences obtained by means of multiple comparisons using the Bonferroni correction (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$)

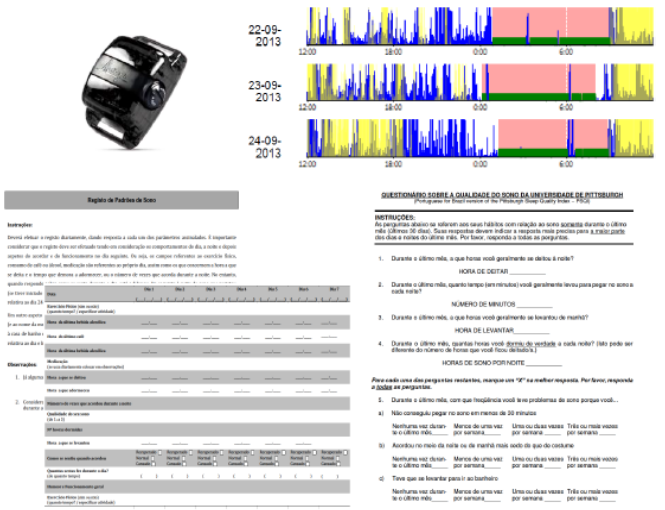
The prevalence of depression in the 6year duration of the course oscilates betweem **12,7 e 20,5%. Suicidal ideation** varied between **2,6 e 6,2**%. The most commonly reported symptoms were sleep and tiredeness ranging from 42,4-64,4% and 51,9-74%, respectively.

Context

Sleep measures in medical students: association with brain functional correlates at rest

Liliana Amorim[1,2,3], Paulo Marques[1,2,3], João Fevereiro[1,2], Carlos Portugal-Nunes[1,2,3], Nuno Sousa[1,2,3], Nadine Correia Santos[1,2,3]

[1] Life and Health Sciences Research Institute (ICVS), School of Health Sciences, University of Minho, Campus Gualtar, 4710-057 Braga, Portugal; [2] ICVS/3B's - PT Government Associate Laboratory, Braga/Guimarães, Portugal; [3] Clinical Academic Center – Braga, 4710-057 Braga, Portugal



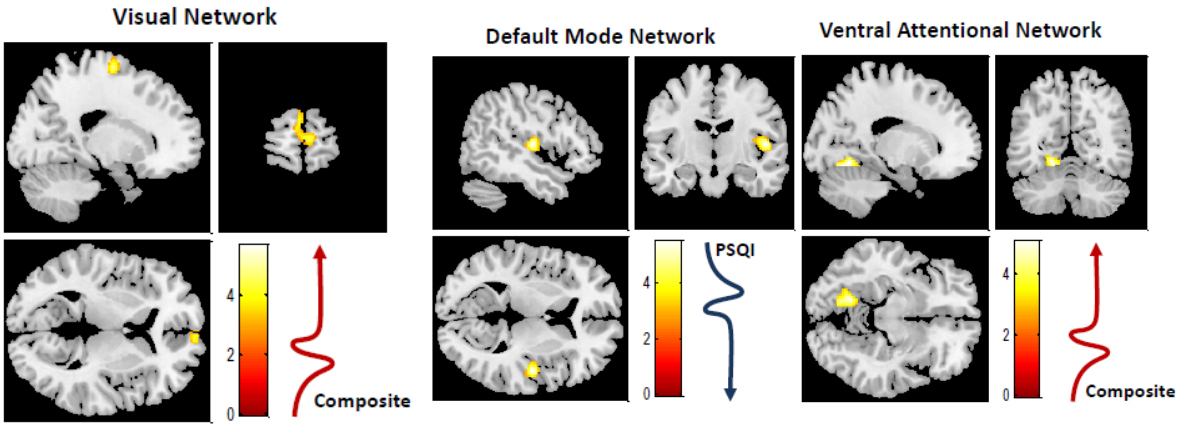


Figure 1. Significant associations between sleep parameters and RSNs FC. Networks were extracted by independent component analysis and results were considered significant if $p<0.05$ corrected for multiple comparisons.
PSQI total score is negatively associated with FC in DMN; the sleep composite was positively associated with FC in the ventral attention network (VAN) and the visual network (VN).

Context

The interaction between sleep quality and academic performance

K. Ahrberg [a], M. Dresler [a], S. Niedermaier [b], A. Steiger [a], L. Genzel [a,*]

[a] *Max-Planck-Institute of Psychiatry, Kraepelinstr.2-10, 80804 Munich, Germany*
[b] *Dr-von-Haunersches-Kinderhospital of Ludwig-Maximilian-University Munich, Munich, Germany*

Journal of Psychiatric Research 46 (2012) 1618–1622

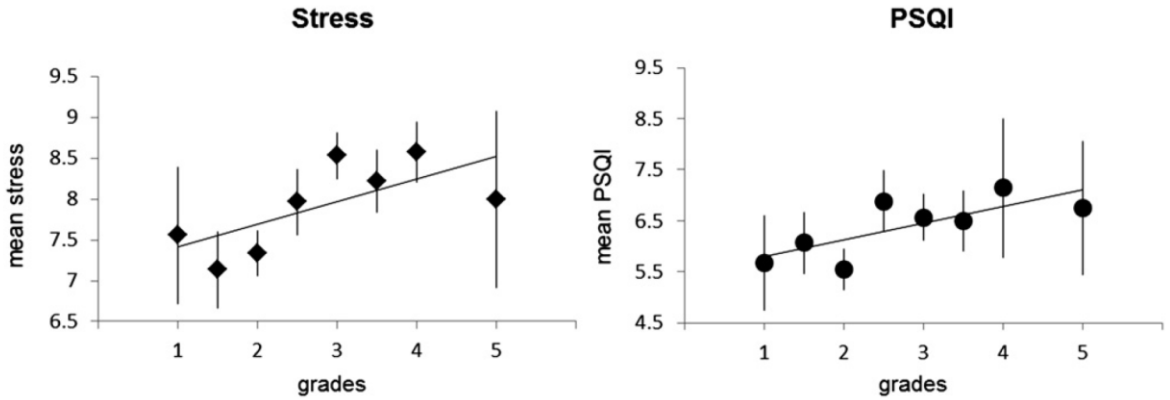


Fig. 1. Shown are the significant correlations between stress pre-exam (left panel) and subjective sleep quality pre-exam (PSQI, right panel) with the academic performance (grade). stress: $r = 0.276$, $P < 0.001$; PSQI: $r = 0.158$; $P < 0.03$. Note that low performance (1 is the best grade) meant low sleep quality (high PSQI) and high stress. PSQI and stress are presented as the mean and SEM of the 144 students for the different possible grades (1–5 in 0.5 steps).

Context

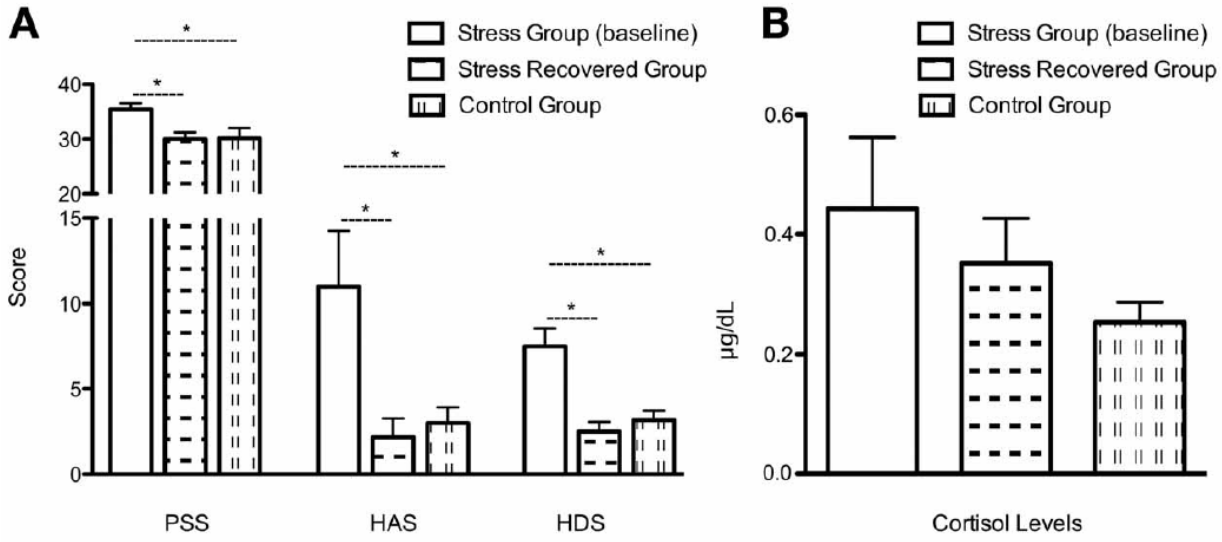
frontiers in
HUMAN NEUROSCIENCE

ORIGINAL RESEARCH ARTICLE
published: 27 December 2013
doi: 10.3389/fnhum.2013.00919

Plasticity of resting state brain networks in recovery from stress

José M. Soares*[1,2,3]*, *Adriana Sampaio*[1,4], *Paulo Marques*[1,2,3], *Luís M. Ferreira*[1,2,3], *Nadine C. Santos*[1,2,3], *Fernanda Marques*[1,2,3], *Joana A. Palha*[1,2,3], *João J. Cerqueira*[1,2,3] and *Nuno Sousa*[1,2,3]

[1] *Life and Health Sciences Research Institute (ICVS), School of Health Sciences, University of Minho, Braga, Portugal*
[2] *ICVS/3B's - PT Government Associate Laboratory, Braga/Guimarães, Portugal*
[3] *Clinical Academic Center, Braga, Portugal*
[4] *Neuropsychophysiology Lab, CIPsi, School of Psychology, University of Minho, Braga, Portugal*



Context

Citation: Transl Psychiatry (2012) 2, e131, doi:10.1038/tp.2012.59

www.nature.com/tp

Stress-induced changes in human decision-making are reversible

JM Soares[1,2,3,5], A Sampaio[1,4,5], LM Ferreira[1,2,3], NC Santos[1,2,3], F Marques[1,2,3], JA Palha[1,2,3], JJ Cerqueira[1,2,3] and N Sousa[1,2,3]

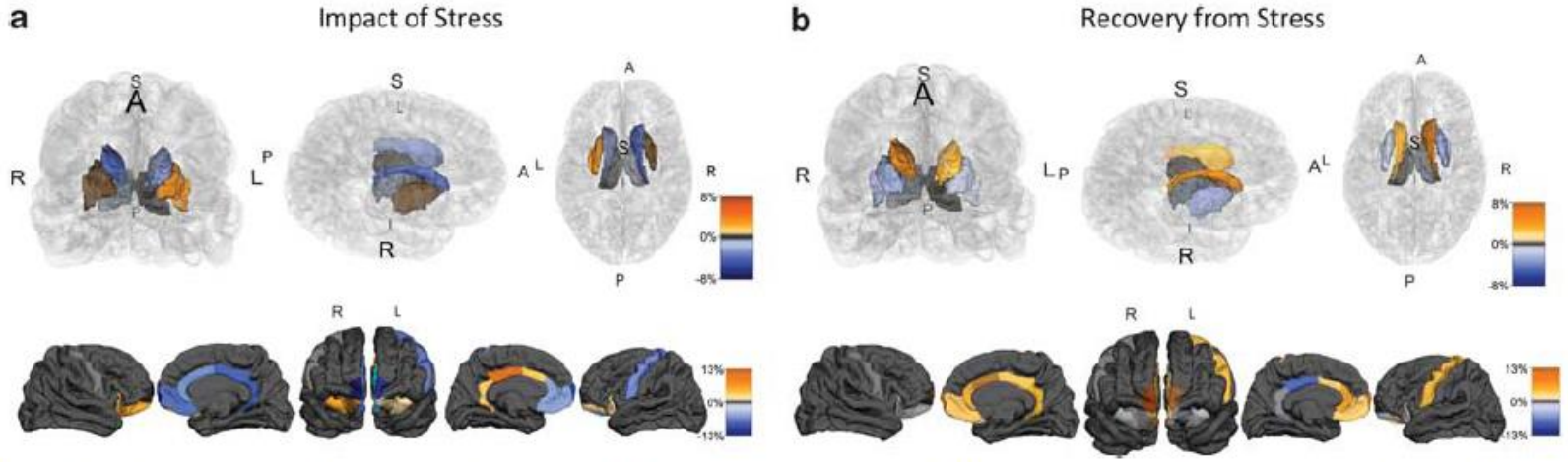


Figure 3 Volumetric changes in the brain after stress exposure (**a**) and after recovery from stress (**b**). Upper panels represent changes in subcortical regions, whereas the lower panels represent volumetric variations in cortical regions. (**a**) The impact of stress in the structure of corticostriatal loop. The color changes illustrate variations in volumes of stressed subjects in contrast to controls. (**b**) The amount of recovery from the impact of stress in the structure of cortico-basal ganglia loop. The color changes illustrate variations in volumes in stressed subjects after recovery from stress.

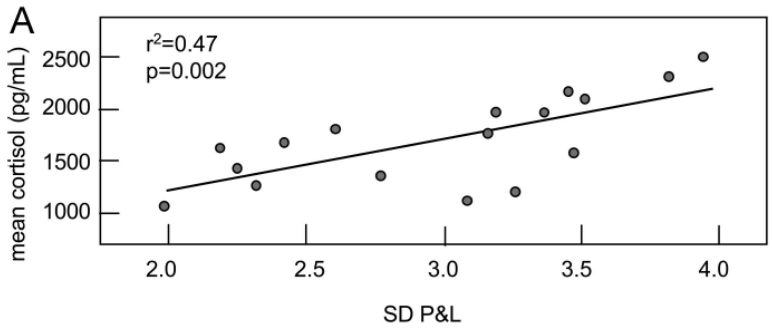
Context

Endogenous steroids and financial risk taking on a London trading floor

J. M. Coates*†‡ and J. Herbert*‡§

*Department of Physiology, Development and Neuroscience, University of Cambridge, Cambridge CB2 3DY, United Kingdom; †Judge Business Sc University of Cambridge, Cambridge CB2 1AG, United Kingdom; and §Cambridge Center for Brain Repair, University of Cambridge, Cambridge C United Kingdom

Edited by Bruce S. McEwen, The Rockefeller University, New York, NY, and approved November 6, 2007 (received for review May 1, 2007)



PNAS | April 22, 2008 | vol. 105 | no. 16 | 6167–6172

Journal of Psychosomatic Research 77 (2014) 420–425

Saliva pH as a biomarker of exam stress and a predictor of exam performance

Miri Cohen [a,*], Rabia Khalaila [b]

[a] School of Social Work, Faculty of Social Welfare and Health Sciences, University of Haifa, Haifa, Israel
[b] School of Nursing, Zefat Academic College, Zefat, Israel

Medical Education Online

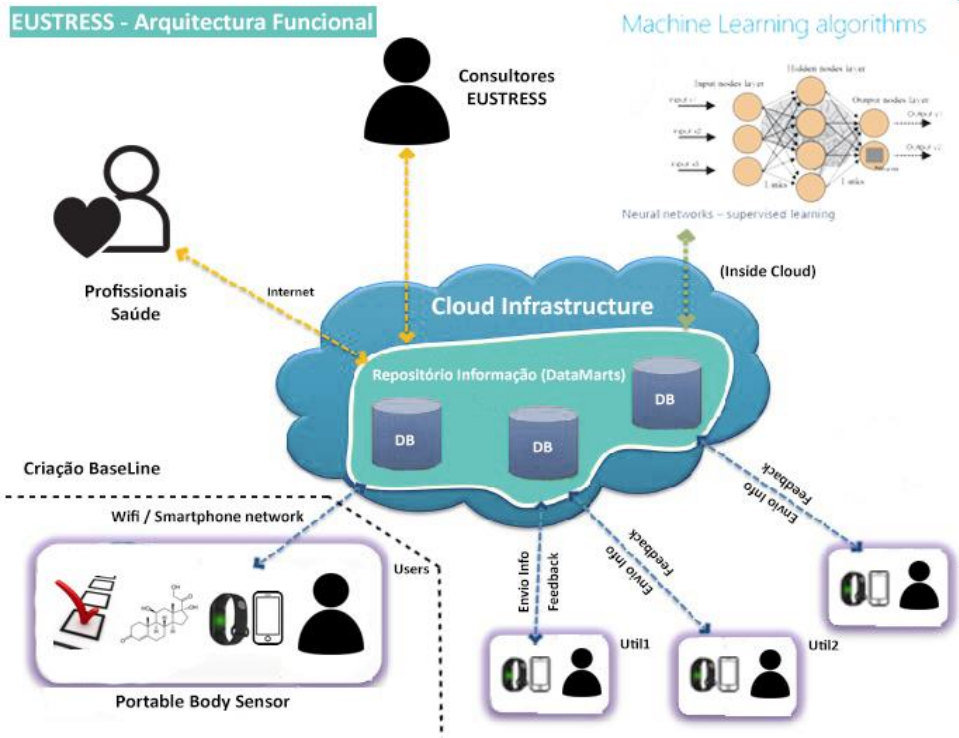
RESEARCH ARTICLE

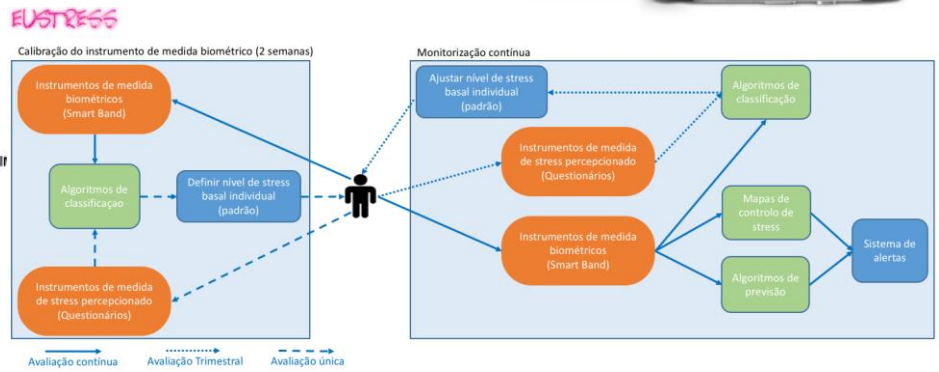
How does the quality of life and the underlying biochemical indicators correlate with the performance in academic examinations in a group of medical students of Sri Lanka?

Manjula Hettiarachchi[1]*, Chathuranga Lakmal Fonseka[1], Priyanka Gunasekara[2], Prasanjanie Jayasinghe[1] and Dasun Maduranga[1]

[1]Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka; [2]Coronary Care Unit, Teaching Hospital, Karapitiya, Galle, Sri Lanka

EuStress Project





Investigate and develop an information system (SI) that monitors and evaluates, in a continuous and real time, the stress levels of the individual, also predicting chronic stress.

1

Determine stress profile types to classify medical students.

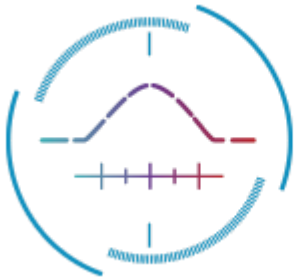
3

Interpret the individuals stress reactivity patterns and predict stress states.

Key ideas

2

Establish associations between biochemical data, neuropsychological information and biometric records.



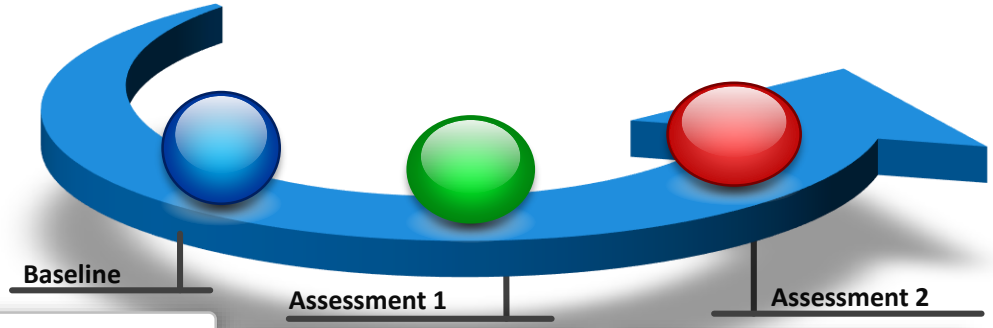
mef 2019
Medical Education Forum
7–9 May 2019 Kraków, Poland

The EuStress Project: monitoring and evaluation of stress levels of medical students

Teresa Costa Castanho, Ana Mónica Pereira, Patricio Costa, Victor Carvalho, José Miguel Pêgo

EuStress main goal: Investigate and develop an information system (SI) that monitors and evaluates, in a continuous and real time, the stress levels of the individual, also predicting chronic stress.

Undergraduate medical students from all curricular years of the medical course



- **Biochemical data:** Salivary Cortisol
- **Neuropsychological information** (Stress, Coping, Test Anxiety, Burnout, Anxiety and Depressive symptoms)

- **Biochemical data:** Salivary Cortisol
- **Neuropsychological information** (Stress)

- **Biochemical data:** Salivary Cortisol
- **Neuropsychological information** (Stress)

eustress

Monitoring week conducted in volunteer students

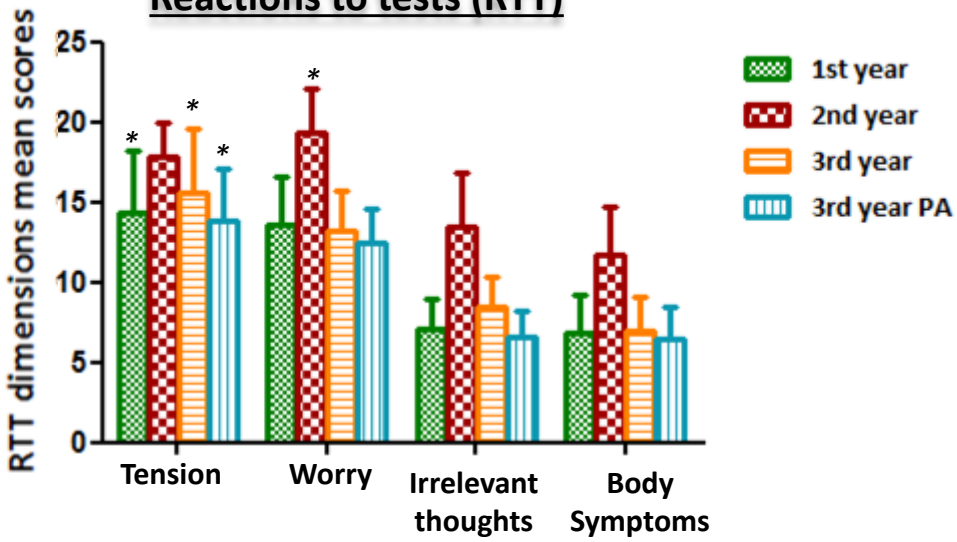
Microsoft Band 2 *EuStress App* *Salivary Cortisol*

- What is the effect of stress in medical students when they are faced with high demand tasks?
- How each individual is affected by stress? There is a specific profile?

Medical students population sample: curricular year (2017/2018)

	N	Percent
Sex		
Male	15	21.1
Female	56	78.9
Total	71	100
Curricular year		
1st year	20	28,2
2nd year	20	28,2
3rd year	15	21,1
3rd year PA	16	22,5
Total	71	100,0

Reactions to tests (RTT)



P<0.05

Coping style: Brief Cope Inventory

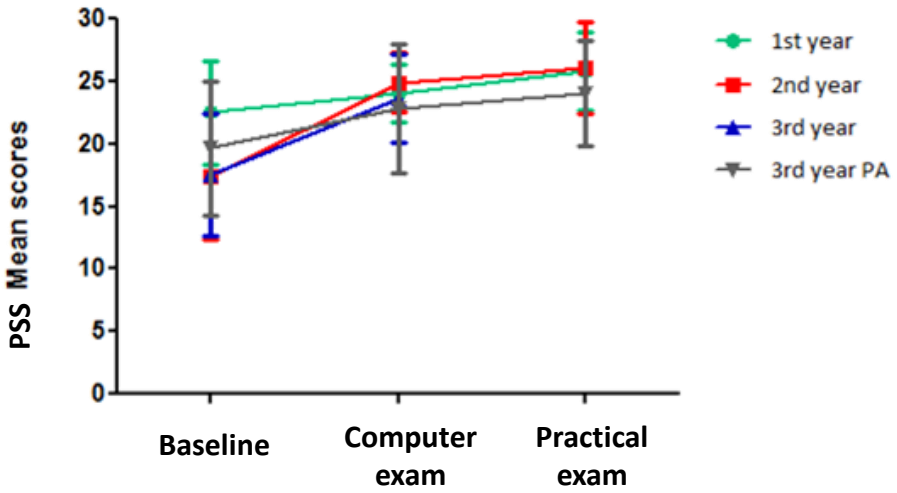
TOTAL SAMPLE	N	Mean	SD
Active Coping	61	3,61	0,954
Planning	60	0,35	0,606
Emotional support	61	1,80	1,108
Social support	61	2,70	0,715
Religion	61	3,05	1,575
Positive reinterpretation	61	2,02	0,764
Self-blame	61	4,02	1,025
Acceptance	60	1,97	1,149
Venting	61	2,82	1,385
Denial	61	2,89	1,253
Self-distraction	61	2,08	1,295
Behavioval disengagement	61	3,18	1,245
Substance use	61	3,02	0,991
Humor	61	2,08	1,441

• ***Differences between Gender and coping styles***

Social Support: *t (59) = 2.028; p< 0.05; Males↑M= 3.09, SD= .701*
Denial: *t (59) = 2.115; p<0.05; Females↑ M= 3.04, SD= 1.245;*
Behavioval disengagement: *t (59) = 2.203; p<0.05; Females↑ M= 3.34; SD= 1.255*

• ***Differences between Curricular year and coping styles***
Substance use: *F (3,57) = 3.466, p<0.05; 1st year ↑ M= 3.40, SD= .828*

Perceived Stress (PSS) and Curricular year



• *1st year with a superior PSS baseline: F(3,58)= 3.751, p<0.05*

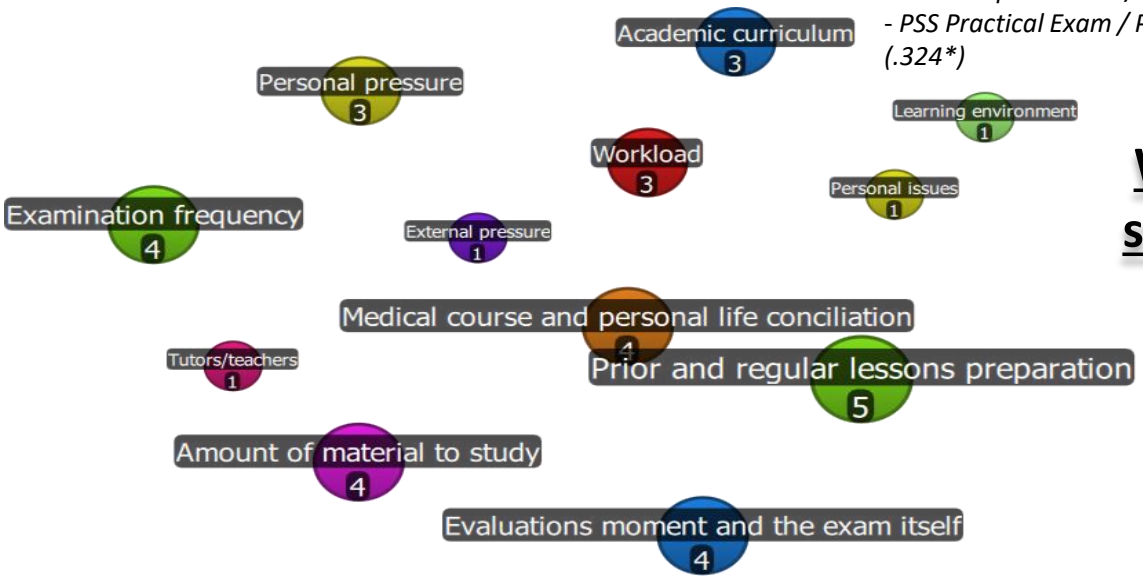
Perceived Stress and total sample

PSS Baseline					
Mean (SD)	Median	Range	25th Percentile	50th Percentile	75th Percentile
19.34±5.191	19.50	9-31	15.00	19.50	24.00
PSS Computer Exam					
23.95±3.410	24.00	17-33	21.00	24.00	26.00
PSS Practical Exam					
25.36±3.718	26.00	15-32	23.00	26.00	28.00

•***Associations between PSS application moments and coping styles***

- PSS Baseline / Active Coping (-.273) and Venting (-.258*)*
- PSS Computer Exam/ Substance use (.268)*
- PSS Practical Exam / Positive reinterpretation (-.331) and Acceptance (.324*)*

**p<.05*



What are the main stressors during the medical course?

Results

Using Mouse Dynamics to Assess Stress During Online Exams

Davide Carneiro[1(✉)], Paulo Novais[1], José Miguel Pêgo[2,3], Nuno Sousa[2,3], and José Neves[1]

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[2] School of Health Sciences, Life and Health Sciences Research Institute (ICVS), University of Minho, Braga, Portugal
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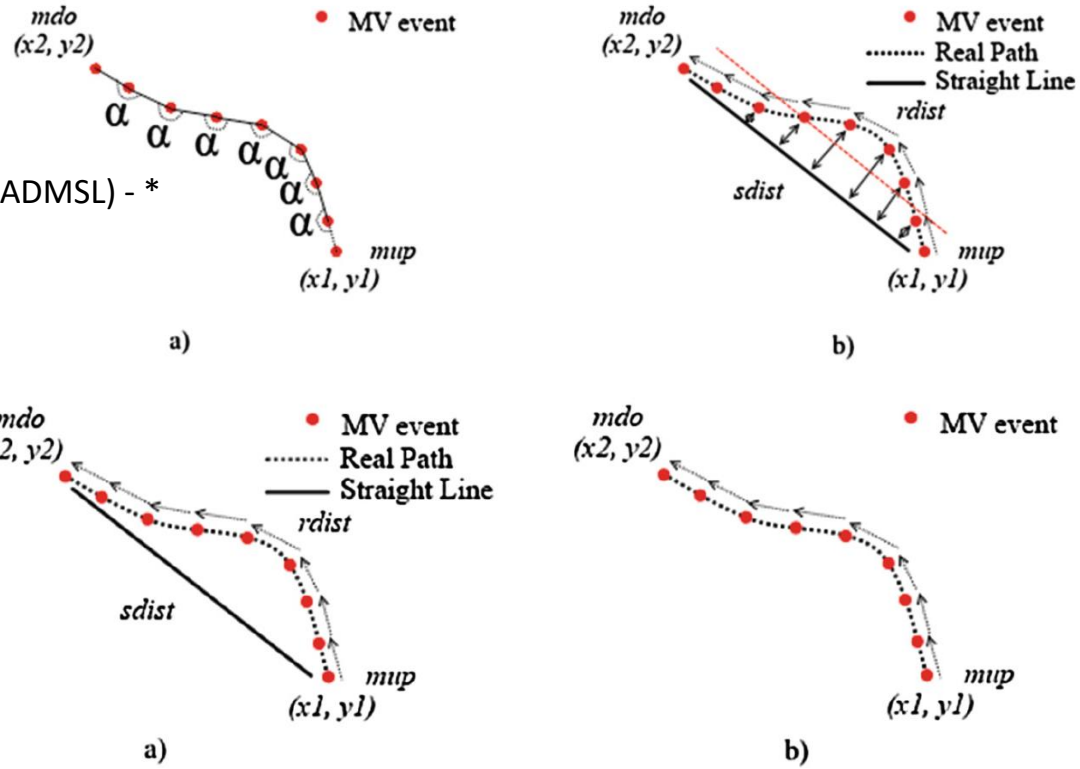
[3] ICVS/3B's - PT Government Associate Laboratory, Braga/Guimarães, Portugal

Results

Absolute Sum of Degrees (ASD) - *
Average Distance of the Mouse to the Straight Line (ADMSL) - *
Average Excess of Distance Between Clicks (AED) - *
Click Duration (CD) - *
Distance Between Clicks (DBC) - *
Distance of the Mouse to the Line (DMSL) - *
Excess of Distance Between Clicks (ED) - *
Mouse Acceleration (MA) - **
Mouse Velocity (MV) - **
Time Between Clicks (TBC) - *

* - increasing value = decreasing performance
** - variable meaning

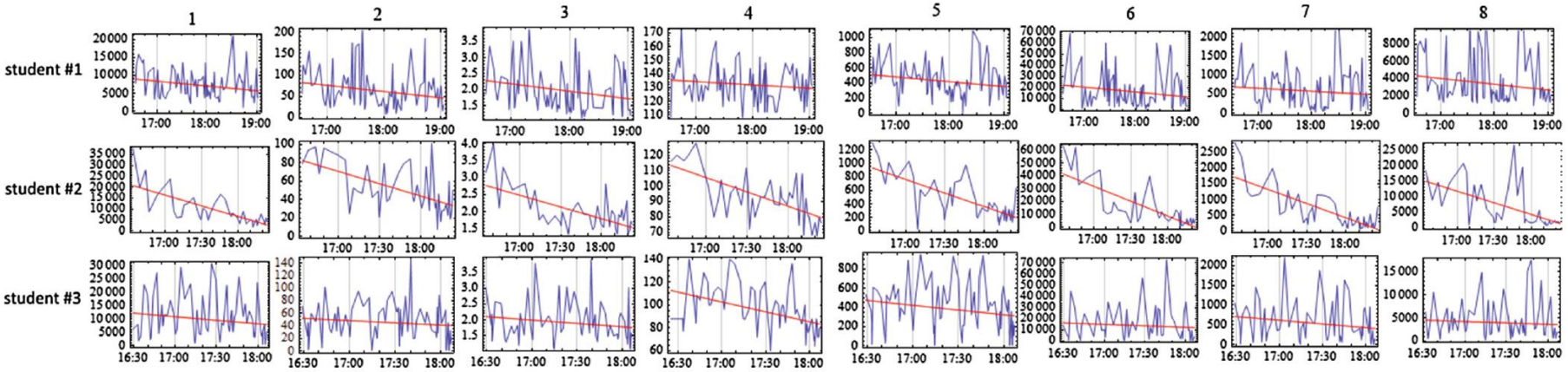


Results

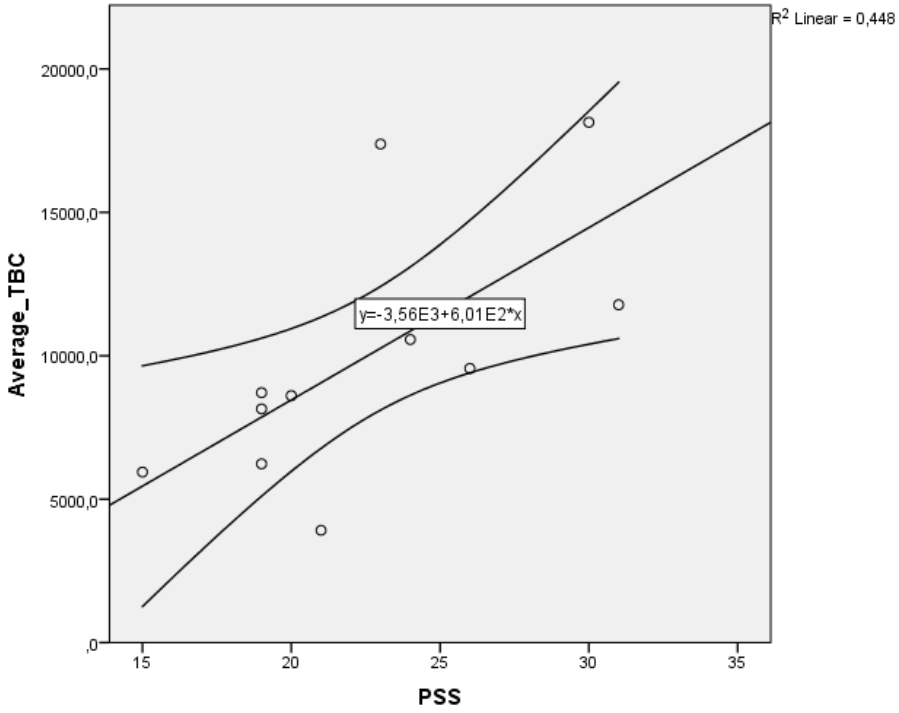
Using Mouse Dynamics to Assess Stress During Online Exams

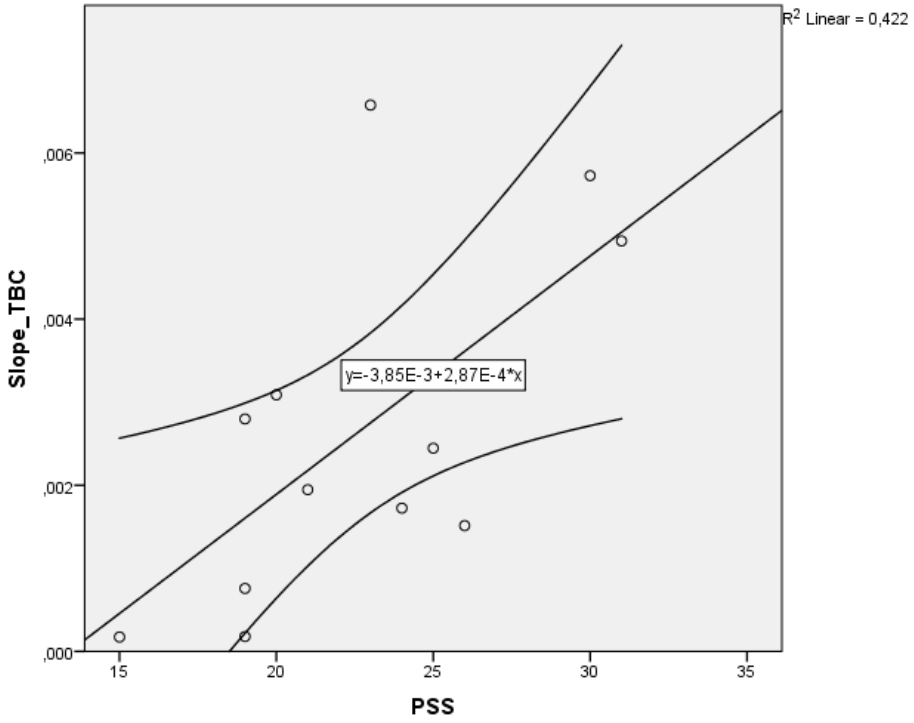
N = 53

Fig. 4. Time plot of the features for three arbitrary students. The negative correlation with time is visible for all features. Lines depict three different students. Columns depict the following eight features: 1 - ASA, 2 - ADMSL, 3 - AED, 4 - CD, 5 - DBC, 6 - DMSL, 7 - ED, 8 - TBC.



Results



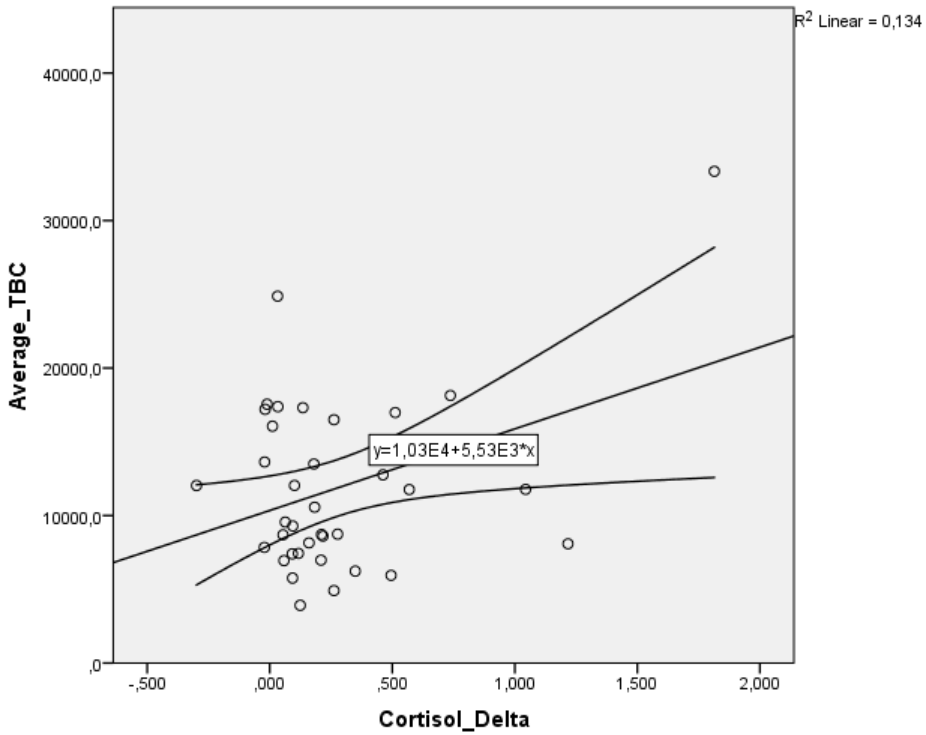


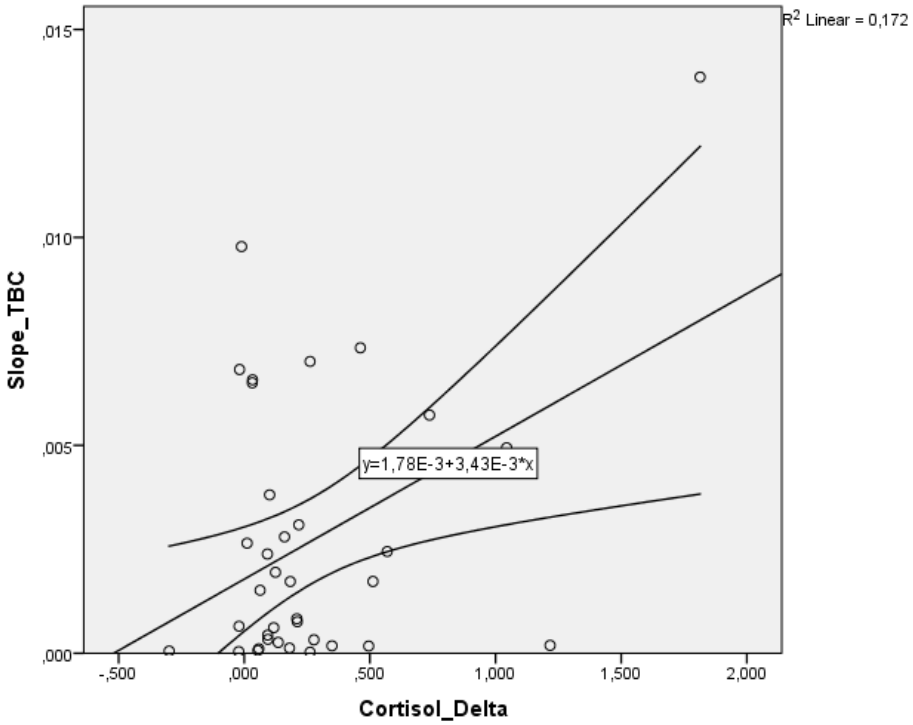
N= 62

R = 0.669; p= 0.017

R = 0.650; p= 0.022

Results



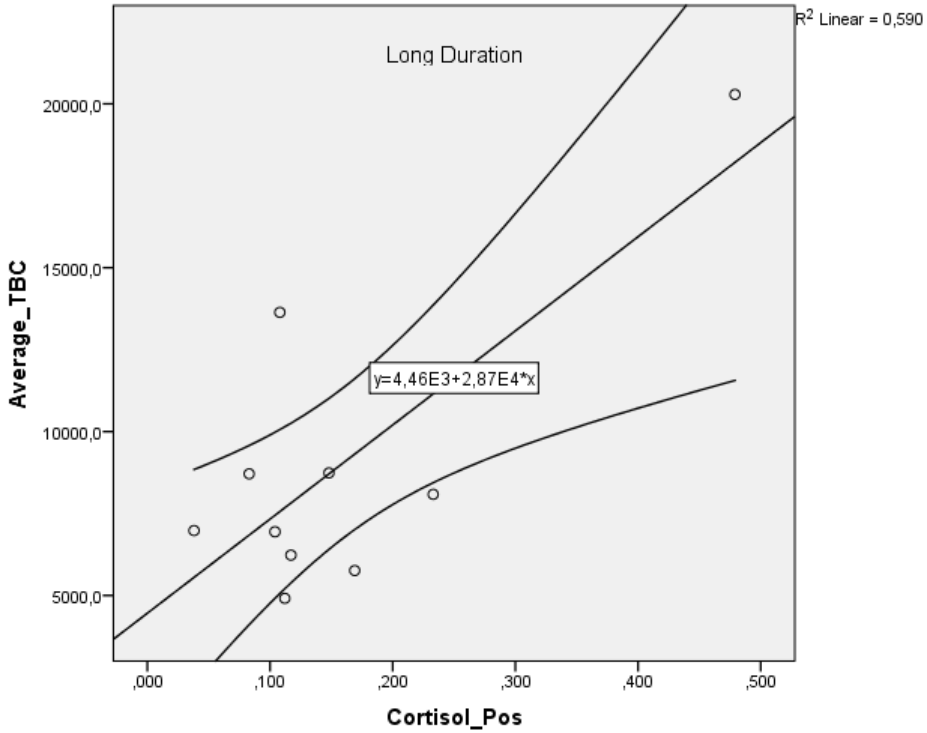


N= 62

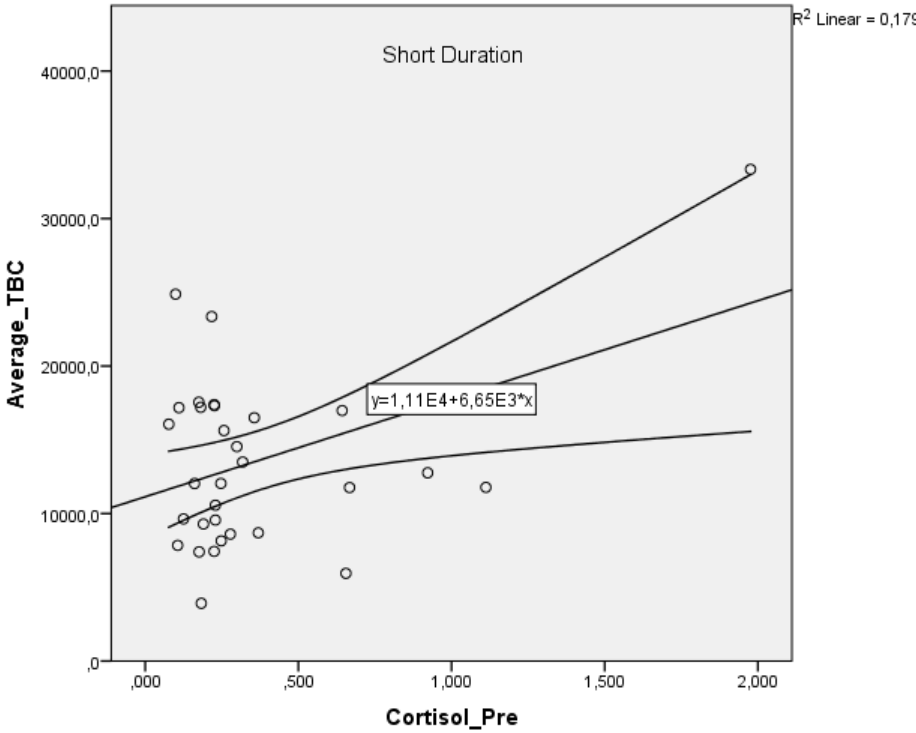
R = 0.366; p= 0.028

R = 0.414; p= 0.012

Results

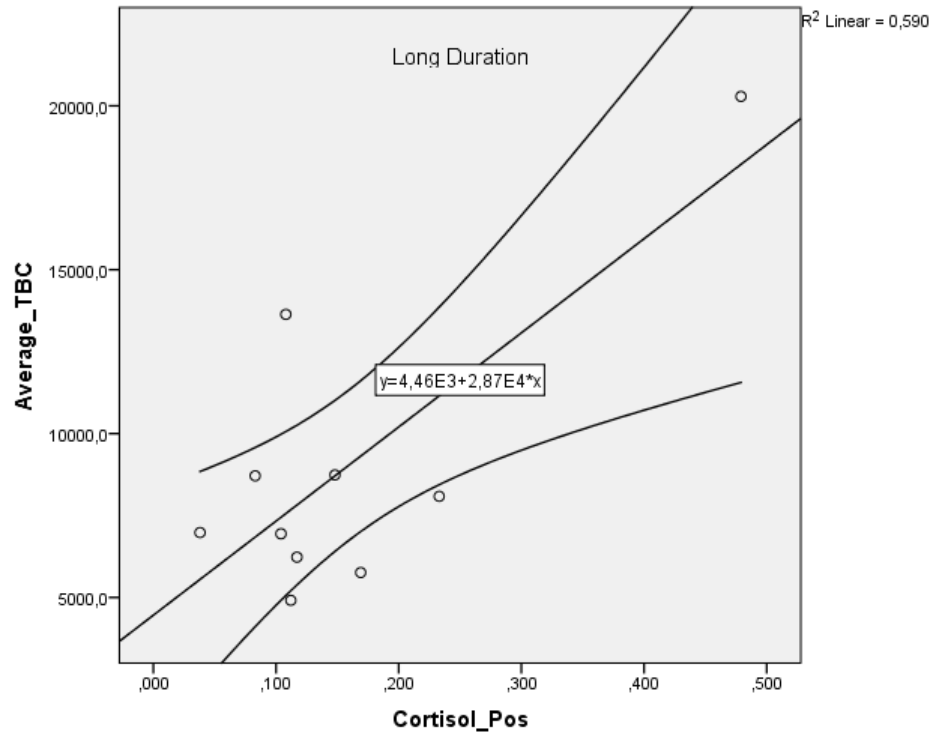


N= 24 R = 0.768; p= 0.009

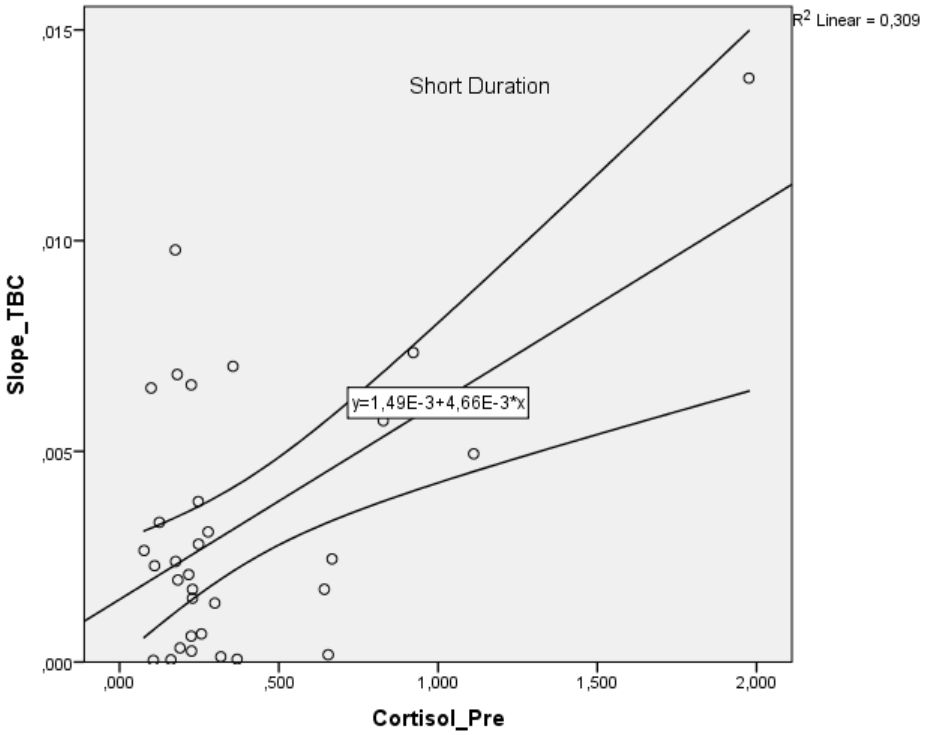


N= 38 R = 0.423; p= 0.016

Results

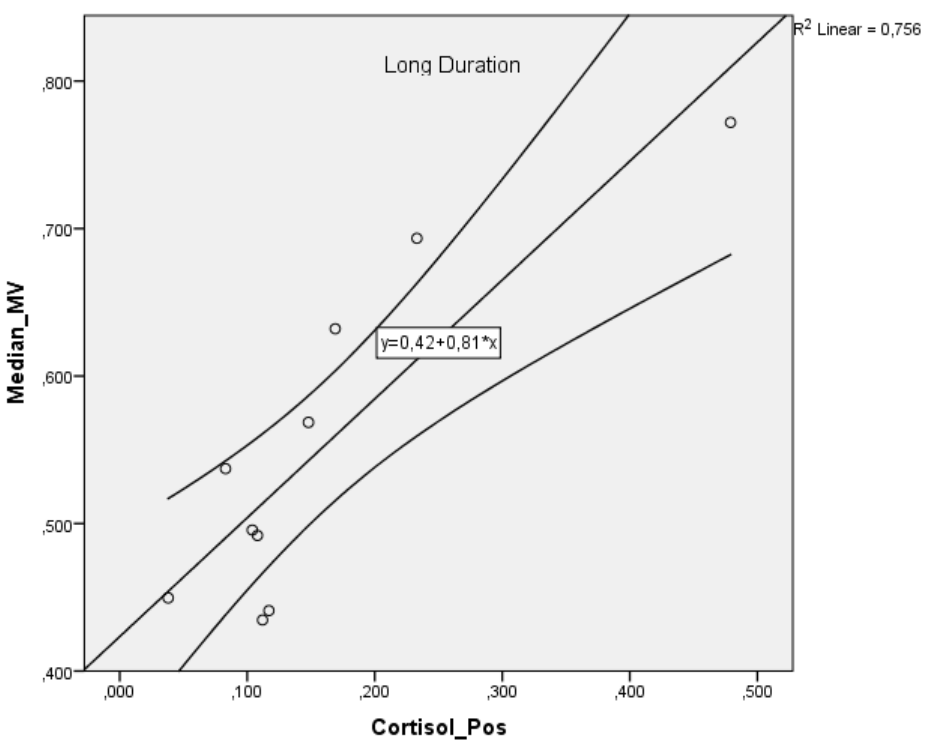


N= 24 R = 0.768; p= 0.009

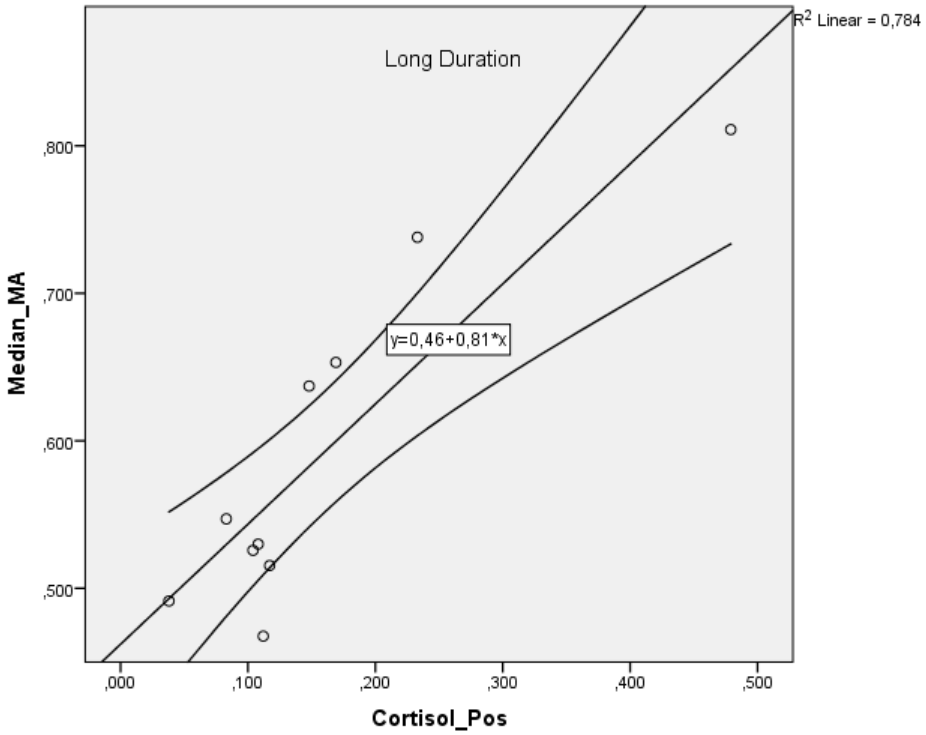


N= 38 R = 0.556; p= 0.001

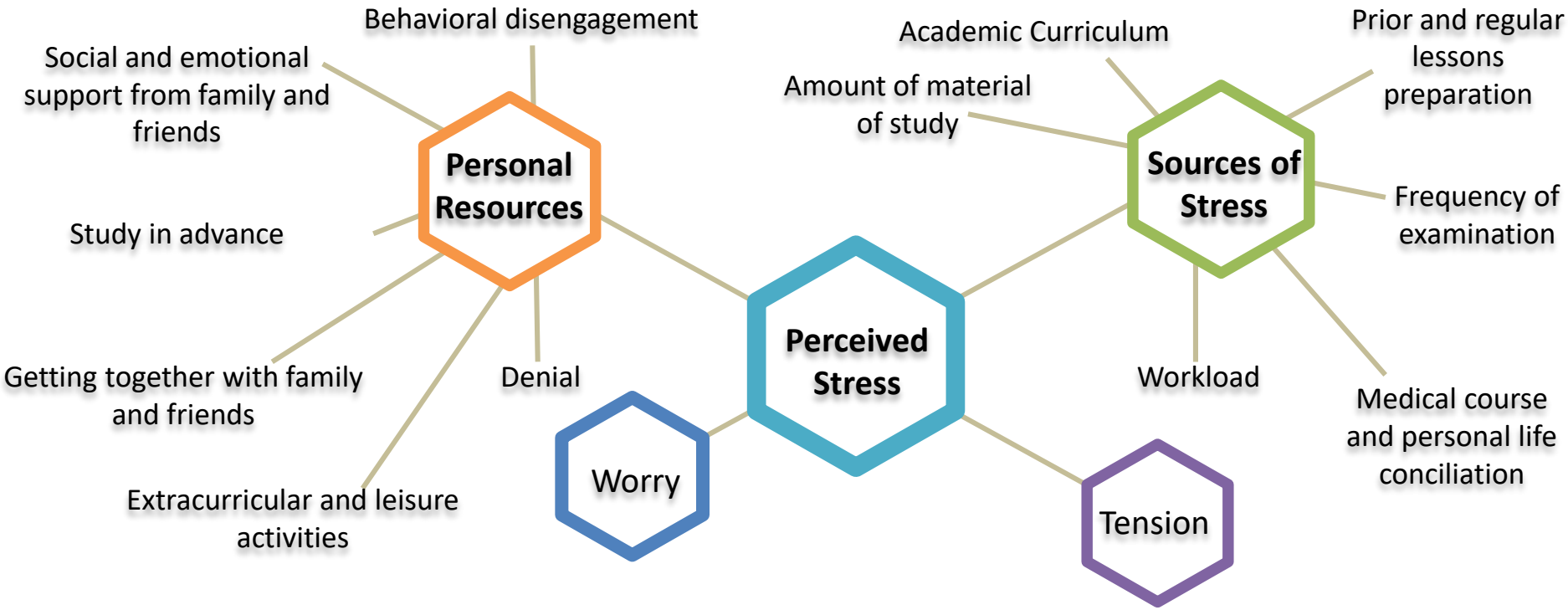
Results



N= 24 R = 0.870; p= 0.001



N= 38 R = 0.886; p= 0.001



- Pointing out how each individual is affected by stress, future results will support the medical school to act on each student by providing coping strategies and personalized training and thus train the future professionals for a practice with quality and a healthy mental status.

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The role of stress in test performance: the good, the bad and the ugly

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