

# Does the Stress of Exams Period Influence Medical Student's Blood Pressure? A Longitudinal Study

Thauler Alves De Oliveira<sup>1\*</sup>, Kenia Ferreira Rosa<sup>1</sup>, Otávio Antoniel Vilela Nunes<sup>1</sup>, Guilherme Augusto Alves de Oliveira<sup>2</sup> and Flávio Ricardo Manzi<sup>3</sup>

<sup>1</sup>School of Medicine, University of Itaúna, Itaúna, MG, Brazil

<sup>2</sup>Department of Clinical Dentistry and Periodontics, "Pontifícia Universidade Católica de Minas Gerais", Belo Horizonte, Brazil

<sup>3</sup>Department of Dental Radiology, "Pontifícia Universidade Católica de Minas Gerais", Belo Horizonte, Brazil

\*Corresponding author: Thauler Alves De Oliveira, School of Medicine, University of Itaúna, 47 João Dornas, Centro, Itaúna, Minas Gerais, Brazil, Tel: +5537998643311; E-mail: [guilherme\\_augusto.o@hotmail.com](mailto:guilherme_augusto.o@hotmail.com)

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## Abstract

**Background:** Based on relation of pathological effects of stress on the body and its reflex on blood pressure, the high level of stress undergone by medical students becomes a concern about quality of medical training and its health. The aim is to verify the possible influence of stress during exam periods on the blood pressure of medical students.

**Method:** The systemic arterial pressure (SAP) of 109 medical students of an institution was measured and analyzed in the period from March to September 2016, using the standardization recommended by the American Heart Association, in 3 time intervals: school holidays, classes without exams, and classes with exams.

**Results:** The authors verified that the systolic arterial pressure and cardiac frequency values checked on exam days were statistically higher (mean of 121.60 mmHg and 85 bpm, respectively) than when measured on class days or during vacations. Whereas the systolic arterial pressure and cardiac frequency values measured on class days were significantly lower than those on the other days (mean of 112.75 mmHg and 74.86 bpm, respectively).

**Conclusion:** The authors statistically verified that stress during exam periods had an influence on the arterial blood pressure of medical students, bringing into focus the need for teaching institutions to provide these students with psychosocial and pedagogical support.

**Keywords:** Medical student; Stress; Education; Blood pressure; Distress

**Abbreviations:** SAP: Systemic Arterial Pressure; SAH: Systemic Arterial Hypertension; SBH: Brazilian Hypertension Society; EHS: European Hypertension Society; SD: Standard Deviation; AP: Arterial Pressure

## Introduction

Systemic arterial pressure is the product of force exerted by cardiac debit against the walls of blood vessels; and is systolic while the heart pumps blood, and diastolic when it relaxes between beats. Arterial pressure values in healthy adults are below 120 mmHg in the systole and 80 mmHg in the diastole. Cardiac frequency is designated as being the number of times the heart beats per minute, and its normal rate at rest, variable from person to person, is from 60 to 100 [1].

Various factors may change the arterial blood pressure, and one of the most common products of this change is systemic arterial hypertension (SAH). This is characterized by sustained high levels of arterial pressure above 140 mmHg systolic and above 90 mmHg diastolic, and may have an influence on homeostasis [2].

Globally, cardiovascular diseases cause 17 million deaths/year, of these, 9.4 million results from SAH complications. In 2008, worldwide,

40% of adult's  $\geq 25$  years of age were diagnosed with hypertension, resulting in the number of 1 billion individuals [3].

Among the various risk factors for the development of SAH and circulatory diseases, the following are cited: family history, age, gender, ethnicity; and those that can be controlled: excess weight, high sodium consumption, alcoholism, smoking, sedentarism, psychosocial stress, socioeconomic factors, sleep apnea and other environmental conditions that tend to contribute to an unhealthy lifestyle [1].

A risk factor greatly involved in the change in arterial pressure and cardiac frequency, stress consists of a pathological change in response to environmental stimuli. This causative agent has become more common in triggering SAH due to the transformation in the social sphere, in which sedentary habits are associated with long working days, eating habits, violence, and so many other factors that contribute to emotional wear [4].

Bearing in mind the pathological effects of stress and their consequences relative to arterial pressure and pulse rate, the high level of stress experienced by medical students must be taken into consideration. The fact that this group is submitted to long days of classes, long hours of study and pressure both in the academic medium and family circle, factors that converge and lead to a high incidence of anguish/distress. This distress could have a profound impact on the professional and personal life of students, and leave them more vulnerable to developing depressive conditions. By virtue of this

stressful situation, this class may present reduction in academic performance, social isolation, exhaustion, and even greater predisposition to developing various pathologies, since the immune system is highly influenced by the emotional and psychological state [5,6].

## Methods

Initially, the project of the present study was sent to the Committee on Ethics in Researches with Human Beings, and after issue of the report favorable to conducting the study, the procedures described hereafter were carried out.

The sample was composed of 109 students out of the total of 300 enrolled in the undergraduate course in Medicine by the University of Itaúna, Minas Gerais, Brazil, comprised of the 1<sup>st</sup> and 7<sup>th</sup> academic periods in the 1st semester of 2016. The sample number was obtained after including students who showed they were in favor of participating in the study. Afterwards, arterial pressure was recorded in 3 time intervals: during school holidays; an academic period without exams, and an academic period during exams. The authors emphasize that at this institution, exams on all the disciplines generally take place during the period of 1 week.

Authorization was obtained from the Coordinator of the Course in Medicine of the University, to conduct the research on the premises of the faculty.

The inclusion criteria were as follows: medical students duly enrolled and attending courses between the 1<sup>st</sup> and 7<sup>th</sup> period at the University of Itaúna; who were in agreement with the Term of Free and Informed Consent, and who authorized the measurements to be taken in the periods determined.

The exclusion criterion was students of the course in Medicine of the University of Itaúna who were attending courses higher than the seventh period, and students who did not authorize their participation in the study.

A questionnaire was applied, covering the students' identification data, follow-up chart of measurement, and questions related to factors that affected the level of arterial pressure and that could have an influence on the research, such as hereditary cardiovascular disease, age, gender, sedentarism, alcohol consumption, smoking, use of medications during the exam periods.

A term of free and informed consent was written in accordance with the criteria established by the University of Itaúna, with the procedures related to the research, risks and benefits detailed in easily understandable language, which each participant signed, and received a copy of equal content signed by the researchers.

The arterial pressure monitor used in the study was the automatic (brachial) Omron HEM-7113-BR, approved by the Brazilian Hypertension Society (SBH) ("Sociedade Brasileira de Hipertensão") and European Hypertension Society (EHS), equilibrated and checked in accordance with the ANVISA No. 80047300345 specification.

The measurements were taken by the same operator, who was trained and calibrated with regard to the pressure monitor manufacturer's specifications, so that this procedure would not interfere in the students' academic obligations.

Measurement was taken after a 30-minute rest, with 2 measurements being taken with an interval of 2 minutes between

them, in accordance with the cardiology guidelines of the American Heart Association. Afterwards the arithmetical mean values of systolic and diastolic arterial pressure were established.

After obtaining the measurements, the results were distributed in an Excel (Microsoft) table, and were afterwards submitted to statistical tests for the analysis of variance and descriptive statistics of the findings with reference to the questions in the questionnaire. The software used to perform the statistical tests were Graph Pad Prism 5.0<sup>®</sup> (GraphPad Software Inc., La Jolla, CA, USA) (Publisher's name: "Pontifícia Universidade Católica de Minas Gerais", Belo Horizonte, Brazil).

## Results

Of the 109 patients, with a mean age of 21.53 years (SD 2.95), who participated in this study 72 (66.05%) were of the female, and 37 (33.95%) of the male gender. The frequency of relevant medical data was tabulated (Table 1).

No data relative to Diabetes, AIDS and cardiac and renal insufficiency were put into the table, since the frequency of students with these conditions was zero.

The authors verified that the systolic arterial pressure and cardiac frequency values checked on exam days were statistically higher (mean of 121.60 mmHg and 85 bpm, respectively) than when measured on class days or during vacations.

Whereas the systolic arterial pressure and cardiac frequency values measured on class days were significantly lower than those on the other days (mean of 112.75 mmHg and 74.86 bpm, respectively).

Characteristics of the sample	Number of Individuals (n)
Female Sex	n = 72 (66.05%)
Male Sex	n = 37 (33.95%)
Age of sample (years)	21.53 (±2.95)
Hypertension	1 (0.91%)
Anti-Hypertensive Medication	2 (1.82%)
History of Hypertension	59 (54.12%)
Dyslipidemia	1 (0.91%)
Sedentarism	51 (46.78%)
Smoking	4 (3.66%)
Use of medications in exam periods	26 (23.85%)

**Table 1:** Characterization of sample composed of 109 individuals.

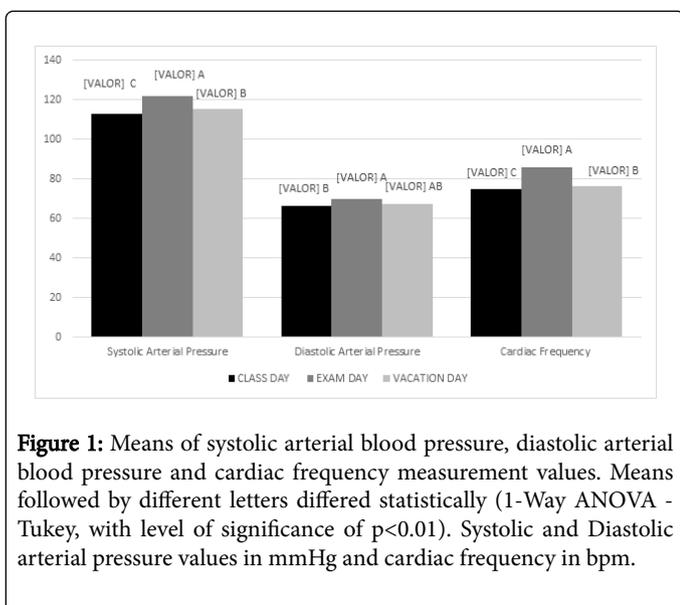
Only for diastolic pressure was there no statistical difference between measurements on class days and vacation days, and between vacation days and exam days. However, there was statistical difference between values of measurement days and exam days (66.32 mmHg and 69.87 mmHg, respectively).

For this purpose, the analysis of variance (One-Way ANOVA - Tukey, was used, with a level of significance of  $p < 0.01$ ) (Table 2 and Figure 1).

	Class Day	Exam Day	Vacation Day
<b>Systolic Blood Pressure</b>			
Mean (SD)	112.75 (± 11.46) C	121.60 (0.78) A	115.22 (11.13) B
<b>Diastolic Blood Pressure</b>			
Mean (SD)	66.32 (7.87) B	69.87 (8.35) A	67.45 (7.08)AB
<b>Cardiac Frequency</b>			
Mean (SD)	74.89 (± 11.31) C	85.67 (14.81) A	76.17 (13.16) B

Means followed by different letters in the horizontal differed statistically (1-Way ANOVA - Tukey, with level of significance of p<0.01). SD: Standard deviation systolic and diastolic arterial pressure values in mmHg and cardiac frequency in bpm.

**Table 2:** Comparison of means and standard deviations of systolic arterial blood pressure, diastolic arterial blood pressure and cardiac frequency measurement values.



**Figure 1:** Means of systolic arterial blood pressure, diastolic arterial blood pressure and cardiac frequency measurement values. Means followed by different letters differed statistically (1-Way ANOVA - Tukey, with level of significance of p<0.01). Systolic and Diastolic arterial pressure values in mmHg and cardiac frequency in bpm.

## Discussion

The study explored (in the field) the variations in arterial pressure (AP) of medical students in periods of classes, exams and vacations; with a view to the different influence of stress on students in these time intervals. This analysis was shown to be statistically true relative to the hypothesis, in which our results led us to clarity about the problem in palpable values of AP and its relationship with stress. As a result, we discussed the data obtained and their implications with studies of relevance.

The percentage of students who alleged sedentarism (46.78%) aroused concern due to its association with an unhealthy life style that leads to the onset of homeostatic imbalance, susceptibility to cardiovascular diseases, and excessive suffering from the load of stress experienced.1 As a similar fact, 23.85% of the individuals used medications in exam periods due to the necessity of diminishing anxiety and psychological anguish, therefore this was an important marker of the psychic state of this group of individuals.

Systolic arterial pressure and cardiac frequency values were statistically higher in exam periods than in the other periods. Diastolic AP was higher in tests than in classes; all of this was palpable proof of the degree to which stress affects the health of medical students. Physiologically a correlation has been verified between cardiovascular reactivity and vagal suppression as a consequence of prolonged activation of the sympathetic system by stress [7]. Exacerbation of the sympathetic function related to renal and vascular abnormalities acts directly as a risk factor not only for SAH, but also for other cardiovascular diseases [8]. Correlation has also been found between exacerbated vasoconstriction stimuli with imbalance of the immune response, proving greater susceptibility of persons affected by stress [9].

The choice of medicine associated with an unbalanced life style could trigger severe pathological questions, and data obtained in this study corroborate this affirmation. Psychological stress associates predisposing factors such as modern life events, problems related to work and family, social isolation, financial problems and violence.4 These conditions converge directly on psychological anguish in medical students, because they develop poor academic performance, increase rate of drop-out from medical schools, break-down of personal relationships, abuse of toxic substances and suicide.5,6 Other causes identified such as lack of learning strategy, nights of sleeping badly before exams, and ingestion of unhealthy foods during the period, have also been described in the literature [10]. In addition, the lack of psycho-pedagogical support and flexibility of exam periods may act as risk factors for stress of students, and become a pathological process inherent to medical education.

As more detailed explanations about the subject, the figures analyzed in this study demonstrated the influence of stress on arterial pressure, and this has a relationship with conditions of depression and psychological anguish. When compared with students of the same age, students of medicine have higher rates of symptomatology of depression: a quarter of them presented substantial symptoms [11]. In one study it was also verified that 35% of the medical interns were positive for significant symptoms of depression, such as cynicism, exhaustion and stress [12] The impact of stress on school performance may diminish the capability of concentration; motivation and cognitive capacity of students, with women being those most affected [13,14]. In short, the data obtained in this study fuse with those of other studies and statistically prove à priori how exam periods and

stress throughout the course degrade the health of students of medicine.

The higher number of women present in this study (66.05%) was in agreement with the results of other similar researches: Mata et al. obtained 65% of women in their analysis about depression among medical interns. Eva et al. recorded 64% in their study about the prevalence of stress in medical students. These data converge on the eminent increase in the participation of women in contemporary medicine which, according to the Association of American Medical Colleges, evolved from 31.4% in 1982 to 47% in 2012 and has increased every year [12,15-17].

As a curiosity for prevention of this problem, in a study conducted with 115 students, those with a larger number of friends were less anxious and depressive. Moreover, the women obtained the highest stress index when compared with men, and other biological gender and social factors may also be involved [17]. An eminent datum that corroborated the situation of stress experienced, according to The American Foundation for Suicide Prevention, showed that approximately 300 American doctors commit suicide per year, with the risk for men being 1.41 and risk for women being 2.27 times higher than that for others of different professions [18,19].

## Conclusion

The statistical increase in AP and cardiac frequency proved by this study demonstrated the degree of direct interference of stress in the cardiovascular condition of the students, not only for SAH, but for any and all their cardiac, immunological, renal and psychosocial conditions that work in harmony.

Therefore, the students' health is stated as a right to be considered by the medical curriculum; and this must be protected and supported so that all the wear suffered by students will not be so severe that it would be capable of harming learning, and the students' responsibility towards society, the family environment and their interpersonal relationships, particularly their own personal and spiritual well-being. In view of the foregoing considerations, it is necessary to promote an efficient education, with social responsibility towards the medical class, composed of individuals subjected to a greater dimension of accountability because of their zeal for care of life.

## Ethics Approval and Consent to Participate

Research Ethics Committee 5144 - University of Itaúna, Minas Gerais, Brazil. Corporate Tax Registration No. (CNPJ): 21.256.425/0001-36. CAAE: 53457216.0.0000.5144. Report: Approved, Number: 1.502.530.

## Authors' Contributions

OAVN - worked on obtaining the data, KFR worked on obtaining the data, TAO studied about the subject-matter and write article, GAAO managed roles of each author and assisted in the article creation - FRM - analyzed and interpreted the data regarding the systemic arterial pressure. All authors read and approved the final manuscript.

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