

CONFLICTS OF INTERESTS

None.

REFERENCES

1. Gutiérrez G. I.P. Pavlov: 100 años de investigación

del aprendizaje asociativo. Univ Psychol. 2005; 4(2):251-5.

2. Ministerio de Salud Pública. Anuario Estadístico de Salud 2017. La Habana: Dirección de Registros Médicos y Estadísticas de Salud; 2018.

3. Martínez-Lavín M. Caos, complejidad y cardiología. Arch Cardiol Mex. 2012;82(1):54-8.

Iván Pávlov research grant: open science for learning and research in cardiovascular psychophysiology

Beca Iván Pávlov: ciencia abierta para el aprendizaje y la investigación en psicofisiología cardiovascular

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Key words: Fellowships and Scholarships, Biomedical research, Research promotion, Medical students

Received: September 25, 2018

Accepted: October 16, 2018

Palabras clave: Becas, Investigación biomédica, Promoción de la investigación, Estudiantes de Medicina

To the Editor:

Undergraduate scientific research occupies an important place in the training of professionals of Medical Sciences in Cuba, which has generated new learning forms. Considering this, some authors have referred to the initiative of the Henrich Quincke Research Grant, developed by the Central Laboratory of Cerebrospinal Fluid of the Universidad de Ciencias Médicas de La Habana and the need to create similar spaces, that it promotes new ways of acquiring knowledge among students of Medical Sciences¹.

As a response to the initiative of Dorta-Contreras², the research team of Dr. Miguel Enrique Sánchez Hechavarría, from the Laboratory for Basic Biomedical Sciences, Faculty of Medicine N° 1, Universidad de Ciencias Médicas de Santiago (Cuba), have called, for the first time, the International Research

Grant in Cardiovascular Psychophysiology Ivan Pavlov, held between August 6 and 10, 2018 (**Figure**).

This space, which has the name of the Nobel Prize in Physiology and Medicine in 1904, for his discoveries about the conditional reflex (on the occasion in this year 2019 of his 170th birth anniversary), brought together 21 students from around the country to do 2.0 science.

Cardiac autonomic regulation, hemodynamic parameters, heart rate (HR) variability and the response to certain stimuli such as physical exercise, mental stress and dynamic weight-bearing test, were the main aspects to be analyzed.

The Grant, entirely, comprised five moments:

1. Promotion: where the call was spread through social networks and Cuba's health telematics network, Infomed. The call was officially launched in the III National Student Scientific Event of Internal

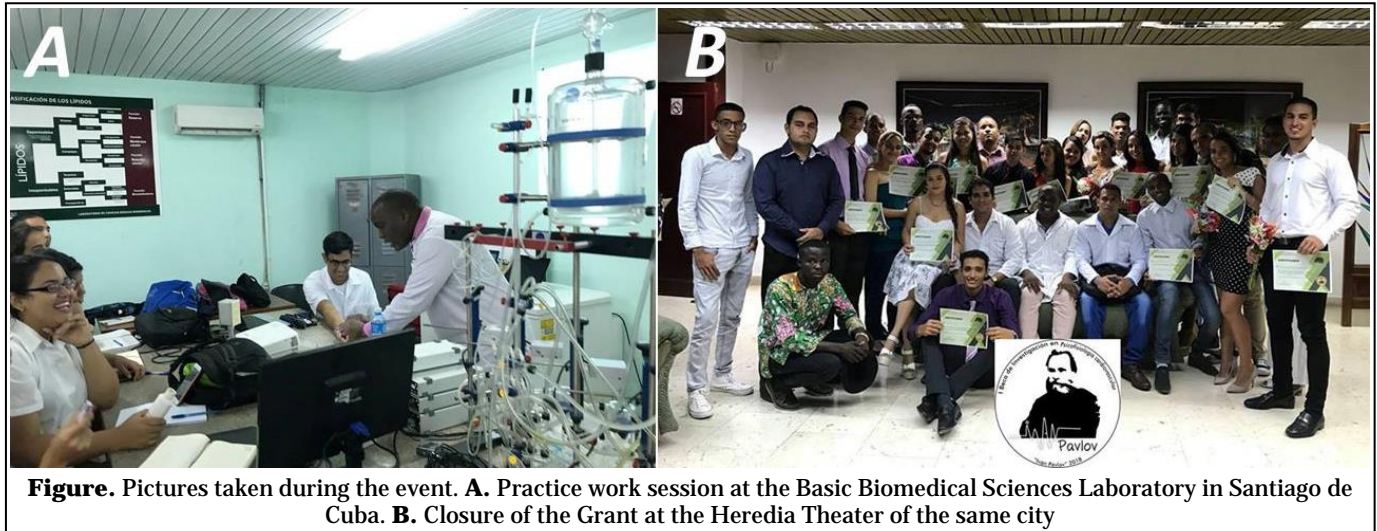


Figure. Pictures taken during the event. **A.** Practice work session at the Basic Biomedical Sciences Laboratory in Santiago de Cuba. **B.** Closure of the Grant at the Heredia Theater of the same city

Medicine «Medintávila 2018».

2. Selection of the winning students: in this stage, the teaching faculty, that later would work in the Grant, as well as the student research team of the professor Miguel Enrique Sánchez Hechavarría, reviewed in a rigorous way, and based on a scoring system, the *curriculum vitae* sent by the aspirants, to finally select 20 students of Medicine and 1 of Stomatology.
3. Sending of preparation modules: library materials and instructional videos on the contents to work in the Grant were distributed to the selected students, through email, as well as biostatistics elements and data processing, with which a modality of distance education was developed.
4. Grant: it was developed, face-to-face, from August 6 to 10, 2018. It included physiology laboratory practices, thematic conferences, collateral workshops and an extensive time fund for independent study.
5. Symposium: it was the final activity, which led to the presentation of the results of the eight original works (**Appendix**) generated from the primary data provided by the team of the Biomedical Basic Sciences Laboratory.

As benefits of this new space, which encourages open science, it should be noted that it does not reproduce studies, but generates studies from a set of data offered by the faculty; it allows remote preparation with the sending of complementary materials to the participating students, prior to the start of the

Grant, and it is intended to present the results obtained in the form of a scientific article, which will facilitate its publication in journals with related subjects. Another novelty of this Grant is that the student becomes the protagonist to be able to lead workshops on the research lines related to psychophysiology, or other common interest for participants such as: scientometric elements, bibliographic reference management and scientific communication through neurolinguistics programming.

The authors of this letter hope that institutions of higher medical education will continue to be added to this initiative, as well as a bigger summon and scientific quality, with students and professors from other parts of the world, as well as international reference centers on this research field.

CONFLICTS OF INTERESTS

None.

REFERENCES

1. Hernández-Negrín H. Beca de investigación Henrich Quincke: ¿se puede multiplicar en Cuba? *Educ Med.* 2017;18(2):150.
2. Dorta-Contreras AJ. Ciencia abierta para estudiantes de medicina: becas de investigación Quincke. *Educ Med.* 2017;18(2):149.

ANEXO

Resúmenes de las 8 investigaciones originales resultantes.

Nonlinear dynamics of cardiac autonomic regulation and hemodynamic parameters during the dynamic weight-bearing test in type 2 diabetic patients

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Introduction: With the increase in the incidence of chronic noncommunicable diseases, such as type 2 diabetes mellitus, it is essential to study it using inexpensive techniques, based on the health burden it represents. It is precisely here, in this disease, where the dynamic weight-bearing test gains value, as a static isometric exercise, observed from the perspective of the nonlinear parameters of the HR variability.

Objective: To determine the variations in the nonlinear dynamics of cardiac autonomic regulation and in the hemodynamic response during the dynamic weight-bearing test in type 2 diabetic patients.

Method: A quasi-experimental study was carried out, before-after, with no control group, in patients with type 2 diabetes mellitus, in the month of August 2018, at the Faculty of Medicine N° 1 in Santiago de Cuba; there were evaluated the nonlinear parameters of the HR variability in the basal state of rest and in the dynamic weight-bearing test.

Results: When comparing the dynamic weight-bearing test with respect to the rest, significant increases were found in the HR ($p=0.036$), blood pressure ($p<0.05$), SD2 ($p=0.003$) and SD2/SD1 ($p=0.005$). Moreover, there was a significant decrease ($p=0.003$) of the sample entropy, the parameter related to the degree of complexity and adaptability of systems.

Conclusions: In type 2 diabetic patients, an increase in the cardiovascular sympathetic response takes place during the dynamic weight-bearing test, affecting the adaptability and complexity of cardiac autonomic regulation.

Keywords: Diabetes mellitus, Dynamic weight-bearing test, Heart rate variability

Differences between males and females in presence of mental stress in the heart rate variability

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Introduction: Stress is the mental health problem of the future. The psychophysiological response of each individual to this noxa is diverse and the HR variability represents an efficient predictor in order to evaluate it.

Objective: To determine the differences between males and females in presence of stress by analyzing the linear dynamics of HR variability.

Method: A quasi-experimental study, before-after, with no control group, was carried out in 10 healthy individuals (5 females and 5 males). We analyzed the linear parameters of the HR variability and the differences between sexes at rest and before a certain stimulus (Stroop Color Test). In the statistical analysis, nonparametric techniques were used, as the Mann-Whitney U test for qualitative variables and the Wilcoxon signed-rank test for quantitative variables.

Results: The low frequency band (LF [$p=0.038$]) had a statistically significant increase from basal state to mental stress. The HR in men was higher at both, basal state ($p=0.016$) and mental stress ($p=0.009$). Women showed a pNN50 (parasympathetic indicator [percentage of consecutive RR intervals that differ by more than 50 ms from each other]) greater

($p=0.009$) in presence of stress than men. In a multiparametric analysis, from the qualitative point of view, the sympathetic index was elevated in males with respect to females.

Conclusions: In men, a greater sympathetic cardiovascular psychophysiological response to stress with respect to women was evidenced.

Keywords: Mental stress, Heart rate variability, Stroop test

Modifications of the nonlinear parameters of the heart rate variability in relation to the systematic practice of physical exercise

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Introduction: In recent years, the relationship between the functioning of the autonomic nervous system, the cardiovascular diseases and the influence of systematic practice of sports has been recognized.

Objective: To determine the modifications that the nonlinear parameters of the HR variability undergo with the systematic practice of physical exercise.

Method: An analytical cross-sectional study was carried out with 36 individuals (18 high-performance baseball athletes and 18 students from the Universidad de Ciencias Médicas de Santiago de Cuba). All data were collected in the Biomedical Sciences Laboratory of the University, through the PowerLab 8-channel polygraph, and analyzed using the Kubios Software version 3.0.4 Premium.

Results: When comparing the athletes regarding the students, there were found statistically significant differences with a decrease in the values of HR ($p=0.0001$) and an increase of nonlinear parameters

of HR variability: SD1 ($p=0.025$), SD2/SD1 ratio ($p=0.007$), sample entropy ($p=0.011$), short-term fluctuations alpha 1 ($p=0.019$), linear average length ($p=0.016$), maximum linear length ($p=0.001$), recurrence rate ($p=0.034$), determinism ($p=0.010$) and Shannon entropy ($p=0.015$).

Conclusions: In athletes, the representation of cardiac autonomic regulation, through the nonlinear parameters of HR variability, undergo modifications that respond to a better adaptability of cardiac function related to the systematic practice of physical exercise.

Keywords: Heart rate variability, Physical exercise, Athletes

Effect of the Stroop word-color test in the nonlinear parameters of the heart rate variability according to the sex

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Introduction: Stress is considered by psychologists to be responsible for changes. When it continues over time can affect many psychological and physiological functions such as the immune system, metabolism, reproduction and circulation. The regulation of the autonomic nervous system on the cardiovascular system that is commonly affected by stress can be evaluated through the HR variability.

Objective: To determine the effect of the Stroop word-color test in nonlinear parameters of the HR variability according to the sex.

Method: A quasi-experimental study was conducted, before-after, with no control group, in 10 medical students of both sexes randomly selected in Santiago de Cuba, for the analysis of the RR intervals' variability of the second standard deviation of the electrocardiogram in the Powerlab 8 device. For the detection of RR peaks, its processing was used and

the variability parameters' calculation of the Premium HRV Kubios program (version 3.1.0).

Results: It was observed that men showed a significant decrease ($p=0.008$) of the sample entropy (parameter related to the degree of complexity and adaptability systems) before the application of the Stroop Color test (pre-test rest) with respect to women.

Conclusions: In the period preceding the Stroop word-color, the men presented a decrease in complexity and adaptability in the autonomic cardiac regulation, with respect to the women, which could lead to a predisposition towards psychic stress and inadequate physiological responses.

Keywords: Stroop test, Nonlinear parameters, Heart rate variability, Psychological stress

Influence of the systematic practice of physical exercises on cardiac autonomic regulation

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Introduction: The systematic practice of physical exercises provides benefits to the health of the individual and induces psychophysiological changes to the HR.

Objective: To determine the modifications induced by the systematic practice of physical exercises in cardiac autonomic regulation.

Method: An analytical cross-sectional study was conducted in a sample of 36 individuals, 18 medical students paired with 18 high-performance baseball athletes in the Biomedical Basic Medical Sciences Laboratory of the Universidad de Medicina de Santiago de Cuba. There were used the sympathetic and parasympathetic indices, from the multiparameter models of the HR variability, from the Premium HRV

Kubios program (version 3.1.0).

Results: When comparing the athletes with respect to the students, a significant increase of the parasympathetic index was found ($p=0.008$), as well as a significant decrease in the sympathetic ($p=0.007$).

Conclusions: In resting conditions, the systematic practice of physical exercises is associated with a reduction of the sympathetic influence and an increase of the parasympathetic on cardiac activity, representing the multiparametric models of the HR variability promising and non-invasive ways of evaluating the cardiovascular health status.

Keywords: Athletes, Students, Heart rate variability

Heart rate variability in deep hypnosis

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Introduction: Hypnosis is a special state of consciousness in which ideas are accepted by suggestion rather than by logical evaluation, with characteristic behavioral and vegetative changes, which can be evaluated through the HR variability.

Objective: To determine the changes in the HR variability in deep hypnosis.

Method: A quasi-experimental study, before-after, with no control group, was performed in 15 20-year-old supposedly healthy young men. There were evaluated 10 minutes of quiet wakefulness with eyes closed (rest) and in another 10 minutes (objective signs) overall HR variability expressed by the standard deviation of the RR intervals (SDNN). The Wilcoxon signed-rank test, the nonparametric statistician for related samples, was used; with a significance level of $p<0.05$.

Results: Comparing deep hypnosis with respect to the rest, there was a significant increase ($p=0.01$ of SDNN with no changes in HR ($p>0.05$)).

Conclusions: In deep hypnosis, there was a global

HR variability that could be associated with the salutogenic effect and the therapeutic potentialities described in hypnotherapy.

Keywords: Hypnosis, Heart rate variability, Young men

Effect of the arithmetic calculation test on the linear parameters of variability in young individuals

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Introduction: The HR variability is the variation of this vital sign during a time interval, previously defined, never greater than 24 hours, in a study of consecutive circadian periods. Its analysis represents an effective method in the evaluation of the autonomic regulation of cardiac activity.

Objective: To determine the effect of the arithmetic calculation test on the linear parameters of the HR variability.

Method: A quasi-experimental study, before-after, with no control group, was conducted, where the effects of arithmetic calculation test were analyzed in the linear parameters of HR variability. The variability indexes were analyzed in a sample of 10 healthy men with an average age of 19.5 years. The RR intervals were obtained under basal (control) and stress conditions.

Results: We found a decrease in the RR intervals ($p=0.005$), of the RMSSD (square root of the mean of the differences of the RR intervals; $p=0.007$), pNN50 (percentage of consecutive RR intervals, which differ by more than 50 ms from each other, $p=0.005$), and the parasympathetic index ($p=0.005$), as well as increases in mean and maximum HR ($p=0.005$), the sympathetic index ($p=0.005$) and the vagal-sympathetic ratio quotient ($p=0.005$).

Conclusions: It was demonstrated that this invasive, quantitative and reproducible technique provides interesting information about the behavior of HR in presence of a controlled mental exercise, where mental stress is shown to be a modifier of cardiovascular variability during the arithmetic calculation test.

Keywords: Heart rate variability, Linear parameters, Arithmetic calculation test

Modifications of the nonlinear parameters of the heart rate variability in relation to the arithmetic calculation test

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Introduction: The responses of the autonomic nervous system to situations of stress and struggle usually translate into an increase in HR, blood pressure and cardiac output. The complexity of these responses can be evaluated through the nonlinear parameters of the HR variability.

Objective: To determine the modifications that the nonlinear parameters of the HR variability undergo when faced with mental stress.

Method: A quasi-experimental study was conducted, with no control group, before-after, a sample consisting of 10 men in the Laboratory of Basic Medical Sciences at the Universidad de Ciencias Médicas de Santiago de Cuba, for the analysis of the RR intervals' variability of the electrocardiogram in the Powerlab 8. For the detection of RR peaks, its processing was used and the variability parameters' calculation of the Premium HRV Kubios program (version 3.1.0).

Results: In the nonlinear parameters of HR variability, when comparing in individuals the mental stress induced by the arithmetic calculation test with re-

spect to the rest state, there was a reduction in the sample entropy ($p=0.047$) –parameter related to the degree of complexity and adaptability of the systems– and an increase of SD2/SD1 ($p=0.005$) that represents the cardiac sympathetic index.

Conclusions: Under conditions of induced mental

stress, the nonlinear parameters of HR variability reflected an increase in sympathetic modulation over the heart and a decrease in the complexity and adaptability in the autonomic cardiac regulation.

Keywords: Mental stress, Heart rate variability, Arithmetic calculation.