

Cardiac Biofeedback training and Subjective Well-Being improvement

Treinamento de Biofeedback Cardíaco e Melhoria do Bem-Estar Subjetivo

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ABSTRACT

Psychosomatic Stress Management, based on computational psychophysiological biofeedback techniques, is a modern method of training and conscious stress control. The Heart Rate Variability biofeedback (HRV) is one of the most reliable strategy for measuring parameters related to the functioning of the autonomic nervous system. The study aim was to apply HRV technique to the evaluation and training university students, correlating cardiac coherence to changes in the perception of Subjective well-being (SWB). Eighty two students from the State University of Goiás, Goiânia, Goiás, Brazil, were evaluated. The cardiac biofeedback evaluation and training were performed using the CardioEmotion software (Neuropsicotronics, University of São Paulo, SP). For the accomplishment of this study, the students' HRVs were measured, in consecutive training sessions, and the pre and post scores training were compared. Significant improvement in SWB was demonstrated after biofeedback training. The technique also helped participants to learn how to reestablish and maintain cardiac coherence. We concluded that HRV training helped to reduce the stress levels and anxiety reported by the study participants.

Keywords: Coherence; Respiratory control; Autonomic regulation; Physiological; Cardiovascular

RESUMO

O Gerenciamento do Estresse Psicossomático, baseado em técnicas de biofeedback psicofisiológico computacional, é um método moderno de treinamento e controle consciente do estresse. O biofeedback de Variabilidade da Frequência Cardíaca (VFC) é uma das estratégias mais confiáveis para mensurar parâmetros relacionados ao funcionamento do sistema nervoso autônomo. O objetivo do estudo foi aplicar a técnica da VFC na avaliação e treinamento de universitários, correlacionando a coerência cardíaca às mudanças na percepção de bem-estar subjetivo (BES). Foram avaliados 82 alunos da Universidade Estadual de Goiás, Goiânia, Goiás, Brasil. A avaliação do biofeedback cardíaco e o treinamento foram realizados utilizando o software CardioEmotion (Neuropsicotronics, Universidade de São Paulo, SP). Para a realização deste estudo, foram medidas as VFCs dos alunos, em sessões consecutivas de treinamento, e comparadas as pontuações pré e pós-treinamento. Melhora significativa no BES foi demonstrada após o treinamento de biofeedback. A técnica também ajudou os participantes a aprender como restabelecer e manter a coerência cardíaca. Concluímos que o treinamento em VFC ajudou a reduzir os níveis de estresse e ansiedade relatados pelos participantes do estudo.

Palavras-chave: Coerência; Controle respiratório; Regulação autonômica; fisiológico; Cardiovascular

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INTRODUCTION

Heart rate variability (HRV) biofeedback is one of the most reliable methods for measuring parameters related to the autonomic nervous system functioning. HRV is defined as the time variation measured between two R's waves. On the electrocardiogram, the heartbeat shows a peak generated by atrial depolarization, P wave, a ventricular depolarization complex, QRS complex, and finally the ventricular depolarization, T wave. The instantaneous heart rate can be established as the interval between two consecutive R's peaks, which is known by RR interval. HRV is, therefore, the variation found in the time intervals between RR peaks in a series of measurements performed in the time domain.(PAUL; GARG, 2012)

There are three cardiac biofeedback action axes in the cardiac coherence state: the baroreflex axis - responsible for the blood pressure regulation -, a second axis, known as vagal afference - where information is sent via the vagus nerve to the upper centers (limbic system - emotions) and the prefrontal cortex. A third mechanism is associated with the anti-inflammatory axis, responsible for reducing inflammation.(PAUL; GARG, 2012)

HRV biofeedback reports the emotional expression index based on the interaction between the sympathetic and parasympathetic systems. A low HRV is associated with vagus nerve less activity and sympathetic nervous system increased activity.(DANUCALOV, 2010)

In the cardiac coherence state, the autonomic nervous system rebalances. This rebalancing results in increased oxygen saturation and better brain and prefrontal cortex oxygenation; hypertension reduction; reduced tension, through muscle relaxation, and reduced chronic pain; reduced heart rate; excess cortisol reduction, by acting on the HPA axis (hypothalamus-pituitary-adrenal), resulting in dehydroepiandrosterone levels increase (DHEA).(DANUCALOV, 2010)

The autonomic nervous system balance is also reflected in the limbic system, promoting a amygdala hyper-reactivity reduction in the hippocampus. As a result, there are stress, anxiety and depression decrease; there are also insomnia, hyperactivity, and lack of attention reduction.(MCEWEN; WINGFIELD, 2003; TROISI, 2001)

Subjective well-being (SWB)

SWB is the studies field that seeks to understand the assessments that people make of their lives.(DIENER; SUH; OISHI, 1997) These must be cognitive (overall satisfaction with life and other specific domains) and must also include a personal frequency analysis which positive and negative emotions are experienced. According to Diener et al (DIENER; SUH; OISHI, 1997), in this field of knowledge, we do not seek to study negative or pathological psychological states, such as depression, anxiety and stress, but to differentiate the levels of well-being that people can achieve in their lives.

The SWB concept appeared in the late 1950s, when quality of life indicators were sought to monitor social changes and the implementation of social policies. Campbell (CAMPBELL; CONVERSE; RODGERS, 1976) held that, although people live in objectively defined environments, they respond to the subjectively defined world. In this perspective, SWB has become an important quality of life indicator. The researchers' current effort are guided by the search for understanding the process that sustains happiness.(DIENER et al., 1999) According to Diener, Oishi and Lucas (DIENER; OISHI; LUCAS, 2003), SWB can only be observed and reported by the individual himself and not by external indicators chosen and defined by third parties.

In SWB, it is necessary to consider that each person evaluates his own life by applying subjective conceptions. In this process, they rely on their own expectations, values, emotions and previous experiences. These subjective conceptions, according to Diener, Oishi and Lucas (DIENER; OISHI; LUCAS, 2003), are organized in thoughts and feelings about individual existence.

It is understood by several scholars (DIENER et al., 1999; DIENER; SUH; OISHI, 1997) that SWB is a broad phenomenon and should be considered as a scientific interest area that encompasses two specific concepts: global satisfaction with life judgments, or with specific domains of it, and positive and negative emotional experiences.(DIENER et al., 1999) In this sense, the SWB concept articulates two perspectives in psychology: one is based on theories about emotional states, emotions, affects and feelings (positive affects and negative affects) and the other one is sustained in the cognition domains, being operationalized by satisfaction evaluations (in general life, in specific life aspects such as work).

Considering the above description, the study aim was to assess whether cardiac biofeedback improves the university students SWB perception.

MATERIAL AND METHODS

Ethical aspects

This study was approved by the Ethics and Research Committee of the State University of Goiás under the number of 2,512,498.

Participants

Eighty two students from the State University of Goiás, Goiânia, Goiás, Brazil, were evaluated. Students who presented any health problem that prevented the biofeedback assessment procedure, such as heart disease; or students who practiced relaxation, meditation and breathing techniques were excluded from the study.

HRV assessment

Cardiac biofeedback assessment and training was performed using the CardioEmotion software (Neuropsicotronics, University of São Paulo, SP). Cardiovascular biofeedback is a physiological self-modulation technique mediated by resonance between two cardiovascular regulation mechanisms: the baroreceptor reflex and respiratory sinus arrhythmia. This measure represents the interval between two consecutive heartbeat pulsations (RR interval). By non-invasive sensors placed on the fingers or the auricular lobe, the beats were captured and then transmitted to a computer program to assess the heart rate. Before starting training in biofeedback, the resonant breathing frequency was established, in which it is possible to obtain more time in cardiac coherence. The time intervals recording between each heartbeat was followed by the mathematical treatment of these data by software. The software attributed a note (range 0 to 10, being 0 total incoherence and 10, perfect coherence). Participants underwent daily biofeedback sessions, lasting 20 minutes, for 8 weeks.

SWB evaluation

A self-administered questionnaire composed by SWB Scale was used for data collection. This scale was developed by Albuquerque and Tróccoli (ALBUQUERQUE; TRÓCCOLI, 2004), and consists in 62 items, of which 21 represent positive affect components, 26 negative affect and 15 life satisfaction.

Self-Esteem assessment

The Self-Esteem Scale developed by Rosenberg (ROSENBERG, 1989) was used. This is a one-dimensional measure consisting in ten statements related to a feelings set of self-esteem and self-acceptance that assesses global self-esteem. Items are answered on a four-point Likert scale ranging from strongly agree, agree, disagree and strongly disagree. In this study, the version adapted to Portuguese by Hutz (HUTZ, 2000) was used.

Hope Assessment

The instrument used was Herth's Hope Scale, adapted to Portuguese by Grossi (2008). The scale consists in 12 statements with responses on a Likert-type scale with scores from 1 to 4 for each of them, and the higher the score, the greater the hope.

Optimism assessment

For the optimism assessment, the Life Orientation Test Revised - LOT-R adapted and validated by Bastianello, Pacico, & Hutz (BASTIANELLO; PACICO; HUTZ, 2014) was used. This instrument consists in 10 items that assess optimism and pessimism.

Data analysis

The collected data were analyzed using the Statistical Package for the Social Sciences - SPSS, version 17 for Windows. The ANOVA test and the paired t test were used to compare biofeedback and SWB variables and pre and post training scores. The

correlation between SWB and HRV factors was assessed using Pearson and Spearman's correlation coefficient.

RESULTS

Participant characteristics

Eighty two volunteers were invited to participate in the present study. However, 50% of participants resigned from participating in the survey between the first and fifth sessions. The main reason for dropping out was the cell phone compulsion. These students claimed shortage of time, difficulty concentrating during training and the inability to refrain of using a cell phone.

Participants who completed the training were between 17 and 45 years old (mean age = 27). Eighty percent were female and 46.7% were married.

HRV coherence

The average score for physiological monitoring observed before training was 4.2. After the biofeedback sessions, there was an increase in coherence, being 7.8 the average grade. When comparing the pre and post-training physiological monitoring average scores, significant results ($p < 0.00001$) were observed after training.

SWB assessment

The SWB increase was observed after the study ending. There was an perception improvement in all SWB scales. A significant increase in the component "life satisfaction" ($p < 0.0001$) and positive affects ($p < 0.0001$), in addition to self-esteem ($p < 0.0001$) and Optimism ($p < 0.002$) was observed (table 1).

Table 1. Average scores and their respective standard deviations for the three Subjective Well-Being Scale factors and the Hope, Self-Esteem and Optimism scales.

Group	Minimum	Maximum	Mean	Median	Standard Deviation	Shapiro-Wilk p
ILS	15	32	20.9	19	4.96	0.162
FLS	25	95	58.3	60	17.9	0.698
IH	36	50	44.3	45	4.27	0.358
FH	25	95	50.3	55	17.9	0.209
ISE	23	30	26.3	27	2.34	0.138
FSE	40	90	80	80	12.1	0.001
IO	29	37	32.5	33	2.56	0.403
FO	10	95	65.3	75	32.5	0.009
INE	11	30	18.7	17	5.73	0.186
FNE	5	50	21.3	25	17.2	0.005
IPA	17	46	35.3	37	7.93	0.162
FPA	25	95	71.7	75	20.9	0.028
IB	0	9.3	2.63	1.60	2.54	0.027
FB	7.9	10	9.64	9.80	0.537	0.001

I- initial note, F- final note, LS- Life Satisfaction, H- Hope; SE- Self-Esteem, O- Optimism, NE- Negative Affects, PA- Positive Affects, B- Biofeedback

After the interventions ending, the volunteers reported having achieved greater emotional control in verbal confrontation situations, as well as a significant improvement in self-esteem and a considerable growth between positive and negative affects. Eleven participants stated a reduction in the general stress level. One volunteer reported less binge eating. It is worth mentioning that 7 people reported an improvement in sleep quality as well.

HRV and SWB correlation

When assessing the correlation between HRV and SWB, the optimism, hope and self-esteem scales, we observed a significant correlation between HRV and the life satisfaction components, positive affect, optimism and self-esteem scales (table 2).

Table 2. HRV correlation test results to three Subjective Well-Being Scale factors and the Hope, Self-Esteem and Optimism scales

		LS	H	SE	O	NE	PA
BN	Pearson's r	0.764	0.242	0.858	0.573	0.020	0.677
	p-value	<.001	0.198	<.001	<.001	0.916	<.001
	Spearman's rho	0.835	0.130	0.793	0.567	-0.093	0.658
	p-value	<.001	0.493	<.001	0.001	0.626	<.001

LS- Life Satisfaction, H- Hope; SE- Self-Esteem, O- Optimism, NE- Negative Affects, PA- Positive Affects, BN- Biofeedback note

DISCUSSION

Cardiovascular Biofeedback has been considered a complementary therapy in achieving complete physical, mental and spiritual well-being, resulting in cardiovascular and metabolic diseases reduction.(GOMES; COGHI; COGHI, 2014) In addition, this therapeutic approach contributes to the anxiety reduction, depression and post-traumatic stress disorders.(LANTYER; VIANA; PADOVANI, 2013) In this study, we observed that Biofeedback therapeutic approach was relevant in SWB components life satisfaction and positive affect, in addition to improving self-esteem and optimism.

Studies have shown that individuals who present “positive affect” excellent results have easy sociability, being able to interact in a natural and pleasant way with other people.(PASSARELI; SILVA, 2007) In the present study, after Biofeedback training, participants achieved high positive affect rates, presenting average scores close to 80%. In this way, this therapeutic approach contributes for obtaining better sociability and integration in an increasingly competitive and demanding world.(SIQUEIRA; PADOVAM, 2008) At the study ending, the participants also reported greater satisfaction

with life, which was another component significantly influenced by biofeedback intervention.

Optimism was another component influenced by HRV training. Although optimism does not belong to SWB scales, it contributes to the SWB improvement, based on the strategy elaboration to face problems, such as coping. According to bottom-up and top-down theories, the SWB determinants can be intrinsic and extrinsic. The former include psychological aspects, religiosity and beliefs, coping strategies, values and physical health conditions. Extrinsic are sociodemographic, cultural and life events. Among them, the main SWB determining factor is the individual's personality.(WOYCIEKOSKI; STENERT; HUTZ, 2012) In this study, we observed that most individuals experienced improvement in SWB components, after Biofeedback treatment. This fact corroborates the concept that this therapy, especially when combined with other complementary therapies (meditation, physical activity, group sessions), has the potential to contribute for physical and individuals mental well-being improve and to cope with situations unpleasant emotions.(KOTOZAKI et al., 2014)

However, it is worth mentioning that, despite the HRV biofeedback benefits demonstrated, we observed a high percentage of students who resigned participating in the study. The main reason was the compulsion to use the cell phone. This data is worrying and, as noted by Cappellozza (CAPPELLOZZA; DE MORAES; MUNIZ, 2017), there is a general tendency to consider health and quality of life not being a priority, above all, due to the use of cell phones.(CAPPELLOZZA; DE MORAES; MUNIZ, 2017)

CONCLUSION

The present study demonstrated that cardiac biofeedback, associated with conscious respiratory control, contributed to SWB, optimism and life satisfaction increase and stress reducing levels.

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