INFLUENCE OF A CONTROLLED BREATHING TECHNIQUE ON STRESS-RELATED INDICATORS IN VOLLEYBALL PLAYERS

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ABSTRACT
Breathing plays a key role in regulating a person's physiological and psychological states, with increasing research emphasizing its importance in managing stress and maintaining emotional stability. In sports, specific breathing techniques are also considered effective for improving training effectiveness and mental resilience in high-pressure competitive situations. This study aims to examine the relationships between specific personality traits and physiological stress indicators, as well as the impact of a controlled breathing practice on situational anxiety and physiological responses in athletes. The study was conducted in 2024. The research involved 20 volleyball players from the "Minior-Pernik" sports club (9 women and 11 men, aged between 16 and 18), divided into two groups: a control group (n=10) and an experimental group (n=10). The experimental group followed a 30-day training program in controlled breathing. Before the experiment, all athletes (n = 20) were tested on several physiological indicators (VO_2 max, blood pressure, RR, heart rate, etc.), and three psychological questionnaires were administered. A comparative analysis of the pre-experiment data across the whole group showed statistically significant differences based on gender in four variables: perceived stress, neuroticism, VO_2MAX/kg, and body fat percentage (BF%). No statistically significant differences were found between the control and experimental groups before the experiment. After the training period, results from the Wilcoxon Signed Ranks Test showed statistically significant differences in the experimental group before and after the intervention in the following indicators: diastolic blood pressure ($Z = -2.553$, $p = .011$), with a significant decrease. Heart rate ($Z = -2.654$, $p = .008$) significant decrease. Situational anxiety ($Z = -2.098$, $p = .036$) significant decrease. In the control group, no statistically significant change was observed in any measured indicators before and after the experiment. Regression analysis results indicated that trait anxiety significantly influenced perceived stress ($\beta = 0.640$), and perceived stress influenced athletes' situational anxiety ($\beta = 0.453$). The findings of this study can be considered when working with 16–18-year-old volleyball players, especially when managing overall stress and coping with high expectations and responsibilities during competitions.

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INTRODUCTION

In the contemporary world, characterized by rapid changes and increasing demands, stress and anxiety have become widespread issues, significantly impacting individual well-being and functioning. Understanding these conditions is crucial for developing effective coping strategies. One of the most influential theoretical models explaining the subjective experience of stress is Lazarus and Folkman's transactional model of stress and coping (1984). This model emphasizes that stress is not merely a reaction to external events but a dynamic process involving cognitive appraisal of the situation and individual resources for coping with it. Perceived stress arises precisely from this subjective interpretation, where environmental demands may exceed perceived personal capabilities. The inability to cope with stress and pre-competition anxiety raises the question of appropriate methods for regulation and self-regulation (e.g., self-talk, breathing techniques, visualization) to help manage anxious states. These skills establish the connection and transfer between training activities and competitive performance, where athletes' tension and efforts are greatest (Yancheva & Domuschieva-Rogleva, 2014).

Alongside perceived stress, anxiety is also a subject of in-depth research, with one of the most established distinctions proposed by Charles D. Spielberger (1983). His theory differentiates between state anxiety – a temporary emotional state dependent on the specific situation, and trait anxiety – a relatively stable personality characteristic reflecting an individual's predisposition to perceive situations as threatening. This conceptualization allows for a more nuanced understanding of anxious states and their influence on behavior and physiology.

In response to the growing need for effective methods to reduce stress and anxiety, controlled breathing has emerged as a promising intervention. Its scientifically proven benefits include improving stress tolerance and reducing anxiety levels. Systematic reviews and meta-analyses show a significant effect of breathing exercises on perceived stress, anxiety, and depressive symptoms (Fincham et al., 2023; Banushi et al., 2023; Bentley et al.,2023). Breathing directly affects the autonomic nervous system, offering a "bottom-up" approach to stress management. Specific techniques such as cyclic sighing, researched by Balban et al. (2023), demonstrate their ability to increase positive affect and reduce sympathetic tone associated with stress. These breathing practices also lead to a significant reduction in negative affect and state anxiety. Although studies do not show a significant change in trait anxiety, the impact on state anxiety and emotional states is significant. The ease of application and high safety profile of these techniques make them accessible and appealing to a wide population.

Given the proven benefits of controlled breathing for regulating psychophysiological states, the present article aims to deepen the understanding of the interaction between breathing practices, perceived stress, and various aspects of anxiety. It will review contemporary scientific data and highlight the potential of controlled breathing as a tool for improving mental health and adaptation to stressors.

Aim

This study aims to examine the relationships between specific personality traits and physiological stress indicators, as well as the impact of a controlled breathing practice on situational anxiety and physiological responses in athletes.

METHODOLOGY

Participants

The research involved 20 volleyball players from the "Minior-Pernik" sports club (9 women and 11 men, aged 16 to 18), divided into two groups: a control group (n = 10) and an experimental group (n = 10).

Procedure

The organization and conduct of the study proceeded through the following stages:

- *Stage I (December 2023 – February 2024):* Literature review, selection of testing methodologies, preparation of the psychological-pedagogical experiment, and sending information to the sports organization and participants. All participants and their legal guardians (as the participants were minors) provided written informed consent prior to their inclusion in the study.
- *Stage II (March – June 2022):* Initial testing of all participants before the experiment. Psychological testing was conducted between March 05-07, 2024, in the "Krakra" sports hall, before training, after the subjects were acquainted with the purpose and essence of the experiment. Comprehensive functional testing was conducted from March 12 to 14, 2024, at the Center for Scientific and Applied Activities in Sports at the National Sports Academy "Vasil Levski". For three consecutive days, divided into groups, 20 athletes were tested for the following indicators: BIA body composition analyzer (body impedance analysis) using an Inbody 270 device (active body mass, % subcutaneous and visceral fat, amount of water, bones, segmental analysis of all these components, assessment of body composition through a diagram – weight, skeletal muscle, body fat weight), measurement of arterial pressure and heart rate, measurement of VO_2max through gas analysis and work on a cycle ergometer. Participants were randomized into two groups (control and experimental) based on gender, trait anxiety level, and maximum oxygen consumption (VO_2max). The experimental group was trained through demonstration, explanation, and shared video material in the practice of controlled breathing, "Cyclic Sighing,". The 'Cyclic Sighing' technique consists of two consecutive inhalations through the nose (a deep one followed by a shorter one) and one prolonged exhalation through the mouth. The athletes were instructed to perform this for 5 minutes daily for 30 days. The control group continued with their regular training schedule without any specific breathing intervention during the same period.
- *Stage III (March 18, 2024 - April 18, 2024):* Conduct of the experimental methodology. Thir-

ty days after the experimental group received training and applied breathing techniques, a second test was conducted for both groups. One day before upcoming important matches (competitions), physiological indicators were measured, including heart rate and arterial pressure (using the Sendo Primo device), as well as participants' situational anxiety.

- *Stage IV:* Processing and analysis of the obtained results.
- The following variables were investigated:
- VO_2MAX/kg: Maximum oxygen consumption, adjusted for body weight (ml/kg/min).
- BF %: Body Fat Percentage
- RR/S: Systolic blood pressure
- RR/D: Diastolic blood pressure
- HR: Heart rate at the beginning
- Trait Anxiety
- State Anxiety
- Extraversion
- Neuroticism
- Psychoticism
- Social desirability
- Perceived stress

Data analysis

Data were analyzed with SPSS Version 23.0. Different methods were employed, including variation analysis, comparative analysis (Mann-Whitney *U* Test and Wilcoxon Signed Ranks Test), Cohen's *r* (Effect Size), and stepwise regression analysis.

Method

Psychological testing: It was conducted prior to the physiological indicators research, including VO-2max, in the scientific and technical laboratory of the National Sports Academy "Vasil Levski". Three psychological questionnaires, adapted for Bulgarian conditions, were applied:

1. *The Eysenck Personality Questionnaire (EPQ), Bulgarian adaptation by Paspalanov, Shtetinski, Eysenck, S. (1984).* It includes 86 "yes" or "no" questions, grouped into four scales: extraversion (20 questions), neuroticism (23 questions), psychoticism (24 questions), and lie (19 questions).
2. *Spielberger's State-Trait Anxiety Inventory (STAI - Form Y), a Bulgarian adaptation by Shtetinski and Paspalanov (1989).* It consists of two scales for measuring anxiety as a state and as a trait. Each of the two scales contains 20 items. ("SA" scale measures state anxiety; "TA" scale measures trait anxiety).
3. *Perceived Stress Questionnaire (PS-1) (Cohen, Kamarck, Mermelstein, 1983). The test was adapted for Bulgarian conditions by Karastoyanov and Rusinova (2000).*

The scale is the most widely used psychological instrument for measuring the perception of stress. It consists of 7 positively and 7 negatively formulated items. The participants were asked to evaluate their feelings and thoughts on a scale of 1 to 5 regarding the frequency during the two months of lockdown. The results characterize a relatively stable evaluation style for a given period of time.

RESULTS

Mean values and standard deviations for all investigated variables are shown in *Table 1.*

Table 1. *Average of studied variables*

Variable	*Mean (M)*	*Standard Deviation (SD)*
VO_2MAX/kg	38.05	5.87
BF %	18.45	8.73
RR/S	123.75	5.82
RR/D	86.65	9.99
HR	105.95	10.68
Trait Anxiety	43.15	7.52
State Anxiety	37.55	7.20
Extraversion	15.30	2.87
Neuroticism	11.65	5.34
Psychoticism	4.25	1.48
Social desirability	9.95	3.15
Perceived stress	38.65	7.09

Comparative analysis by gender for the entire group (N=20)

A comparative analysis (Mann-Whitney) of psychological indicators revealed statistically significant differences between participants grouped by gender in perceived stress ($U = 21.500$, $p = .033$,

r = .48) and neuroticism (U = 12.500, p = .005, r = .63). The results of this analysis are highly influenced by sample size (which is small in our study), necessitating the determination of effect size. For this analysis, we used Cohen's r coefficient. Perceived stress was more pronounced in women (M = 42.22; SD = 6.14) compared to men (M = 35.73; SD = 6.66). For neuroticism, the same statistically significant difference was observed, but in favor of men (M = 8.82, SD = 5.40). Women had higher neuroticism scores (M = 15.11, SD = 2.62). The effect size for the first variable (perceived stress) was typical (medium effect), while for neuroticism, it was much larger than typical, leading us to consider the results reliable. Regarding the investigated physiological indicators (Table.2), statistically significant differences were found in: *VO_2MAX/kg:* men (mean rank = 14.41) had higher values than women (mean rank = 5.72), U = 6.50, p = .001; *BF % (Body Fat Percentage):* Women (mean rank = 15.28) had a higher body fat percentage than men (mean rank = 6.59), U = 6.50, p = .001.

Table 2. *Descriptive Statistics and Comparison of Psychophysiological and Personality Variables by Gender*

Variable	*Gender*	*N*	*M ± SD*	**Comparative test**
VO_2max/kg	Female	9	33.22 ± 2.68	U = 6.500; p = .001
	Male	11	41.91 ± 2.70	
Body Fat %	Female	9	26.67 ± 5.61	U = 6.500; p = .001
	Male	11	11.91 ± 2.43	
Neuroticism	Female	9	15.00 ± 4.58	U = 12.500; p = .005
	Male	11	9.00 ± 4.29	
Perceived Stress	Female	9	41.44 ± 6.20	U = 21.000; p = .033
	Male	11	36.45 ± 7.21	

Effect of the Breathing Intervention

To evaluate the effect of the 30-day breathing program, the results of the experimental and control groups were compared before and after the intervention. The comparative analysis is summarized in Table 3.

Table 3. *Comparison of Psychological and Physiological Indicators Before and After the 30-Day Intervention*

Variables	*Group*	*N*	*Before (M ± SD)*	*After (M ± SD)*	*Statistics (p-value)*
Diastolic blood pressure (mmHg)	Experimental group	10	86.50 ± 9.92	76.50 ± 8.83	p = .011
	Control group	10	88.00 ± 6.99	87.90 ± 6.98	n.s.
Heart rate (bpm)	Experimental group	10	106.00 ± 10.69	99.40 ± 12.40	p = .008
	Control group	10	105.90 ± 11.23	105.80 ± 10.70	n.s.
State Anxiety (points)	Experimental group	10	37.80 ± 8.03	34.00 ± 8.58	p = .036
	Control group	10	37.30 ± 6.70	37.20 ± 6.58	n.s.

A comparative analysis between the experimental and control groups (Mann-Whitney U test) found *no statistically significant differences* in any of the investigated indicators.

The analysis conducted between the two groups at the end of the experimental training revealed that only one indicator (RR/D_{final}) showed a statistically significant difference, with the control group (mean rank =14.10, M = 87.90, SD = 6.98) exhibiting higher values than the experimental group (mean rank =6.90, M = 76.50, SD = 8.83), U = 14.00, p = .006. In the experimental group, *diastolic blood pressure decreased,* which is an indicator of better training.

The results from the Wilcoxon Signed-Rank Test for the experimental group (n = 10) showed a statistically significant decrease in diastolic blood pressure (Z = -2.553, p = .011, with a large effect size r = .81), heart rate (Z = -2.654, p = .008, with a large effect size r = 0.84), and situational anxiety (Z = -2.098, p = .036, with a medium effect size r = .66). These results indicate that the controlled breathing practice had a significant positive impact on the psychophysiological state of the athletes in the experimental group. The changes in the experimental group are illustrated in Figure 1.

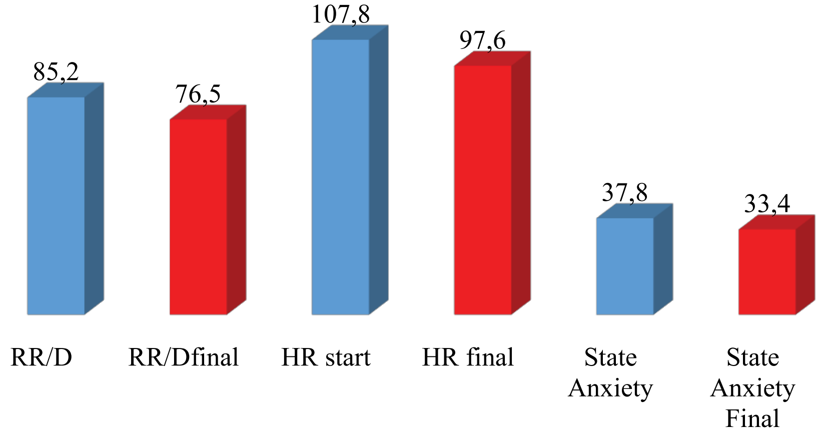

Figure 1. *Changes in psychological and physiological indicators in the experimental group (n=10) pre- and post-intervention.*

The results of this analysis are highly influenced by the sample size (which is small in our study, n = 10), necessitating the determination of the effect size. For this analysis, we used Cohen's r coefficient. The effect sizes for the first two variables (r = .81 and r = .84) indicate a very strong effect, while the last one (r = .66) shows a medium to strong effect. This means that the applied methodology was effective in reducing diastolic blood pressure, heart rate, and situational anxiety in the experimental group, with particularly strong effects on the physiological indicators.

In contrast, no statistically significant differences were found in the control group (n = 10) for the same indicators between the initial and final measurements.

Regression Analysis of Relationships Between Psychological Variables

To determine the influence of psychological variables on the *situational anxiety* and *perceived stress* of the athletes in the group as a whole, we applied a stepwise regression analysis. Two regression models were examined. In the first model, we set situational anxiety as the dependent variable and the other psychological indicators as independent variables. Results showed that only perceived stress influenced situational anxiety.

The Perceived Stress explains 20.5% of the variance in Situational Anxiety (R^2 = .205), with an adjusted R^2 of .161. The regression model was statistically significant, $F(1, 18)$ = 4.637, p = .045. Perceived Stress was a significant positive predictor for Situational Anxiety, B = .460, SE = .214, β = .453, $t(18)$ = 2.153, p = .045. This indicates that with increasing values of Perceived Stress, situational anxiety also increases. The confidence interval for B was between .011 and .908.

In the second model, perceived stress was set as the dependent variable, and the other psychological indicators were independent variables. Trait Anxiety exerted a stronger influence on perceived stress (β = .640), with this model explaining 40.9% of the variance (R^2 = .409). The result was also statistically significant (p = .045). Trait Anxiety was a significant positive predictor for Perceived Stress, with β = .640 and p = .045. This highlights the importance of personality characteristics in the perception of stress.

The results indicate that both models show statistically significant relationships. The second model (trait anxiety - perceived stress) demonstrates a stronger effect, suggesting that trait anxiety plays a leading role in the experience of stress, which has been established in numerous other studies as well.

DISCUSSION

A comparative analysis between genders revealed statistically significant differences in levels of perceived stress, neuroticism, VO_2max/kg, and body fat percentage (BF%). Women exhibited higher levels of perceived stress and neuroticism, as well as a higher body fat percentage, while men had a higher VO_2max/kg. These findings align with previous studies that have established gender differences in psychological and physiological responses to stress (Domuschieva-Rogleva, 2009; Allen et al., 2013; Sheel, 2016, etc.). Women often report higher levels of stress and anxiety, while men generally possess greater cardiorespiratory capabilities.

Crucially, no statistically significant differences were found between the control and experimental groups for any of the investigated indicators before the start of the experimental methodology. This is vital for the study's validity, as it confirms the groups were comparable prior to the intervention, allowing for a more accurate attribution of observed changes to the applied breathing technique. The results from the comparative analysis within individual groups (Wilcoxon Signed Ranks Test) are among the most significant findings. In the experimental group, a statistically significant reduction in diastolic blood pressure, heart rate, and situational anxiety was observed after the methodology was applied. Cohen's r effect size indicates a very large effect for diastolic blood pressure and heart rate, and a medium to strong effect for situational anxiety. This reduction in diastolic blood pressure and heart rate provides direct support for the findings of Balban et al. (2023), who demonstrated that cyclic sighing can reduce physiological arousal by increasing parasympathetic tone. These results strongly support the hypothesis that regular practice of controlled breathing techniques, similar to "cyclic sighing," can significantly improve stress and anxiety management.

The reduction in situational anxiety is particularly important in a sports environment, as this condition is directly linked to performance in competitive settings (Kamlesh, 2011; Craft, 2003; Hanin, 1995; Jokela & Hanin, 1999; Lazarus, 2000; Hardy, 1996; Domuschieva-Rogleva, 2006; Domuschieva-Rogleva & Yancheva, 2012). In contrast, the control group showed no statistically significant changes in any of the measured indicators, further supporting the effectiveness of the intervention.

Limitations of the study

It's essential to note that this study was conducted with a small sample size ($n = 10$ for each group). As indicated, this can affect the statistical power and generalizability of the results. Although the use of Cohen's r coefficient partially compensates for this limitation, larger samples would be necessary for more conclusive and generalizable findings.

CONCLUSION

Despite the limitations in sample size, the current study successfully demonstrates the effectiveness of controlled breathing techniques in improving the psychophysiological state of young athletes. These findings have important practical implications for sports psychology and can be used to develop interventions aimed at managing stress and anxiety in competitors, especially in high-pressure and competitive situations. Future research could expand the sample size and employ more theoretically grounded methods for variable selection.

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