



**BSc in Psychology**  
**Department of Psychology**

Effects of HRV Biofeedback Training on  
Reducing Anxiety-, Stress- and Traumatic  
Stress Symptoms Among Police Officers in  
Iceland

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Foreword

Submitted in partial fulfillment of requirements of the BSc Psychology degree, Reykjavík University, this thesis is presented in the style of an article for submission to a peer-reviewed journal.

### Abstract

In their occupation, police officers experience stressful situations, witness traumatic events, and have to make critical decisions under high pressure. These circumstances can take a toll on the officer's mental health. Research has shown that HRV biofeedback training can significantly improve individuals' mental health. Therefore, the present study aimed to examine the effects of HRV biofeedback training in reducing Icelandic police officers' anxiety-, stress-, and traumatic stress symptoms. The research was conducted over ten weeks. Participants were randomly assigned to one of two groups: an intervention group that received the HRV biofeedback training at the beginning and a wait-list control group that received the training at week five. All participants took part in a questionnaire that included the DASS-Anxiety, PCL-5, PSQ-Op, and PSQ-Org, baseline measurements, and individual training where customized breathing frequency was found for each participant, which maximized their heart rate variability. The results did not show a significant main- or interaction effect between the HRV biofeedback training and anxiety-, stress-, and traumatic stress symptoms. However, there was a noticeable decrease in stress for the intervention group measured by PSQ-Op and PSQ-Org, questionnaires specifically designed to measure factors related to law enforcement. The limitations of the results include a small sample size.

*Keywords:* HRV, biofeedback, police officers, anxiety, stress, traumatic stress

### Útdráttur

Í starfi sínu, upplifa lögregluþjónar streituvaldandi aðstæður, verða vitni að áfalla miklum atburðum, og þurfa að taka mikilvægar ákvarðanir undir miklu álagi. Þessar aðstæður geta haft áhrif á andlega heilsu lögregluþjónanna. Rannsóknir hafa sýnt að áhrif HRV biofeedback þjálfunar getur bætt andlega heilsu einstaklinga til muna. Þess vegna, miðar þessi rannsókn að því að kanna hvaða áhrif HRV biofeedback þjálfun hefur til að draga úr kvíða-, streitu- og áfallastreitueinkennum íslenskra lögregluþjóna. Rannsóknin fór fram yfir tíu vikna tímabil. Þátttakendum var skipt niður með tilviljanakenndum hætti í einn af tveimur hópum: tilraunahóp sem fékk HRV biofeedback þjálfun í upphafi rannsóknar og biðlista-samanburðarhóp sem fékk þjálfunina í viku fimm. Allir þátttakendur tóku þátt í spurningalista sem innihélt DASS-Anxiety, PCL-5, PSQ-Op og PSQ-Org, grunnlínumælingum og einstaklingsþjálfun þar sem sérsniðin öndunartíðni var fundin fyrir hvern þátttakanda, sem hámarkaði hjartsláttarbreytileika þeirra. Niðurstöðurnar sýndu ekki marktæk megin- eða samvirkniáhrif á milli HRV biofeedback þjálfunarinnar og kvíða-, streitu- og áfallastreitueinkenna. Hins vegar, var áberandi minnkun á streitu hjá tilraunahópnum mæld með PSQ-Op og PSQ-Org, spurningalistum sem eru sérstaklega hannaðir til þess að mæla þætti sem tengjast löggæslu. Takmarkanir niðurstaðna fela meðal annars í sér lítið úrtak.

*Lykilorð:* HRV, biofeedback, lögregluþjónar, kvíði, streita, áfallastreita

## **Effects of HRV Biofeedback Training on Reducing Anxiety-, Stress- and Traumatic Stress Symptoms Among Police Officers in Iceland**

Police work is among the most stressful professions in the world (McCraty & Atkinson, 2012). In their occupation, police officers experience stressful situations, witness traumatic events, and have to make critical decisions under high pressure (McCraty & Atkinson, 2012). These circumstances can take a toll on the officer's mental health by causing symptoms of mental illness and high-stress levels (Tomes et al., 2020). Because of this, police officers must be trained to reduce their symptoms of mental illness, including anxiety-, stress- and traumatic stress symptoms that they might experience (Andersen et al., 2018). That is, to ensure that their performance is at its best and that they are able to make the right decisions for every circumstance.

### **Why HRV biofeedback?**

Reduced heart rate variability (HRV) can have serious consequences (Lehrer et al., 2020; Lehrer & Woolfolk, 2021). Symptoms of mental health disorders, for example, anxiety and depression, as well as high-stress levels, can reduce individuals' heart rate variability, which increases the risk of psychological and medical diseases (Lehrer et al., 2020; Lehrer & Woolfolk, 2021). Research has shown that by increasing heart rate variability by using HRV biofeedback training, one's health can improve significantly, as well as increase the likelihood of improved performance in complex situations (Goessl et al., 2017; Lehrer et al., 2020; Pizzoli et al., 2021). Therefore, knowing how to control the variability of the heart is essential. HRV biofeedback training has been shown to help individuals to affect their heart rate activity, that is, by changing the activity of their heart rate regarding variability and dominant rhythms (Moss, 2004). There are many ways that HRV biofeedback can be used, one of them being resonance frequency breathing training, which involves practicing deep and slow breathing at one's resonance frequency (Lehrer & Woolfolk, 2021).

That is, breathing at the exact rate that resonates with the individual's heart rate. The resonance frequency differs for everyone, but research has shown that the most common breathing rate is about 5,5 - 6 breaths per minute (Moss, 2004).

The effects of HRV biofeedback training on mental health disorders, such as anxiety, depression, and stress, have been extensively researched (Brammer et al., 2021; Chaitanya et al., 2022; Goessl et al., 2017; Henriques et al., 2011; Lagos et al., 2008; Lehrer et al., 2020; Michela et al., 2022; Pizzoli et al., 2021; Sutarto et al., 2012). These studies have shown the effectiveness of the training in improving individuals' mental health disorders and their overall performance. Moreover, the effects of HRV biofeedback training on traumatic stress symptoms are not as common in the current literature field. However, studies have been conducted on the matter, mainly focusing on veterans and military members, as they are likely to experience traumatic stress due to their occupation (Petta, 2017; Reyes, 2014; Schuman & Killian, 2019; Tan et al., 2011). The studies that have been conducted on the matter have shown positive results of the training in reducing participants' symptoms of traumatic stress (Petta, 2017; Reyes, 2014; Schuman & Killian, 2019; Tan et al., 2011). HRV biofeedback is, therefore, especially beneficial to occupations that involve highly stressful environments that may trigger anxiety-, stress-, and traumatic stress symptoms, including veterans, military members, and police work (Michela et al., 2022; Petta, 2017; Reyes, 2014; Tomes et al., 2020).

### **HRV biofeedback and anxiety**

Mental health disorders are pervasive among individuals worldwide. As of 2022, around one billion people, which is approximately one in eight individuals, suffer from some mental health disorder (World Health Organization, 2022). Anxiety disorders are among the most common mental health disorders (World Health Organization, 2022). According to existing research literature, a common method to treat anxiety symptoms is HRV biofeedback

training (Goessl et al., 2017; Henriques et al., 2011; Lagos et al., 2008; Lehrer et al., 2020).

According to Lehrer et al. (2020) meta-analysis, anxiety disorders were among the disorders that HRV biofeedback treatment had the most significant effect.

Considering the likelihood of police officers experiencing anxiety due to the responsibilities and stressful situations they have to experience; previous literature includes the discussion about the effect of HRV biofeedback training on police officers' anxiety symptoms (Brammer et al., 2021; Michela et al., 2022). Furthermore, the results show positive effects of the training on the police officers' symptoms, as their symptoms reduced significantly after the training (Brammer et al., 2021; Michela et al., 2022). Therefore, it is apparent from previous literature that there is strong evidence that the use of HRV biofeedback training can be highly effective in treating anxiety symptoms, including police officers' symptoms (Goessl et al., 2017; Henriques et al., 2011; Lagos et al., 2008; Lehrer et al., 2020).

### **HRV biofeedback and stress**

Much like anxiety disorders, stress is prevalent among individuals worldwide as it affects all individuals to some extent (World Health Organization, 2023). Further, it is how each individual responds to stress, how effective it can be on one's overall well-being. High-stress levels can significantly affect individuals' health (World Health Organization, 2023). The stress that people experience can vary depending on their occupation (Rao & Chandraiah, 2012). Studies have shown that the occupation of police officers is among the most stressful professions in the world (Luo & Ruiz, 2012; Nisar & Rasheed, 2020; Wang et al., 2014). Operational- and organizational stress has been found to be two types of stress that police officers often experience (McCreary & Thompson, 2006). Operational stress relates to different aspects of being a police officer and the stress-related factors involved in their occupation (Maran et al., 2018). For example, they respond to emergency calls and witness

serious incidents that are often a part of their daily work (Maran et al., 2018). Organizational stress relates directly to each employee and involves stress related to internal organization and management associated with the law-enforcement (Shane, 2013). Considering the prevalence of stress among police officers, it is essential for them to know how to cope with stress in various situations to prevent health issues related to stress (Maran et al., 2018; Shane, 2013; World Health Organization, 2023). Moreover, to ensure that they can work in high-stress circumstances.

As seen in the existing literature, HRV biofeedback training can be an effective intervention to treat symptoms of stress (Chaitanya et al., 2022; Goessl et al., 2017; Sutarto et al., 2012; Weltman et al., 2014). A study conducted using HRV biofeedback training as a coping strategy to reduce police officers' stress levels showed significant results in the training (Weltman et al., 2014). After four weeks of HRV biofeedback training, police officers showed 40% less stress symptoms than before the training (Weltman et al., 2014). Moreover, a study by Chaitanya et al. (2022) concluded that perceived stress in healthy adults reduced after eight weeks, that is, four weeks of training and another four weeks of breathing at the resonance frequency for twenty minutes each day. Further, Sutarto et al. (2012) study found similar effects, where their results indicated that participants' stress levels significantly decreased after HRV biofeedback resonant frequency breathing intervention. However, in both studies, the participants assigned to a control group did not report reduced stress levels after the training (Chaitanya et al., 2022; Sutarto et al., 2012). The current literature on the effects of HRV biofeedback training on reducing symptoms of stress shares the same limitations of small sample sizes and homogeneous samples regarding age, gender, and participants' occupation (Chaitanya et al., 2022; Goessl et al., 2017; Sutarto et al., 2012; Weltman et al., 2014). Even though the effects of HRV biofeedback training on police

officers' stress symptoms have been researched, more studies are needed considering the importance of the topic (Luo & Ruiz, 2012; Nisar & Rasheed, 2020; Wang et al., 2014).

### **HRV biofeedback and traumatic stress**

Experiencing traumatic events can lead to individuals developing traumatic stress (Kilpatrick et al., 2013). Traumatic stress is a normal reaction that can lead to sadness, difficulty sleeping, anger, intrusive thoughts, and more (Kilpatrick et al., 2013). In addition, individuals can develop posttraumatic stress disorder (PTSD) after experiencing or witnessing highly traumatic events, such as accidents, abuse, natural disasters, or terrorism. PTSD symptoms include avoidance, intrusive memories, changes in overall mood, and more (Mayo Clinic, n.d.).

Lehrer et al. (2020) meta-analysis concluded that HRV biofeedback had the slightest effect sizes on post-traumatic stress compared to depression and anxiety. However, other previous studies have shown the effectiveness of HRV biofeedback in treating symptoms of traumatic stress and PTSD (Petta, 2017; Reyes, 2014; Schuman & Killian, 2019; Tan et al., 2011). In addition, studies on veterans and individuals in the military who suffer from traumatic stress and the effect of HRV biofeedback training on their symptoms are frequently seen in the research field (Schuman & Killian, 2019; Tan et al., 2011). Those studies have shown how effective HRV biofeedback training is in reducing veterans' and military members' trauma symptoms (Schuman & Killian, 2019; Tan et al., 2011). However, the current literature lacks more studies on traumatic stress and the effect HRV biofeedback training has on reducing the symptoms. The current literature especially lacks studies on whether HRV biofeedback training effectively reduces police officers' symptoms of traumatic stress, as their occupation requires them to experience stressful situations that are often traumatic (McCraty & Atkinson, 2012).



## **Present study**

Considering the limitations of the current literature and the importance of further research on the topic, the present study aimed to investigate whether HRV biofeedback training effectively reduces anxiety-, stress- and traumatic stress symptoms among police officers in Iceland. Considering the prevalence of anxiety and stress disorders and the increased risk of experiencing symptoms of anxiety and stress due to the stressful and high-pressure work of police officers, further research on the topic is needed (Tomes et al., 2020; World Health Organization, 2022). Moreover, the effects of HRV biofeedback training in reducing traumatic stress symptoms are needed, as the current literature lacks studies on the topic. Given those limitations, this topic was chosen for the present study.

Even though similar studies have been conducted before (Brammer et al., 2021; Michela et al., 2022; Schuman & Killian, 2019; Tan et al., 2011), the effects on Icelandic police officers have yet to be investigated. Therefore, the present study aimed to answer three research questions. Firstly, is HRV biofeedback training effective in reducing anxiety symptoms among Icelandic police officers? Secondly, is HRV biofeedback training effective in reducing stress symptoms among Icelandic police officers? Lastly, is HRV biofeedback training effective in reducing traumatic stress symptoms among Icelandic police officers? Moreover, it was hypothesized that HRV biofeedback training would successfully reduce Icelandic police officers' anxiety-, stress-, and traumatic stress symptoms.

## **Methods**

### **Participants**

A total of 27 police officers participated in the study, nine females (33.3%) and 18 males (66.7%). Participants' average age was 37.56 (SD = 9.5), ranging from 24 to 61. Participants were randomly assigned to one of two groups, an intervention group (N = 13) or a wait-list control group (N = 14). The intervention group consisted of four females and nine

males, with an average age of 38.85 (SD = 10.2). The wait-list control group consisted of five females and nine males, with an average age of 36.36 (SD = 9). Participants were recruited by sending an email to the police officers where the study was presented as part of the schedule at the Centre for Police Training and Professional Development in Iceland. The inclusion criteria were that participants had to work in general law enforcement as working police officers, as well as detective police officers.

### **Measures**

Participants' anxiety-, stress- and traumatic stress symptoms were assessed using four different questionnaires: the Depression Anxiety Stress Scale (DASS-21), Posttraumatic Stress Disorder Checklist (PCL-5), Operational Police Stress Questionnaire (PSQ-Op), and Organizational Police Stress Questionnaire (PSQ-Org).

#### ***Depression Anxiety Stress Scale (DASS-21)***

The DASS-21 scale was used to detect participants' anxiety symptoms. The DASS is originally a 42 item self-report scale used to detect depression-, anxiety-, and stress symptoms (Lovibond & Lovibond, 1995). However, for the present study, a shortened version of the scale, which includes 21 items, and an Icelandic version was used, translated by Pétur Tyrfingsson in 2005. The DASS-21 contains statements where participants indicate how well they apply to them on a four-point scale (0 = “Did not apply to me at all” – 3 = “Applied to me very much or most of the time”), based on their behavior and feelings over the past week. The list included: “I experienced breathing difficulty”, “I was worried about situations in which I might panic and make fool of myself”, “I felt close to panic”, and “I felt scared without any good reason” (Lovibond & Lovibond, 1995).

#### ***Posttraumatic Stress Disorder Checklist (PCL-5)***

The PCL-5 checklist was used to assess participants' traumatic stress symptoms. PCL-5 is a self-reported checklist that contains 20 questions related to The Diagnostic and

Statistical Manual of Mental Disorders (DSM-5) diagnostic criteria, which assesses participants' traumatic stress symptoms (Blevins et al., 2015). In addition, participants indicate how much each traumatic stress symptom has disturbed them during the last month on a five-point scale (0 = “Never” – 4 = “Very frequently”). The checklist includes: “Feeling very upset when something reminded you of the stressful experience”, “Having difficulty concentrating”, “Irritable behavior, angry outbursts, or acting aggressively”, and “Repeated, disturbing, and unwanted memories of the stressful experience”. The list is widely used in research and has good psychometric properties (Bovin et al., 2016; Marx et al., 2022).

### ***Operational Police Stress Questionnaire (PSQ-Op)***

PSQ-Op is a 20-item questionnaire where each item is presented with a seven-point Likert scale (0 = “No stress at all” – 7 = “A lot of stress”) (McCreary & Thompson, 2006). The items relate to different aspects of being a police officer and measure stress-related factors involved in the occupation of police officers. The items include: “shift work”, “overtime demands”, “traumatic events”, “risk of being injured on the job” and “feeling like you are always on the job”. The present study used the questionnaire to determine how much stress each item had caused the police officers recently (McCreary & Thompson, 2006).

### ***Organizational Police Stress Questionnaire (PSQ-Org)***

PSQ-Org is a 20-item questionnaire where each item is presented with a seven-point Likert scale (0 = “No stress at all” – 7 = “A lot of stress”) (McCreary & Thompson, 2006). The items relate to different aspects of being a police officer and measure stressors associated with law enforcement concerning each police officer. The items include: “dealing with co-workers”, “feeling like you always have to prove yourself to the organization”, “dealing with supervisors”, “staff shortages” and “lack of resources”. The present study used the questionnaire to determine how much stress each item had caused the police officers recently (McCreary & Thompson, 2006).

## Procedure

The study required a laboratory setting, researchers, measurements for physiological activity, cognitive performance, and subjective questionnaires. Participants were randomly assigned to two groups: an intervention group that received the HRV biofeedback resonance frequency training in the beginning and a control group that received the same training later, at week five. The research period took place over a total of ten weeks. In the first week, all participants underwent a baseline measurement. They were asked to put on a PolarH10 heart rate monitor and relax for five minutes while connected to the OpenHRV application, which recorded their heart rate data. They also took part in a cognitive test and answered a questionnaire that included the DASS-Anxiety, PCL-5, PSQ-Op, and PSQ-Org.

In addition, the intervention group participated in individual training, where the researchers found a customized breathing frequency for each participant, which maximized their heart rate variability (HRV). The training was done using the EliteHRV application. The participants were then instructed to practice breathing at the breathing frequency assigned to them, two times daily for 20 minutes each time for a total of five weeks, using the EliteHRV app while wearing a PolarH10 monitor. Participants were instructed to write down in a workbook each time they did the breathing practices, the date, how many minutes they did the breathing exercise, and rate their feelings, stress, and concentration on a scale of 0-10. During the five weeks, participants received weekly phone calls from the researchers, where they reviewed the breathing exercises' progress.

Participants in the intervention group underwent baseline measurements three times during the five weeks, in the beginning, middle, and once at the end, where they completed the cognitive tests and the questionnaire again. The control group underwent baseline measurements as often as the intervention group during the first five weeks. At week five, they participated in the same individual training that the intervention group underwent at the

beginning. In addition, they were assigned a breathing frequency that maximized their heart rate variability. The control group then repeated all the steps the intervention group underwent for five weeks. All participants signed an informed consent form before participation and were informed that they could stop participating at any point during the research period. The present study was approved by the National Bioethics Committee of Iceland (VSN-22-061).

### **Research Design and Data Analysis**

The study's research design was a randomized control trial with a wait-list control. Three dependent variables were used in the present study: anxiety, stress, and traumatic stress. HRV biofeedback training was the independent variable.

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS), version 28 (IBM Corp., 2019). Descriptive statistics were presented in the form of means (*M*) and standard deviation (*SD*) for the questionnaires: DASS-Anxiety, PCL-5, PSQ-Op, and PSQ-Org, for both the intervention- and control groups, before and after the intervention. To examine the effect of HRV biofeedback resonance frequency training on participants' anxiety-, stress-, and traumatic stress symptoms, a repeated measures multivariate analysis of covariance (MANCOVA) was used to investigate the main- and interaction effect of the two groups, intervention, and control, pre-training, and post-training. The level of significance was fixed at 0.05 ( $p = 0.05$ ). Lastly, a Pearson's correlation was run to examine the relationship between the outcome from the questionnaires after the intervention and the number of minutes and the number of times that the participants did the breathing exercises.

## **Results**

### **Descriptive statistics**

Table 1 presents the descriptive statistics for each variable that was used in the study (DASS-Anxiety, PCL-5, PSQ-Op, and PSQ-Org). In addition, the table shows the means (*M*)

and standard deviations (*SD*) for all four questionnaires and the intervention and control groups before and after the intervention. As shown in table 1, the mean scores for the DASS-Anxiety list for the intervention group were higher after the HRV biofeedback training,  $M = 9.53$ ,  $SD = 3.04$  before and  $M = 10.23$ ,  $SD = 3.26$  after. Similarly, the mean scores for the PCL-5 list for the intervention group were also higher after the HRV biofeedback training,  $M = 33.52$ ,  $SD = 11.05$  before and  $M = 35.14$ ,  $SD = 3.26$  after.

**Table 1**

*Descriptive statistics for the questionnaires before and after the intervention*

Variable	Before				After			
	Intervention group		Control group		Intervention group		Control group	
	M	SD	M	SD	M	SD	M	SD
DASS-Anxiety	9.53	3.04	10.21	2.86	10.23	3.26	10.14	3.52
PCL-5	33.52	11.05	39.59	12.65	35.14	13.18	33.91	8.25
PSQ-Op	55.61	19.64	55.28	17.61	51.38	24.52	55.71	18.68
PSQ-Org	58.53	23.75	57.85	17.06	52.46	24.81	60.71	24.45

However, the mean scores for the PSQ-Op were lower for the intervention group after the HRV biofeedback training,  $M = 55.61$ ,  $SD = 19.64$  before and  $M = 51.38$ ,  $SD = 24.52$  after. Moreover, the mean scores for the PSQ-Org were also lower for the intervention group after the training,  $M = 55.61$ ,  $SD = 19.64$  before and  $M = 51.38$ ,  $SD = 24.52$  after. As for the control group, the mean scores were opposite compared to the intervention group. That is, higher before the intervention and lower after for the DASS-Anxiety and PCL-5. For PSQ-Op and PSQ-Org, the mean scores were lower before the intervention and higher after.

### **Analytical statistics**

A repeated measure multivariate analysis of covariance (MANCOVA) was conducted to analyze the data, with age and weight as covariates and gender and the two groups,

intervention, and control, as between-subject factors. The main- and interaction effects between the two groups were explored before and after the HRV biofeedback training.

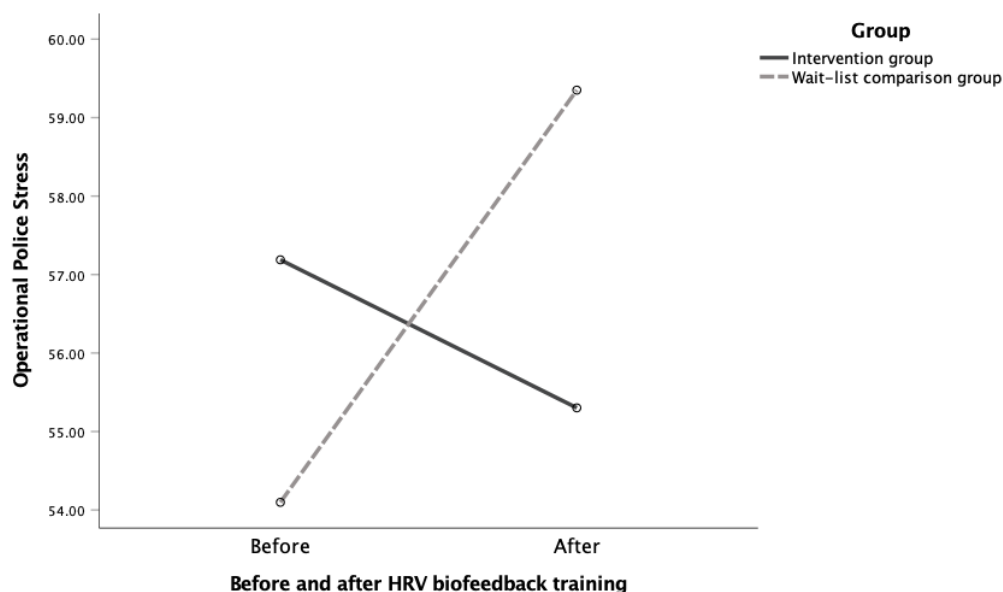
**Main and interaction effects**

The results of the MANCOVA did not show a significant main effect for anxiety, measured by DASS-Anxiety ( $F(1, 21) = .009, p = .925$ ), operational stress, measured by PSQ-Op ( $F(1, 21) = .004, p = .949$ ), organizational stress, measured by PSQ-Org ( $F(1, 21) = .407, p = .531$ ) or traumatic stress, measured by PCL-5 ( $F(1, 21) = .247, p = .624$ ).

Further, the results of the MANCOVA did not show a significant interaction effect for anxiety ( $F(1.000, 21.000) = 1.629, p = .216$ ), operational stress ( $F(1.000, 21.000) = .817, p = .376$ ), organizational stress ( $F(1.000, 21.000) = 3.135, p = .091$ ) or traumatic stress ( $F(1.000, 21.000) = 3.259, p = .085$ ). However, there was a noticeable decrease in stress for the intervention group measured by PSQ-Op and PSQ-Org. Although not statistically significant, figure 1 shows a considerable difference in mean scores for operational stress between the intervention- and control groups. The scores for the intervention group decreased after the HRV biofeedback training, whereas for the control group, the scores increased.

**Figure 1**

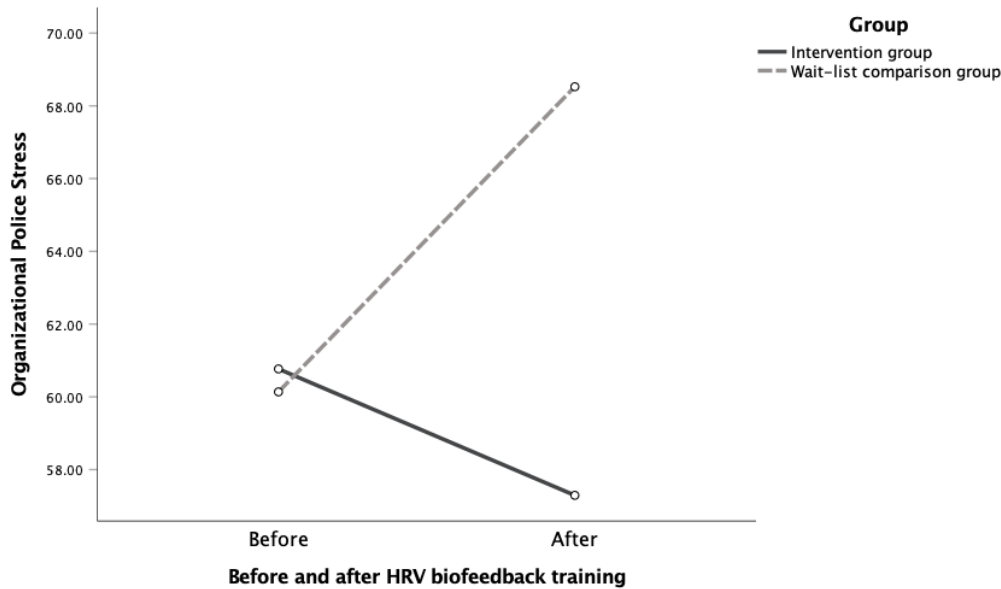
*Operational police stress before and after HRV biofeedback training*



Further, in figure 2, a considerable difference in mean scores for organizational stress between the intervention- and control groups can be seen. The scores for the intervention group decreased after the HRV biofeedback training but increased for the control group.

**Figure 2**

*Organizational police stress before and after HRV biofeedback training*



**Correlation**

The correlation between the results from the questionnaires after the intervention and the number of times and minutes participants did the breathing exercises during the five weeks was explored. As seen in table 2, although not statistically significant, the correlation was negative in all cases except for the correlation between the DASS-Anxiety list and the number of minutes participants did the breathing exercises.

**Table 2**

*Correlation between the number of minutes and times and the questionnaires*

	DASS-Anxiety	PCL-5	PSQ-OP	PSQ-ORG
Number of minutes	.023	-.204	-.382	-.311
Number of times	-.001	-.136	-.354	-.260



## Discussion

The present study aimed to explore the effects of HRV biofeedback resonance frequency breathing training on reducing police officers' symptoms of anxiety, stress, and traumatic stress. The study did not find significant effects of the HRV biofeedback training on Icelandic police officers' anxiety-, stress-, or traumatic stress symptoms. Therefore, the hypotheses that the training would affect the participant's symptoms of anxiety, stress, and traumatic stress were not supported as no significant main or interaction effects were found in the present study. These results differ from the vast majority of findings in the existing research literature discussed in the introduction (Brammer et al., 2021; Chaitanya et al., 2022; Goessl et al., 2017; Henriques et al., 2011; Lagos et al., 2008; Lehrer et al., 2020; Michela et al., 2022; Pizzoli et al., 2021; Sutarto et al., 2012). This may, among other reasons, result from the small sample size ( $N = 27$ ) present in the current study. However, even though the results for the effects of the HRV biofeedback training on police officers' operational- and organizational stress were not significant, there was a noticeable decrease in both operational- and organizational stress for the intervention group, compared to the control group, where their stress levels increased. Further, the correlation between the results from the questionnaires after the HRV biofeedback training and the number of minutes and the number of times that the participants did the breathing exercises is in the right direction. That is, the correlation is negative, which means that the more minutes and times the participants spent doing the breathing exercises, the fewer symptoms of anxiety, operational stress, organizational stress, and traumatic stress they showed. That is in accordance with other previous studies that have shown the effects of HRV biofeedback training in reducing symptoms of operational- and organizational stress (Maran et al., 2018; Shane, 2013).

Considering the reduced stress levels and the negative correlation between the questionnaires and the number of minutes and times that the participants did the breathing

exercises, it would be interesting to perform a more detailed analysis by filtering out the participants who did the breathing exercises for 20 minutes twice per day for five weeks. That is, to achieve more detailed results of how effective the HRV biofeedback training is in reducing those participants' anxiety-, stress-, and traumatic stress symptoms.

When interpreting the results of the present study, some limitations should be considered. Firstly, the small sample size is worth noting; the results may have been more significant with a larger sample size. Secondly, there was no inclusion criteria included in the study for the participants to be experiencing anxiety-, stress-, or traumatic stress symptoms before participating in the study. Therefore, the HRV biofeedback training could not reduce some participants' symptoms as the symptoms were not necessarily present before or after the study. Lastly, it could not be completely ensured that the participants would do the breathing exercises for 20 minutes twice daily for five weeks. As a result, the participants did not do the breathing exercises for the same amount of minutes or the same amount of times; that limitation is worth noting as it could have interfered with the results.

Despite these limitations, it is worth noting some strengths that the present study had. Firstly, the effects of HRV biofeedback training on Icelandic police officers had not been investigated before. Secondly, the questionnaires used in the present study, the DASS-Anxiety, PCL-5, PSQ-Op, and PSQ-Org, have all been widely used in previous research studies, and they have good psychometric properties, which is essential when conducting research studies (Bovin et al., 2016; Lovibond & Lovibond, 1995; Marx et al., 2022; McCreary & Thompson, 2006). Lastly, the research methods were standardized to ensure that all participants in the study received the same information and the same experience throughout the research period. For example, a script was used for participants' individual training and all measurements throughout the study to ensure that all participants received the same information. Researchers also followed a script when telephone interviews took place.

Future research should continue exploring the effects of HRV biofeedback training on police officers' anxiety-, stress-, and traumatic stress symptoms. A larger sample size should be used in future research, as well as including participants with symptoms of anxiety, stress, or traumatic stress by having that be a part of the inclusion criteria. Further, future research should also focus on filtering out participants who do the breathing exercises for the number of times and minutes they are advised to achieve more accurate results.

In conclusion, the present study explored the effect of HRV biofeedback training on reducing Icelandic police officers' anxiety-, stress- and traumatic stress symptoms. The results did not show a significant main- or interaction effect. However, there was a noticeable decrease in operational- and organizational stress for the intervention group after the HRV biofeedback training. Furthermore, there was a negative correlation between the results from the questionnaires and the number of minutes and times the participants did the breathing exercises. This indicated that the more often the participants did the breathing exercises and the more time they spent doing them, the fewer symptoms of anxiety, stress, and traumatic stress they showed. The limitations of the present study warrant further research on the topic to explore the insignificant difference found between groups. Even though the results of the present study were not statistically significant, they brought up interesting findings which could be explored further.

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