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PSYCHOPHYSIOLOGICAL STATE OF STUDENTS UNDER THE WAR

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The war in Ukraine has an impact on the psychophysiological state of citizens, whether they are direct participants in the conflict or reside far from the front line. Considering this, studying the psychophysiological state of students continuing their education in a country at war is a relevant issue. Understanding this state can aid in developing effective strategies for preserving the psychological health of youth. The limbic system, which regulates emotions, directly influences the cardiovascular system. Therefore, the research aimed to establish the connection between the frequency of heartbeats (heart rate) during air alarms and mental states (depression, anxiety, stress) of students, as well as components of their emotional intelligence (self-motivation, managing one's own emotions and the emotions of others, empathy).

In the study, 62 second-year students from the Biological Faculty Ivan Franko National University of Lviv participated. Students assessed their psychoemotional state using the «Global Emotional Intelligence Test» and «DASS21» questionnaires. Heart rate (HR) was monitored using smartwatches in combination with corresponding smartphone applications.

The average daily heart rate of students was 78.12±0.74 beats/min (n=62), while during air alarms, it increased to 91.21±2.54 beats/min (p≤0.001, n=21). Individuals with additional physical activities showed a tendency toward higher HR during air alarms compared to those who did not engage in exercises. It was found that 50 % of students experienced anxiety, 20 % reported high and extremely high stress levels, and 10 % had a high level of depression. A moderate negative correlation was established between the level of depression and HR during air alarms (r=-0.55, p≤0.05, n=13). A high level of emotional intelligence indicators was observed in the following percentages of students: managing the emotions of others – 27 %, empathy – 24 %, self-motivation – 23 %, managing one's own emotions – 8 %, and integrative emotional intelligence – 2 %. Positive correlations of moderate strength (p≤0.05) were identified between HR during air alarms and the psychological and emotional states of students: r=0.51 (n=11) with anxiety, r=0.59 (n=13) with the level of integrative emotional intelligence, r=0.62 (n=13) with self-motivation, and r=0.63 (n=13) with managing the emotions of others.

Therefore, war has an impact on the psychophysiological state of students, resulting in an increased level of anxiety. This is evident in the rise of heart rate (HR) during air alarms, which is considered a normal response of the body to a stress factor. However, the more depressive a person is, the lower the HR during air alarms. Thus, there is a correlation between HR during air alarms and psychophysiological state of students.

Keywords: heart rate, health, anxiety, stress, depression, emotions

Residents of various regions of Ukraine are at different distances from the epicenter of the war, but all Ukrainians feel a strong emotional tension. Anxiety among Ukraine's residents has increased as a reaction to fear [2]. The «Air Alarm» signal carries both a real and potential threat to human life and health. The entire period of an air alarm can be considered as a stress factor that negatively affects a person's psychophysiological state. When a person's nervous system experiences emotional overload, stress develops – a state of excessive and prolonged psychological tension [2, 10]. The stress response in humans due to the potential danger of an aerial attack is carried out through a universal complex of neurohumoral reactions.

Stress through cortical and limbic connections triggers the release of corticotropin-releasing factor (CRF) from the paraventricular nuclei of the hypothalamus. The release of CRF mediates endocrine and immune responses [30]. Stress affects the neural structure of the hippocampus, amygdala, and prefrontal cortex [23]. The amygdala-like body plays a crucial role in processing physiological and behavioral responses to stress. The influence of chronic stress factors and corticosterone, the secretion of which is induced by stress, may enhance the expression of CRF in the amygdala. Under the influence of stress, changes occur in the amygdala that underlie emotions such as anxiety and fear [32]. It is known that the amygdala-like body interacts with the autonomic nervous system (sympathetic and parasympathetic), and therefore, it can impact the function of internal organs [30], including altering heart rate.

Heart rate (HR) is an indicator that reflects the state of the cardiovascular system and the corresponding activity of the autonomic nervous system, controlled by higher centers of the midbrain. Under the influence of stress factors, the human body enters a «fight or flight» state. This state is characterized by excessive activation of the sympathetic nervous system, a component of the stress system [8, 18]. Elevated levels of catecholamines mediate the increase in heart rate. For instance, an increase in heart rate has been observed in individuals who have experienced earthquakes [7, 24], terrorist acts [25, 26], or in response to emergency alarm [13]. Air alarm alerts (from the signal indicating the start to its end) belong to stress factors, as they indicate the potential possibility of traumatic events. The impact of air alarm alerts during wartime on the heart rate of civilians and the relationship between changes in heart rate and the mental and emotional states of people are still insufficiently studied.

Researching the impact of stressors on a person's heart rate (HR) in real life is meaningful when conducted using the method of ambulatory 24-hour monitoring through personal digital devices (such as smartphones, fitness bracelets, and eHealth applications for smartphones) [16].

Emotional intelligence encompasses concepts such as recognizing emotions, self-motivation, empathy, and regulating emotional states [15]. It's believed that higher levels of emotional intelligence lead to better societal adaptation through emotional regulation [15].

It's known that the centers of the limbic system are responsible for the emergence of emotions [29]. They are functionally connected to the autonomic nervous system, which regulates the functioning of internal organs. Based on this, we hypothesized a connection between the state of the cardiovascular system's activity and skills related to emotional state regulation.

Currently, the influence of war on the psychophysiological state of the civilian population of Ukraine, especially the student population, who experiences the stressor of air alarm alerts almost daily, remains insufficiently researched. Therefore, the aim of the study was to establish a connection between heart rate during air alarm alerts and mental states (depression, anxiety, stress) of students, as well as components of their emotional intelligence (self-motivation, emotional self-regulation, empathy). In addition, the aim of the work is to understand the psychophysiological state of students. This can help us in the development of effective strategies for preserving the psychological health of young people. In particular, by clarifying the importance of following recommendations for a healthy lifestyle, normal sleep duration, and avoiding conditions that disrupt psychological balance. After all, a state of increased anxiety or chronic stress can lead to health disorders, so it is important to practice methods of stress management and psycho-somatic relaxation to prevent mental and somatic health disorders.

Materials and Methods

We conducted the study among students of Ivan Franko National University of Lviv. Sixty-two second-year biology students, aged 18–19 years, participated in the study. Of them, eight were male and fifty-four were female. The students provided the consent to participate in the research study. We measured participants' HR using trackers or smartwatches worn on the wrist (such as Xiaomi Mi Smart Band 3–7, Apple Watch Series 3–7) connected to corresponding smartphone apps (Apple's «Healthy,» «Pulse Monitor Check Your Heart,» «Samsung Health,» «Heart Rate & Pulse»).

The average daily HR (arithmetic mean of HR over a day) was recorded for the entire group of students (n=62) based on data from trackers or smartwatches, which were read by respective smartphone apps. The students entered HR data into individual Google Sheets. We calculated the average HR value across all days of the study for each student and computed the average value for the corresponding sample. Histograms present the mean value for the students' sample as M±m [M min – M max].

Among the entire cohort of participating students (62 individuals), HR measurements were taken in the morning and evening from 24 participants. Twenty-six physically active students additionally measured and recorded HR data before and after physical activities (fast walking, running, cardio, and strength training), while the remaining 36 individuals had little physical activity.

The study was conducted in October-November 2022. During this period, there were daily air alerts in the city of Lviv, where the participants lived and studied. From the indicators collected by the trackers, we wrote out HR indicators during the period of air alarms. HR data during air alerts were recorded for 21 students from the total sample, including 13 physically active students and 8 inactive individuals.

Out of all participants, 38 students agreed to complete two questionnaires: the «Global Emotional Intelligence Test» [12] and the «DASS21» [14]. The questionnaires were administered as Google Forms. During the questionnaire completion, students assessed their emotions and actions in various situations described in the questions. The DASS-21 assesses depression, anxiety, and stress states using three scales, each containing 7 items. The answers allow for assessing the levels of depression, anxiety, and stress. The Depression Scale assesses dysphoria, hopelessness, life devaluation, self-deprecation, lack of interest, and inertia. The Anxiety Scale evaluates vegetative arousal, skeletal muscle effects, situational anxiety, and subjective experience of anxious affect. The Stress Scale is sensitive to the level of chronic nonspecific arousal. It assesses difficulties with relaxation, nervous arousal, ease of getting upset /excited, irritability /excessive reactivity, and impatience. Scores are assigned for each of the three subscales, which are then categorized for stress, anxiety, and depression as follows: normal range (0–7), mild (8–9), moderate (10–12), severe (13–16), and extremely severe (17 and above).

The «Global Emotional Intelligence Test» [12], developed by N. Hall, measures emotional intelligence (EQ) levels and components. This test evaluates abilities to manage personal and others' emotions. It includes scales for emotional awareness, emotional management, self-motivation, empathy, and recognition of others' emotions. Scores indicate high, moderate, or low emotional intelligence. Levels of partial emotional intelligence according to the results: 14 and above – high; 8–13 – moderate; 7 and below – low. The integrative level of emotional intelligence, taking into account the dominant sign, is determined by the following quantitative indicators: 70 and above – high; 40–69 – moderate; 39 and below – low [12].

Mean values (M), standard error of the mean (m), and standard deviations (σ) were evaluated for each parameter. Student's t-test assessed the likelihood of mean differences between the two samples. Pearson correlation coefficient (r) was calculated to assess correlations, where values from 0.5 to 0.7 indicated moderate correlation, and from 0.7 to 1 indicated strong correlation. Positive values indicated direct correlations, while negative values indicated inverse correlations. Statistical significance was determined at $p<0.05$. All statistical calculations were performed using Microsoft Office Excel.

Results and Discussion

An increase in anxiety among the population signifies a state of purposeful preparatory enhancement of sensory attention and motor readiness in situations of potential danger, leading to corresponding fear responses [2]. Emotional states such as fear, anxiety, and tension are considered psychological manifestations of stress when they occur with sufficient intensity and duration [10]. It is widely acknowledged that stressful situations and emotional stimuli lead to the activation of the stress system as a whole and the sympathetic branch of the autonomic nervous system in particular [23]. The stress system is a complex neuroendocrine system composed of the hypothalamus-pituitary-adrenal axis and the locus coeruleus of the brainstem/norepinephrine – part of the autonomic nervous system [18]. Psychoemotional influences activate the sympathetic nervous system, which in turn stimulates heart activity. Consequently, an external manifestation of the impact of psychoemotional factors on the human body is an increase in HR [7, 24–26]. Determining HR is one of the objective methods for assessing stress levels [31]. Therefore, we used HR as a marker of stress system activation in students under different conditions. HR is an indicator reflecting the state of the cardiovascular system and the corresponding activity of the autonomic nervous system, which is controlled by higher centers of the brainstem. Normal resting HR is an indicator of both physical and mental health [22].

We found that the average HR of students in the morning was 72.28±0.91 [min: 52.32–max: 90.09] bpm (Fig. 1A). In these individuals, the average HR in the evening was 78.95±0.99 [min: 63.43–max: 92.4] bpm. The HR of students in the evening was 9.23 % higher than their morning HR ($p\leq0.05$, $n=24$). The calculated average 24-hour HR for the entire sample of students ($n=62$) was 78.12±0.74 [min: 68.8–max: 88.36] bpm.

The average HR during air alarms was recorded using the applications that made the measurements automatically without student involvement.

It was revealed (Fig. 1B) that the average HR during air alarms was 91.21±2.54 [min: 70.0–max: 101.0] bpm. This value was 16.8 % higher ($p\leq0.001$) than the average 24-hour HR for all participants in the study ($n=62$), as well as those who recorded their HR during air alarms ($n=21$). Our results showed confirms that air alarm alerts are a stressor that affects the state of students.

Changes in HR are an important physiological mechanism that ensures the adaptation of the circulatory system to physical loading. HR is directly dependent on the intensity of the work performed. Therefore, HR is considered an objective indicator of the intensity of physical activity and mental stress [17]. Furthermore, HR is the primary criterion for assessing an individual's fitness level. Changes in HR facilitate the body's adaptation to physical loading. It has been established that physical exercises have a neuroprotective effect, attributed to the activation of kynurenine pathway genes [4]. Recent research has highlighted the significant neuromodulatory role of kynurenines in the brain [27]. To understand the significance of the changes in HR during air alarms, we also investigated the influence of physical activity on this parameter.

Before physical loading (running, exercises, fast walking), the average HR of students (Fig. 2A) was 74.33±0.67 [min: 55.5–max: 85.59] bpm. After activity, the average HR was

113.18±1.37 [min: 82.07–max: 150.7] bpm. Thus, after physical loading (Fig. 2A), the HR of students increased by 52.3 % ($p \leq 0.001$, n=26). This is a normal physiological response, as physical activity requires more oxygen-rich blood. We investigated the changes in HR during air alarm alerts in physically active and physically inactive students.

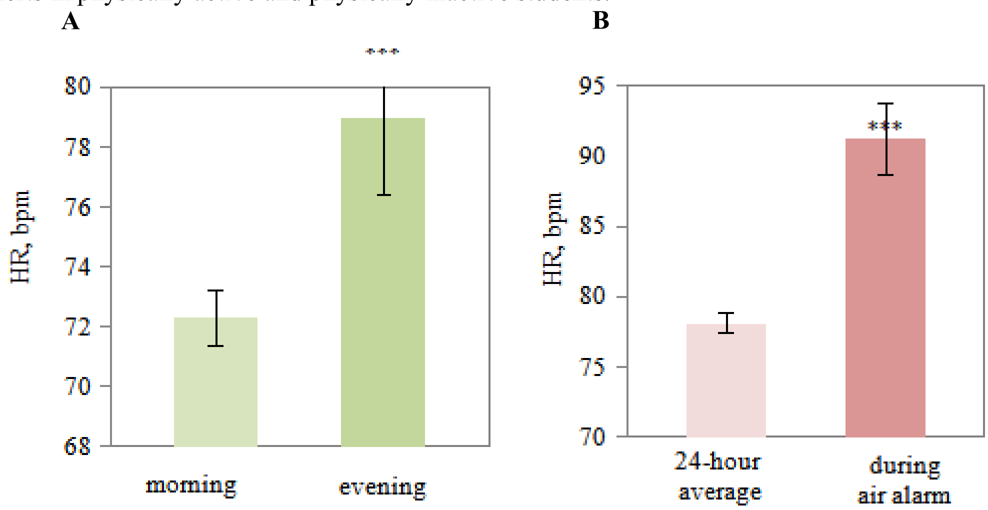

Fig. 1. Heart rate (HR, beats/min) values under different conditions: morning and evening (**A**), and average values throughout the day compared to HR during air alarms (**B**)

We divided the students with known HR during air alarms into two subgroups: 1) physically active individuals (n=13) – regular physical exercises, running, brisk walking; 2) physically less active individuals (n=8) – no sports activities. The HR values in both subgroups before activity were similar and amounted to 78.9±0.74 bpm and 77.28±0.54 bpm, respectively (Fig. 2B). During air alarms, the HR of physically active students increased by 18.51 % ($p \leq 0.001$, n=13) to 93.03±2.98 bpm.

Similarly, the HR during air alarms increased by 14.19 % ($p \leq 0.001$, n=8) to 88.25±1.79 bpm in the subgroup of physically less active students. We did not find a significant difference in HR during air alarms between the two subgroups of students. There was only a slight trend towards higher HR values in physically active individuals.

Therefore, during air alarms, students experience a 16.8 % increase in HR. However, this increase in HR does not exceed the 52.3 % increase observed during physical loading. This indicates a moderate level of stress [6] among students, which may impact their psychological state.

According to the results of the DASS21 questionnaire, we assessed the levels of depression, anxiety, and stress in 38 students.

We found (Fig. 3) that only 8 % of students had a normal level of anxiety, 16 % had mild anxiety, 24 % had a moderate level of anxiety, 13 % had severe anxiety, and 37 % had extremely severe anxiety. Thus, 50 % of students (combined severe and extremely severe) experienced anxiety beyond the normal range.

We also found (Fig. 3) that 18 % of individuals had a normal level of stress, 29 % had mild stress, 27 % had a moderate level of stress, 18 % had severe stress, and 2 % of students had extremely severe stress. Therefore, 20 % of students (combined severe and extremely severe) experienced stress levels above the norm.

We established (Fig. 3) that 32 % of individuals had no signs of depression (normal), 24 % of students had mild depression, 32 % had a moderate level of depression, 5 % had severe depression, and 5 % had extremely severe depression. Thus, 10 % of students (combined severe and extremely severe) experienced depression, while 90 % of students showed no signs of depression.

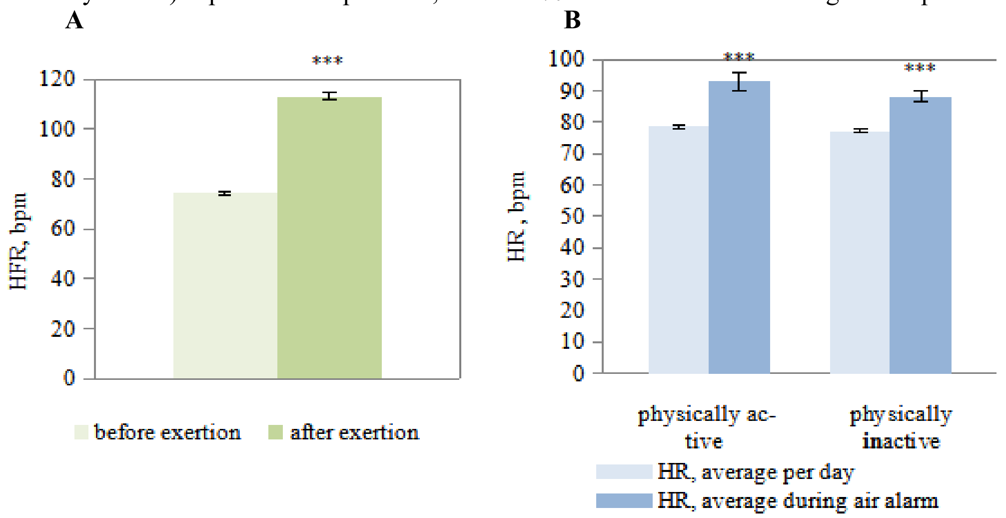

Fig. 2. The influence of physical activity (running, exercises, brisk walking) on HR (**A**), HR during air alarm in physically active and physically inactive students (**B**)

Correlation analysis showed (Fig. 4) that anxiety scores strongly correlated with stress scores (r=0.83, p≤0.05, n=13): higher stress levels were associated with higher anxiety levels.

We conducted a correlation analysis between HR during air alarms and the levels of anxiety, stress, and depression in students. We found a moderate negative correlation between the level of depression and HR during air alarms (r=-0.55, p≤0.05, n=13).

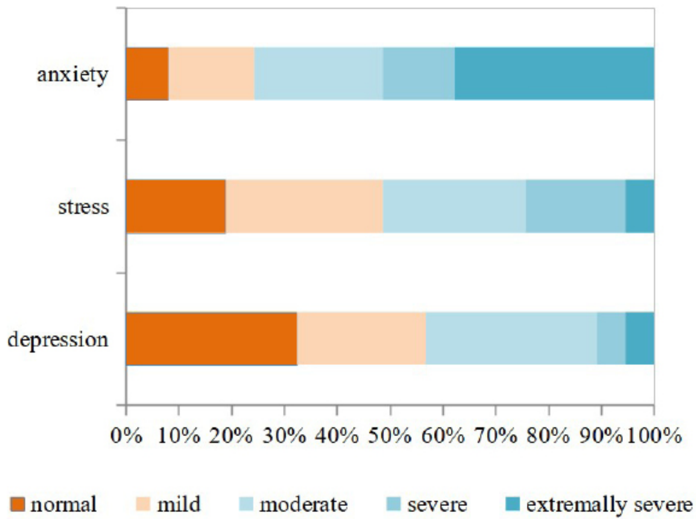

Fig. 3. Levels of anxiety, stress, and depression in the studied group of students based on DASS21 questionnaire results

Thus, the more depressive a person is, the lower their HR during the air alarm signal. Indeed, individuals with the highest level of depression (n=2) did not experience an increase in HR during air alarms, as opposed to most participants, where HR decreased.

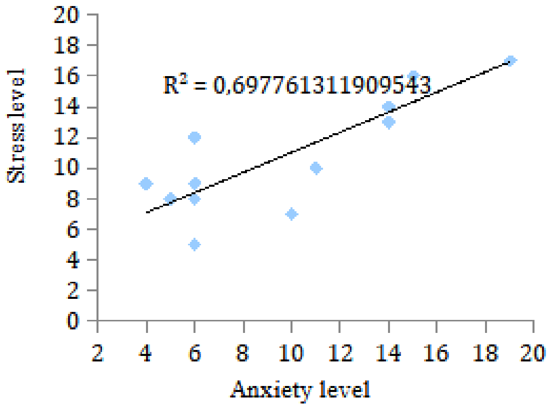

Fig. 4. Direct correlation between stress level and individuals' anxiety. *Pearson correlation coefficient r=0.83, p≤0.05, n=13*

If we exclude individuals with extremely high levels of depression from the sample (n=2), than there was no correlation between depression and HR during air alarms in the remaining students (n=11). In these individuals (**Fig. 4A**), a moderate positive correlation was shown between the anxiety score assessed by the questionnaire and HR during the air alarm signal (r=0.51, p≤0.05, n=11).

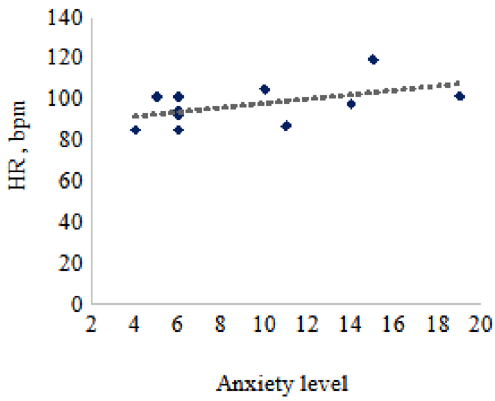

Fig. 4A. Direct correlation between students' anxiety level and HR during air alarm. *Pearson correlation coefficient r=0.51, p≤0.05, n=11*

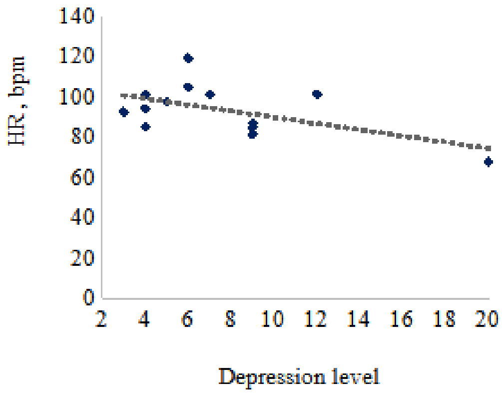

Fig. 4B. Inverse correlation between students' depression and HR during air alarm. *Pearson correlation coefficient r=-0.55, p≤0.05, n=13*

Therefore, there is a higher HR during air alarms in more anxious students, but this is not the case for depressive individuals.

We also tested whether HR correlated with the level of stress during air alarms in the sample excluding individuals with severe and extremely severe levels of depression. Interestingly, there was a weak correlation (r=0.37, p≤0.05, n=11) between HR and stress levels in students. However, in general, there was a tendency towards higher HR values during alarms in individuals with higher stress levels.

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there was a weak correlation ($r=0.37$, $p\leq0.05$, $n=11$) between HR and stress levels in students. However, in general, there was a tendency towards higher HR values during alarms in individuals with higher stress levels.

Our findings are consistent with both ukrainian and international authors concerning the relationship between war and anxiety disorders in the civilian population [3, 5, 19]. For instance, Kurapov et al. (2023) conducted a survey involving 706 Ukrainian citizens aged 18–65 years across different regions of the country and refugees. The authors found that levels of anxiety, depression, and stress were higher in women compared to men. The highest levels of these symptoms were observed in the age group of 26–40 years compared to individuals aged 18–20 years and >40 years [21]. Similarly, the work by Yurieva LM et al. (2022) confirmed the presence of anxiety and depression, especially in female participants [3]. These studies were conducted at the onset of the war, and their results indicated considerably higher levels of anxiety and depression than those observed in our study. Kurapov et al. also demonstrated worsening psychosocial states, including depression, exhaustion, and loneliness, specifically among students during wartime [20]. Psychological distress due to the war is also experienced by residents of other countries. In a study by Chudzicka-Czupała et al. (2023), participants from Ukraine (n=362), Poland (n=1051), and Taiwan (n=185) were included. The study was conducted at the beginning of the war in Ukraine. Anxiety was the most common symptom among the three groups. Ukrainians exhibited the highest levels of depression, anxiety, and stress. According to the survey, Polish and Taiwanese respondents followed. Polish respondents expressed the highest level of hopelessness regarding the war in Ukraine. The lowest level was found in Ukrainians and Taiwanese respondents [9]. Experiences of life events impact the state and health of the cardiovascular system. Increased HR is a leading factor contributing to the development of cardiovascular diseases [1]. It's known that a greater negative impact of life events is associated with an increase in HR during stress [28]. Despite the war, Ukrainian students continue to receive education through blended or distance learning, which is inherently stressful. For instance, stress frequency correlates with stress perception ($r=0.384$) in medical students at the University of Copenhagen who exhibited symptoms of depression. Conversely, in non-depressive students, there was no correlation between stress frequency and stress perception ($r=0.1$) [11]. Ukrainian students' typical academic stress has been compounded by the stress associated with war. Education demands significant intellectual effort, emotional resilience, and psychological balance. Academic activities and student self-realization are directly linked to their emotional intelligence.

Emotional intelligence is the ability to recognize one's own emotions and the emotions of others, use emotional information to regulate thinking and behavior, and differentiate various feelings and express them appropriately. Managing one's own emotions and the emotions of others falls under the concept of emotional intelligence. A higher level of emotional intelligence is significantly associated with lower levels of stress and burnout. Additionally, emotional intelligence affects stress levels, task performance, and effectiveness in working with others [15]. We assessed all components of emotional intelligence using the Global Emotional Intelligence Test questionnaire. Among all the students who filled out the questionnaires, average daily HR values were measured, and only 13 participants had additional HR recordings during air alarms.

We found (Fig. 5) that among the surveyed students (n=38), only 2 % had a high level of integrative emotional intelligence (≥70 points), 62 % had an average level (40–69 points), and 35 % had a low level of integrative emotional intelligence (≤39 points). We established (Fig. 6) a positive correlation of moderate strength between the level of integrative emotional intelligence and HR during air alarms ($r=0.59$, $p\leq0.05$, $n=13$).

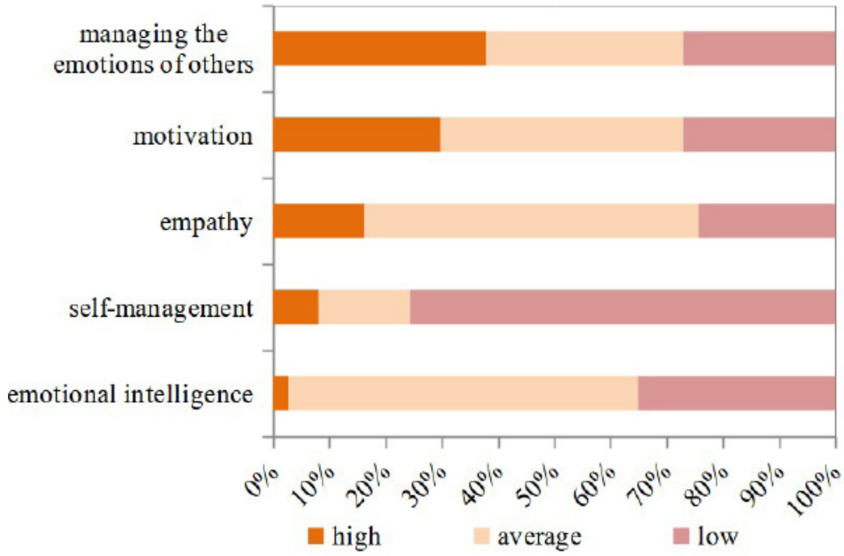

Fig. 5. Assessment of emotional intelligence and its components (self-motivation, empathy, emotional self-management, and managing the emotions of others)

We discovered (Fig. 5) that 23 % of surveyed students have a high level of emotional self-motivation, 43 % have an average level, and 29 % have a low level. A moderate positive correlation was observed between the level of self-motivation and HR during air alarms (Fig. 6) ($r=0.62$, $p\leq0.05$, $n=13$). We also found (Fig. 5) that only 8 % of students have a high level of emotional self-management, 16 % have an average level, and 75 % have a low level. We did not find a correlation between the level of self-emotion management and average daily HR ($r=0.04$, $p\geq0.05$, $n=38$). During air alarms (Fig. 6), a very weak correlation was observed between these indicators ($r=0.3$, $p\geq0.05$, $n=13$), which was not statistically significant. We found (Fig. 5) that 27 % of surveyed students have a high level of managing the emotions of others, 35 % have an average level, and 37 % have a low level. A positive correlation of moderate strength was established between the level of managing the emotions of others and HR during anxiety episodes (Fig. 6) ($r=0.63$, $p\leq0.05$, $n=38$).

Additionally, we found (Fig. 5) that 24 % of surveyed students have a high level of empathy, 59 % have an average level, and only 16 % have a low level. A positive correlation of moderate strength was established between the level of empathy and HR during air alarms (Fig. 6) ($r=0.41$, $p\geq0.05$, $n=38$).

Thus, we examined the components of emotional intelligence: emotional awareness, emotional regulation, self-motivation, empathy, and management of others' emotions.

We found a direct correlation of moderate strength between average HR during air alarm alerts and the following indicators: a) ability to manage others' emotions ($r=0.63$, $p\leq0.05$, $n=13$); b) integrative level of emotional intelligence ($r=0.59$, $p\leq0.05$, $n=13$); and c) self-motivation ($r=0.62$, $p\leq0.05$, $n=13$).

These indicators were higher in students with higher HR values during air alarm alerts. We observed an interesting trend: higher self-motivation was associated with lower levels of depression ($r=-0.31$, $p\geq0.05$, $n=13$). There was also a tendency towards an inverse relationship between students' integrative level of emotional intelligence and depression ($r=-0.29$, $p\geq0.05$, $n=13$).

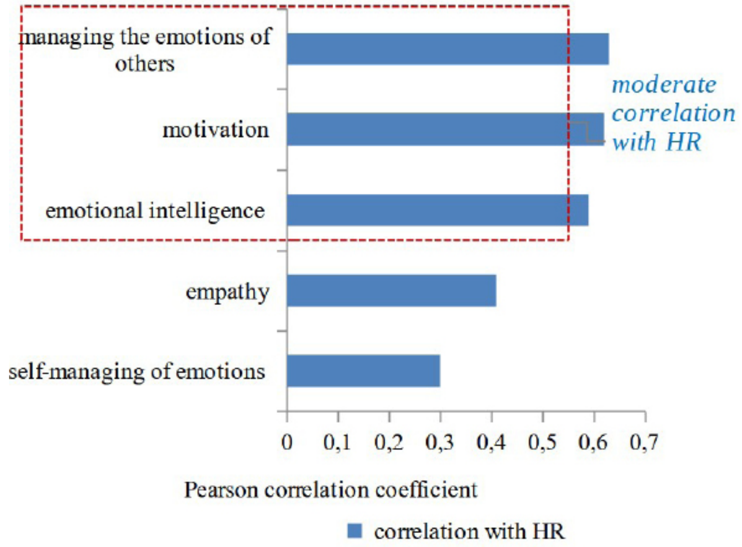

Fig. 6. Pearson correlation coefficient values between HR during air alarm and emotional intelligence components (*Pearson correlation coefficient values from 0.5 to 0.7 represent a moderate level of correlation; from 0.7 to 1 indicate a strong correlation*)

According to our data, severe and extremely severe levels of anxiety and stress were present in 50 % and 20 % of students, respectively. Among more anxious students, higher HR during air alarm alerts was observed, but this was not the case for depressed individuals. There is a moderate positive correlation between HR during air alarm alerts and students' mental and emotional states: r=0.51 (n=11) with anxiety; r=0.59 (n=13) with the level of integrative emotional intelligence; r=0.62 (n=13) with self-motivation; r=0.63 (n=13) with the level of managing others' emotions.

Conclusions

During the period of air alarm, the students' HR increased by 16.8% compared to the average daily HR. The obtained changes indicate that air anxiety is a stressful factor for the body of students, however, the increase in heart rate during anxiety was less than during physical activity, when the HR increased by 52.3 %. Both subgroups of students, physically active and physically inactive, responded to the air alarm by increasing HR by 18.51 % and 14.19 %, respectively. However, we did not find a statistically significant difference in HR between these two subgroups of students during the air alarm period.

We also observed a trend toward higher HR values during anxiety in individuals with higher levels of stress. We established an inverse relationship between the level of depression and heart rate during air anxiety in students with absent and moderate symptoms of depression. On the other hand, two people with the maximum level of depression showed a decrease in heart rate under these conditions. Therefore, it can be concluded that the more anxious a person is, the higher his HR will be during the air alarm signal, which does not apply to depressed people

Students with higher HR values during air anxiety showed higher indicators of components of emotional intelligence, such as the ability to manage other people's emotions, integrative level of emotional intelligence, and self-motivation.

So, the war in general and air alarm in particular have an impact on the psychophysiological state of students, which is manifested in increased anxiety.

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ПСИХОФІЗІОЛОГІЧИЙ СТАН СТУДЕНТІВ В УМОВАХ ВІЙНИ

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Війна в Україні чинить вплив на психофізіологічний стан громадян незалежно від того, чи є вони безпосередніми учасниками бойових дій, чи проживають далеко від лінії вогню. Зважаючи на це, вивчення психофізіологічного стану студенів, які продовжують навчатися в країні за умов війни, є актуальною проблемою, розуміння якої може допомогти розробити ефективні стратегії збереження психологічного здоров'я молоді. Відомо, що лімбічна система, яка регулює емоції, має безпосередній вплив на роботу серцево-судинної системи. Тому метою дослідження було встановити зв'язок між частотою серцевих скорочень (ЧСС) під час повітряної тривоги та психічними станами (депресія, тривожність, стрес) студентів і складовими їхнього емоційного інтелекту (самомотивація, керування власними емоціями й емоціями інших людей, емпатія).

У дослідженні взяли участь 62 студенти другого курсу біологічного факультету Львівського національного університету імені Івана Франка. Студенти оцінювали свій психоемоційний стан за опитувальниками «Global *Emotional Intelligence Test*» та «DASS21». ЧСС відстежували за допомогою смарт-годинників у поєднанні з відповідними програмами на смартфонах.

Середньодобова ЧСС студентів становила 78,12±0,74 уд/хв (n=62), а у проміжок часу, коли була оголошена повітряна тривога, – 91,21±2,54 уд/хв (p≤0,001, n=21). В осіб, які мали додаткові спортивні навантаження, спостерігали тільки тенденцію до вищих значень ЧСС під час повітряної тривоги, порівняно з тими, хто не виконував вправи. Виявлено, що 50 % студентів перебувають у стані тривожності, 20 % студентів відчувають важкий і надзвичайно важкий рівні стресу та 10 % студентів мають важкий рівень депресії. Встановлено середньої сили негативний кореляційний зв'язок між рівнем депресії та ЧСС під час повітряної тривоги (r=-0,55, p≤0,05, n=13). Високий рівень досліджуваних показників емоційного інтелекту виявили у такої кількості студентів: керування емоціями інших людей – 27 %, емпатія – 24 %, самомотивація – 23 %, керування власними емоціями – 8 % та інтегративний емоційний інтелект – 2 %. Між показниками ЧСС під час повітряної тривоги та психічними й емоційними станами студентів встановили позитивний кореляційний зв'язок середньої сили (p≤0,05): r=0,51 (n=11) – з тривожністю; r=0,59 (n=13) – з рівнем інтегративного емоційного інтелекту; r=0,62 (n=13) – з рівнем самомотивації; r=0,63 (n=13) – з рівнем керування емоціями інших людей.

Отже, війна впливає на психофізіологічний стан студентів, унаслідок чого зростає рівень тривожності. Це проявляється у зростанні ЧСС під час повітряної тривоги, що є нормальною реакцією організму на стресовий чинник. Проте чим депресивнішою є особа, тим нижчим виявляється показник ЧСС у період повітряної тривоги. Таким чином, є взаємозв'язок між показниками ЧСС під час повітряної тривоги та психофізіологічним станом студентів.

Ключові слова: частота серцевих скорочень, здоров'я, тривожність, стрес, депресія, емоції