Original Article

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Psychological and Physical Determinants of Rescue Readiness: State and Trait Anxiety in Lifeguard Candidates

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Abstract: *Background:* Effective lifeguard performance depends not only on physical preparedness but also on psychological functioning under stress. However, limited research has simultaneously examined anxiety levels and somatic-motor characteristics in lifeguard candidates at the initial stage of training. *Methods:* Fifty lifeguard candidates (19 women, 31 men) participated in the study. State and trait anxiety were assessed using the State–Trait Anxiety Inventory (STAI). Somatic parameters included body mass index (BMI) and body fat percentage (FAT%). Motor performance was evaluated using the countermovement jump (CMJ), with biomechanical variables recorded via an inertial measurement unit (IMU). Between-group comparisons and Spearman's rank correlations were applied. *Results:* Mean anxiety levels were within normative ranges for non-clinical adult populations. No significant differences were observed between state and trait anxiety. Women demonstrated a tendency toward higher anxiety levels than men, though differences were not statistically significant. No significant associations were found between anxiety levels and somatic or motor parameters. A very strong positive correlation was identified between BMI and FAT% in both sexes ($p < 0.001$), with no sex differences in correlation strength. *Conclusions:* Anxiety levels in lifeguard candidates at the beginning of training appear independent of basic physical fitness and body composition parameters. Standard physical selection criteria may not identify individuals with elevated anxiety. Incorporating psychological screening and mental skills training into lifeguard education may enhance adaptation to training demands and improve operational effectiveness under stress.

Keywords: psychophysiological profile; stress regulation; rescue readiness; body composition; explosive power; gender differences; motor control; training adaptation

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INTRODUCTION

The profession of a lifeguard belongs to occupations characterized by a high level of responsibility, in which operational effectiveness depends not only on physical and technical preparation but also on psychological functioning under conditions of elevated stress [1,2]. Life-threatening situations, time pressure, and the necessity to make rapid decisions mean that the ability to regulate emotions, including the level of experienced anxiety, constitutes an important component of rescue readiness [3,4].

In the literature, anxiety is described as a multidimensional construct encompassing both state anxiety, referring to a temporary emotional tension, and trait anxiety, understood as a relatively stable individual predisposition to respond with anxiety [5]. A commonly used instrument for assessing both components is the State–Trait Anxiety Inventory (STAI), which has been widely applied in research involving athletic populations, uniformed services, and high-risk professions [6–8]. Previous studies indicate that anxiety levels may influence cognitive functioning, decision-making processes, and performance effectiveness in stressful situations [4].

At the same time, the physical preparation of lifeguards—encompassing somatic parameters and motor abilities—constitutes a fundamental area of selection and training [9]. A high level of physical fitness, appropriate body composition, and the ability to generate muscular power are crucial for effective rescue operations [10]. Previous studies have also demonstrated that systematic physical training can significantly influence anthropometric characteristics and body composition in young athletes, highlighting the importance of monitoring these variables during long-term training processes [11,12]. Although numerous scientific studies have examined the relationships between body structure and physical performance, these issues have far less frequently been addressed in conjunction with the simultaneous assessment of psychological components [4].

Despite the growing interest in the psychological aspects of rescuers' functioning, there remains a lack of studies combining the assessment of state and trait anxiety with analyses of somatic and motor parameters [13,14], particularly during the initial phase of training for lifeguard candidates [15]. In the context of goal-directed (intentional) actions, the psychological factor represents a significant determinant of how tasks are executed. This relationship has been confirmed in studies demonstrating a significant influence of psychological factors on motor control during the performance of complex movement tasks [16,17]. Further support for this perspective is provided by the concept of the target kinematic effect, within which relationships between kinematic parameters and psychological aspects have been analyzed during the execution of sport tasks requiring a high level of precision [18].

Consequently, there is a clear research gap concerning the psychophysical profile of lifeguard candidates at the initial stage of training, encompassing the simultaneous assessment of anxiety, somatic parameters, and motor abilities. Addressing this gap may provide valuable insights from both the perspectives of sport science and psychology, as well as training practice, enabling a more holistic approach to the preparation of lifeguards.

The aim of the present study was to assess the level of state anxiety and trait anxiety in lifeguard candidates at the beginning of their training and to analyze the relationships between psychological variables and selected somatic and motor parameters. An additional objective was to determine whether sex and training experience differentiate anxiety levels among candidates, as well as to identify sex differences in selected physical parameters. Accordingly, the following research questions were formulated:

1. What are the levels of state anxiety (STAI X-1) and trait anxiety (STAI X-2) among lifeguard candidates at the beginning of training?
2. Do state anxiety and trait anxiety levels differ significantly between women and men?
3. Does training experience differentiate state and trait anxiety levels among the examined lifeguard candidates?
4. Are there significant relationships between anxiety levels (STAI X-1 and STAI X-2) and selected somatic and motor parameters?
5. Are there sex differences in selected somatic and motor parameters relevant to rescue performance?

MATERIAL AND METHODS

Research group

The study included lifeguard candidates participating in a specialized training course. Only individuals for whom complete psychological data as well as selected somatic and motor parameters recorded at the initial stage of training were available were included in the analysis.

The study group consisted of 50 participants, including 19 women (age: 19.36 ± 5.89 years; body mass: 63.68 ± 8.85 kg; body height: 166.97 ± 5.86 cm) and 31 men (age: 22.66 ± 9.39 years; body mass: 76.96 ± 14.27 kg; body height: 177.75 ± 8.08 cm). The participants represented varying levels of physical fitness and sport experience, reflecting the heterogeneous nature of the examined population. All individuals were healthy and eligible to participate in physically demanding activities, and none reported any medical contraindications to taking part in the training.

The assessments were conducted under controlled conditions in accordance with established measurement procedures. Participation in the study was voluntary. All participants were informed about the purpose and procedures of the study and provided written informed consent prior to participation.

The study was conducted in accordance with the principles of the Declaration of Helsinki. The Research Ethics Committee of Jan Długosz University in Częstochowa approved the study protocol and assigned the reference number KE-U/90/2025.

Research Protocol

The study was conducted at the initial stage of training for lifeguard candidates, before the main part of the specialised classes began. The research protocol included one-time psychological, somatic, and motor measurements, carried out under the same conditions for all participants.

A standardised STAI questionnaire was used to assess anxiety as a state and trait, and specialised measuring equipment was applied to analyse body composition and motor parameters. Biomechanical data during the countermovement jump (CMJ) were recorded using a BTS G-Sensor wireless inertial sensor.

In the first stage of the study, participants completed the State–Trait Anxiety Inventory (STAI) questionnaire to assess the level of state anxiety (STAI X-1) and trait anxiety (STAI X-2). The questionnaire was completed in conditions ensuring psychological comfort and confidentiality of responses, without time limits, in accordance with the standard instructions for the instrument.

In the second stage, anthropometric measurements and body composition assessments were performed, including body mass, body height, and body mass index (BMI). The percentage of body fat (FAT%) was determined using a standard body composition analysis method. All measurements were performed by the same research team in accordance with a uniform measurement protocol.

Body mass and body height were measured using a scale with a height gauge (WPT 150.0; RadWag; Poland) with an accuracy of 0.1 kg and 0.5 cm, respectively.

BMI was calculated based on body mass and body height. Body composition measurements were performed using a Selvas Healthcare Accuniq BC310 body composition analyser. The following variables were obtained: percentage body fat (FAT%), total body fat (FAT mass), fat-free mass (FFM), and total body water (TBW).

In the third stage, selected motor parameters were assessed, including vertical jump height, treated as an indicator of lower limb power generation capacity. The jump tests were preceded by a standardised warm-up.

A countermovement jump (CMJ) test was used to assess lower limb power. Participants performed the test in a standing position with their hands placed on their hips to eliminate the influence of arm swing. Their task was to perform a dynamic downward movement followed by a maximal vertical jump and a controlled landing.

Due to organisational constraints, such as limited testing time, each participant performed one CMJ trial. However, previous studies indicate that a single trial performed according to a standardised protocol and using validated equipment ensures acceptable reliability and validity of the obtained results [19,20]. The analysed biomechanical indicators included jump height (determined based on flight time), maximum power, and maximum velocity.

Biomechanical and neuromuscular data were recorded using a BTS G-Sensor wireless inertial sensor (BTS Bioengineering S.p.A., Garbagnate Milanese, Italy), belonging to the class of inertial measurement units (IMU). The device enables the acquisition of kinematic data during CMJ performance and is intended for both clinical and experimental applications. It features a compact design (weight: 37 g; dimensions: 70 × 40 × 18 mm) and integrates high-resolution triaxial inertial sensors: an accelerometer (16 bits per axis, range up to ±16 g), a gyroscope (16 bits per axis, range up to ±2000°/s), and a magnetometer (13 bits, ±1200 μT).

The entire research procedure was carried out during a single measurement session, in a fixed sequence of stages (psychological assessment → somatic measurements → motor tests) to minimise the influence of fatigue and potential confounding factors. The study was conducted in accordance with applicable safety standards.

Description of the Water Rescue Course

All participants took part in a full training cycle lasting 63 teaching hours, including theoretical and practical classes in accordance with the Regulation of the Minister of Internal Affairs of 21 June 2012 on water rescue training (Journal of Laws 2012, item 747), where the course participant must be at least sixteen (16) years of age, hold a Junior WOPR Lifeguard licence, and preferably hold an additional licence useful in water rescue (e.g. motorboat helmsman, yacht sailor, scuba diver, swimming instructor).

The criteria for admission to the course were passing the entrance exam, which included: a. swimming a distance of 100 m using any stroke in less than 1:40 sec., b. swimming 25 m underwater (starting from the water surface), c. towing a fellow trainee for a distance of 50 m on their back with frog kick, d. swimming a distance of 400 m using any stroke in less than 8 minutes

In order to determine the initial level of special skills for a lifeguard, the following swimming tests were conducted: a. 50 m freestyle, b. 50 m rescue crawl towing a 20 kg manikin, c. 50 m sailing style, d. 50 metres with both hands under the armpits, e. 50 metres with one hand behind the jaw.

All tests were conducted in a 25-metre swimming pool accredited for swimming competitions.

Statistical analysis

Statistical analysis was performed using Statistica (TIBCO Software Inc.), Python (pandas, SciPy libraries), and G*Power 3.1 software. Descriptive statistics were calculated for all analysed variables and presented as mean ± standard deviation (SD) and median with interquartile range (IQR).

The normality of data distribution was assessed using the Shapiro–Wilk test. If the assumptions of normality and homogeneity of variance were met, the Student's t-test for independent samples was used to compare differences between women and men. When these assumptions were not satisfied, the Mann–Whitney U test was applied.

Differences between training internship categories were analysed using the Kruskal–Wallis test. In the case of significant results, appropriate post hoc comparisons were planned.

Within-group comparisons between state anxiety (STAI X-1) and trait anxiety (STAI X-2) were performed using the Wilcoxon signed-rank test, as these variables represented paired observations obtained from the same participants.

Relationships between selected variables were analysed using Spearman's rank correlation coefficient (r_s). Additionally, Fisher's r-to-z transformation was used to compare the strength of correlation coefficients between women and men.

Effect sizes were calculated to assess the practical significance of the results: Cohen's d for the Student's t-test, r for the Mann–Whitney U test and the Wilcoxon signed-rank test, and η^2 for the Kruskal–Wallis test. The level of statistical significance was set at $p < 0.05$.

Additionally, for the significant relationship between body mass index (BMI) and percentage body fat (FAT%), a post hoc power analysis was conducted using G*Power 3.1, based on the observed correlation coefficients. At the assumed significance level of $\alpha = 0.05$, statistical power was very high in both the female ($1 - \beta = 0.999$) and male groups ($1 - \beta = 0.999$), confirming that the sample size was sufficient to detect this relationship.

RESULTS

Descriptive statistics of state anxiety (STAI X-1) and trait anxiety (STAI X-2) in lifeguard candidates are presented in Table 1. In the entire sample, the mean level of state anxiety was 37.20 ± 8.21 points, whereas the mean level of trait anxiety was 40.93 ± 9.56 points, indicating slightly higher values of trait anxiety. However, the comparison of STAI X-1 and STAI X-2 scores using the Wilcoxon signed-rank test did not reveal statistically significant differences between the two scales (Figure 1).

When gender was considered, women demonstrated higher mean values of both state and trait anxiety compared with men. The mean STAI X-1 score in women was 38.44 ± 8.85 points (median: 40.5; IQR: 30.5–42.8), whereas in men it was 35.33 ± 7.11 points (median: 35.5; IQR: 30.0–40.0). Similarly, the mean STAI X-2 score was higher in women (43.18 ± 9.19) than in men (37.45 ± 9.46). However, the differences between sexes were not statistically significant for either state anxiety ($t = 1.02$; $p = 0.318$; $d = 0.39$) or trait anxiety ($U = 63.0$; $p = 0.147$; $r = 0.28$).

Within-group comparisons between state and trait anxiety also did not reveal statistically significant differences in either women ($W = 52.5$; $p = 0.42$; $r = 0.20$) or men ($W = 16.5$; $p = 0.26$; $r = 0.35$).

Analysis according to training internship also did not reveal statistically significant differences in anxiety levels between the analysed groups. For state anxiety (STAI X-1), the Kruskal–Wallis test showed no significant effect of training experience ($H = 3.12$; $p = 0.374$; $\eta^2 = 0.08$). Similarly, no significant differences were observed for trait anxiety (STAI X-2) ($H = 2.89$; $p = 0.409$; $\eta^2 = 0.07$).

Within-group comparisons between STAI X-1 and STAI X-2 across training internship categories also showed no statistically significant differences. The Wilcoxon test results were as follows: ≤3 years ($W = 0.0$; $p = 0.11$; $r = 0.73$), 3–6 years ($W = 3.0$; $p = 1.00$; $r = 0.00$), 6–10 years ($W = 16.5$; $p = 0.83$; $r = 0.00$), and >10 years ($W = 31.0$; $p = 0.53$; $r = 0.17$).

Table 1. Descriptive statistics of state anxiety (STAI X-1) and trait anxiety (STAI X-2) in lifeguard candidates according to gender and training internship, with results of between-group comparisons and within-group Wilcoxon tests.

Criterion	Grupa	STAI X-1		STAI X-2		Statistic
		Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
Gender	Women	38.44 ± 8.85	40.5 (30.5–42.8)	43.18 ± 9.19	44.0 (36.0–48.0)	W=52.5; p=0.42; r=0.20
	Men	35.33 ± 7.11	35.5 (30.0–40.0)	37.45 ± 9.46	36.0 (30.0–44.0)	W=16.5; p=0.26; r=0.35
Statistic		t=1.02; p=0.318; d=0.39		U=63.0; p=0.147; r=0.28		
Training internship	≤3 years	34.75 ± 5.32	33.5 (30.0–38.5)	41.00 ± 5.66	41.0 (37.0–45.0)	W=0.0; p=0.11; r=0.73
	3–6 years	34.67 ± 10.50	35.0 (24.0–45.0)	40.67 ± 16.86	33.0 (29.0–60.0)	W=3.0; p=1.00; r=0.0
	6–10 years	40.12 ± 9.64	40.0 (33.0–48.0)	43.25 ± 9.16	44.0 (37.0–50.0)	W=16.5; p=0.83; r=0.0
	>10 years	36.80 ± 7.97	40.0 (30.0–42.0)	39.73 ± 9.31	37.0 (33.0–46.0)	W=31.0; p=0.53; r=0.17
Statistic		H=3.12; p=0.374; η^2=0.08		H=2.89; p=0.409; η^2=0.07		

Data are presented as mean ± standard deviation (SD) and median with interquartile range (IQR). Differences between women and men were analysed using the Student's t-test (for STAI X-1) and the Mann–Whitney U test (for STAI X-2). Differences between training internship categories were assessed using the Kruskal–Wallis test (H). Within-group comparisons between state anxiety (STAI X-1) and trait anxiety (STAI X-2) were performed using the Wilcoxon signed-rank test (W). Effect sizes were expressed as Cohen's d (t-test), r (Mann–Whitney U and Wilcoxon tests), and η^2 (Kruskal–Wallis test). The level of statistical significance was set at $p < 0.05$.

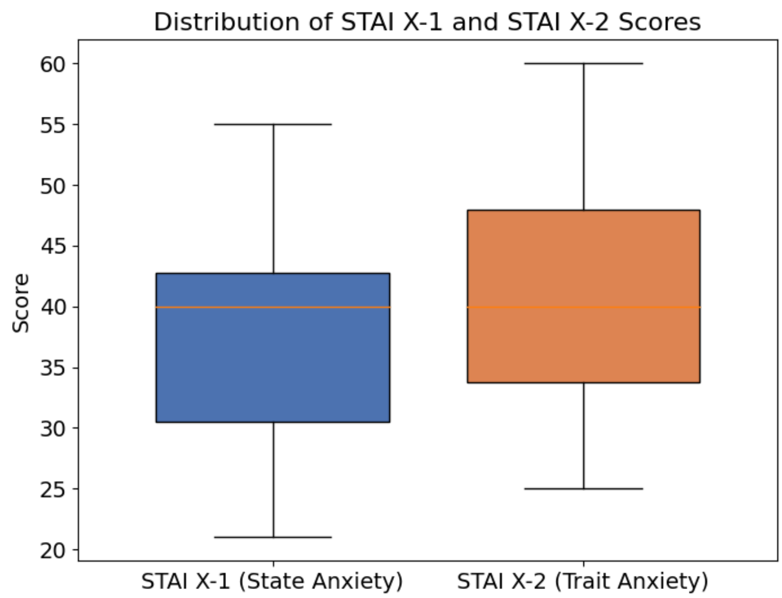

Figure 1. Comparison of state and trait anxiety levels (STAI X-1 and STAI X-2) in water rescue trainees (W = 328.5; p = 0.156).

Table 2. Descriptive statistics of jump height, body mass index (BMI) and percentage body fat (FAT) in lifeguards at baseline, broken down by gender. Data are presented as mean ± standard deviation and median with interquartile range (IQR)

Variable	Gender	Mean ± SD	Median (IQR)
Jump height (cm)	Women	20.14 ± 2.35	20.50 (18.35–21.95)
	Men	26.55 ± 8.42	27.10 (23.90–31.25)
BMI (kg·m^{-2})	Women	22.91 ± 2.58	22.30 (21.00–24.60)
	Men	23.16 ± 3.76	22.30 (20.25–26.35)
FAT (%)	Women	26.49 ± 5.26	27.00 (21.80–29.75)
	Men	15.34 ± 6.76	14.20 (9.75–19.05)

Table 3. Spearman's rank correlations between jump height, body mass index (BMI) and percentage body fat (FAT) in lifeguards, broken down by gender

Gender	Variable 1	Variable 2	r_s	p
Women	Jump height (cm)	BMI	0.09	0.718
	Jump height (cm)	FAT (%)	0.04	0.872
	BMI	FAT (%)	0.91	<0.001
Men	Jump height (cm)	BMI	−0.05	0.777
	Jump height (cm)	FAT (%)	−0.24	0.194
	BMI	FAT (%)	0.84	<0.001

r_s – correlation coefficient, p – statistical significance

Descriptive statistics of selected somatic and motor parameters stratified by sex are presented in Table 2. Men demonstrated higher jump height values and lower body fat percentage compared with women, whereas body mass index (BMI) values were similar between the sexes.

Spearman's rank correlation analysis did not reveal significant relationships between anxiety levels (STAI X-1 or STAI X-2) and the analysed somatic or motor parameters (Table 3). The obtained correlation coefficients were low, indicating weak or negligible associations between the variables.

Separate analyses conducted for women and men revealed a very strong positive correlation between BMI and percentage body fat in both groups (women: r_s = 0.91; p < 0.001; men: r_s = 0.84; p < 0.001). No significant relationships were observed between jump height and BMI or FAT (%) in either sex (p > 0.05). Comparison of correlation strength between sexes using Fisher's r-to-z transformation showed no significant differences (z = 0.98; p = 0.33).

DISCUSSION

The aim of the present study was to assess the levels of state and trait anxiety in lifeguard candidates and to analyse their relationships with selected somatic and motor parameters. The obtained results provide insight into the psychological profile of the examined group at the initial stage of training and into the relationships between psychological variables and physical characteristics relevant to rescue performance.

The mean values of state anxiety (STAI X-1) and trait anxiety (STAI X-2) observed in the present study were within the ranges typically reported for non-clinical adult populations [21]. Although the mean value of trait anxiety was slightly higher than that of state anxiety, the Wilcoxon signed-rank test did not reveal statistically significant differences between the two scales. This finding suggests that the candidates were characterised by a relatively stable and moderate level of emotional tension that was not strongly influenced by the testing situation. In other words, participation in the assessment conducted at the beginning of the training course did not appear to constitute a substantial stressor for the participants.

Sex-based analysis revealed a tendency toward higher levels of both state and trait anxiety in women compared with men. Although these differences were not statistically significant, the observed effect sizes indicate the possibility of practically meaningful differences. This observation is consistent with previous research indicating that women often report higher anxiety levels than men, which may be explained by both biological and psychosocial factors [8,22,23]. In the context of lifeguard training, these tendencies may be relevant when considering psychological support or stress-management strategies during the early stages of professional preparation.

The present study also showed that training experience did not significantly differentiate anxiety levels among the examined candidates. Both state and trait anxiety scores were comparable across training internship categories. This finding suggests that prior experience related to physical activity or rescue-related training may not be a primary determinant of anxiety levels in this population. Previous studies have indicated that emotional responses in demanding situations are influenced not only by experience or expertise but also by individual factors such as personality traits, cognitive appraisal of stressors, and emotion-regulation strategies [24,25].

Correlation analysis did not reveal significant relationships between anxiety levels and the analysed somatic or motor parameters. The obtained correlation coefficients were low, indicating weak or negligible associations between psychological characteristics and the selected indicators of body composition or lower-limb power. This may suggest a relative independence of psychological and physical components at the early stage of lifeguard training. It is also possible that potential relationships between anxiety and motor performance become more apparent under conditions of higher situational stress or during complex rescue tasks requiring rapid decision-making.

Previous studies have suggested that the relationship between anxiety and motor performance is not necessarily linear and may depend strongly on the context in which the motor task is performed [4,25]. In the present study, the motor task used to assess lower-limb power (CMJ) was performed under controlled laboratory-like conditions, which likely limited the influence of emotional factors on performance. Lower-limb power, assessed through jump height, is primarily determined by neuromuscular characteristics [26,27], which may further explain the lack of direct associations with anxiety levels.

A significant and very strong positive correlation between BMI and body fat percentage was observed in both women and men. This finding indicates that, in the examined group, BMI reflected differences in body composition relatively well. Moreover, the absence of significant differences in the strength of this relationship between sexes suggests a similar pattern of association between BMI and FAT (%) in both groups. Similar relationships have been reported in previous studies analysing the usefulness of BMI as a general indicator of adiposity in adult populations [28,29].

Overall, the results of the present study suggest that, at the initial stage of training, anxiety levels in lifeguard candidates remain relatively independent of basic somatic characteristics and simple indicators of motor performance. These findings highlight the importance of considering psychological and physical components as complementary but partly independent aspects of preparation for rescue activities.

Practical implications

The obtained results indicate that the levels of state and trait anxiety among lifeguard candidates at the initial stage of training were within a moderate range and were not significantly associated with basic somatic parameters or motor abilities. From a practical perspective, this suggests that standard physical selection criteria do not allow for the identification of individuals with elevated anxiety levels. Therefore, it appears justified to incorporate simple screening tools assessing the psychological component already at the early stage of training. Moreover, the observed sex differences, although not statistically significant, may be relevant when planning psychological support and stress-management education, particularly in the context of scenarios simulating real-life rescue emergencies. Integrating elements of mental training with physical preparation may contribute to better adaptation to training loads and improved effectiveness of rescue actions under high-stress conditions.

Limitations and Directions for Future Research

The main limitation of the present study is the relatively small sample size, which may have reduced the statistical power of certain analyses, particularly in the case of between-group comparisons and relationships characterized by small effect sizes. Future research should include larger samples to enable the application of more advanced statistical methods and improve the precision of effect estimates.

Another limitation is the cross-sectional nature of the psychological assessment, which did not allow for the evaluation of changes in anxiety levels during the course of training or the analysis of psychological adaptation to increasing demands. Future studies should adopt a longitudinal design, including measurements at different stages of training, in order to assess the dynamics of change and identify factors facilitating effective adaptation.

An additional limitation was the inability to integrate psychological and physical data at the individual level, which restricted the scope of multidimensional analyses. Future research should ensure the integration of psychological, somatic, and motor data, enabling the development of predictive models that incorporate both physical and psychological components.

Furthermore, the study did not account for other potentially relevant variables, such as previous rescue experience, situational stress levels, sleep quality, or coping strategies. Including these variables in future investigations could enhance understanding of the mechanisms underlying effective preparation of lifeguards.

From a broader perspective, future research should also extend analyses to behavioral and decision-making variables reflecting rescuers' functioning in simulated emergency conditions. Such an approach would allow for a more comprehensive evaluation of the practical significance of anxiety levels and their interaction with physical preparedness in real rescue operations.

CONCLUSION

The results of this study indicate that lifeguard candidates at the initial stage of training demonstrate moderate levels of both state and trait anxiety, with no significant differences observed between the analyzed STAI scales. Furthermore, no statistically significant relationships were identified between anxiety levels and the examined somatic or motor parameters, suggesting a relative independence between psychological characteristics and physical fitness components at the early stage of lifeguard training.

The analysis by sex revealed a tendency toward higher anxiety levels among women compared with men; however, these differences did not reach statistical significance, despite clear sex-related differences in somatic and motor characteristics. In addition, a very strong positive association was found between body mass index and percentage body fat in both sexes, confirming the usefulness of BMI as a general indicator of body composition in the studied population.

Overall, the findings highlight the importance of incorporating psychological assessment and support into lifeguard training programs, as a valuable complement to traditional physical fitness evaluation criteria.

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