

Psychological indicators of mental health in boxing athletes according to gender

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Dictionary:

Athlete – noun 1. someone who has the abilities necessary for participating in physical exercise, especially in competitive games and races 2. a competitor in track or field events.

Boxing – A sport in which two people fight each other with their hands, while wearing very large thick gloves (called boxing gloves).

Combat sports – noun a sport in which one person fights another, e.g. ju-jitsu, wrestling, boxing, taekwondo and the combat sports.

Personality – complex totality of thoughts, emotions and behaviour providing a human life with a course and cohesion.

RSC – in boxing, stands for 'Referee Stops Contest'. It is an official result declared when a referee (or ringside physician) steps in to end a fight because a boxer is outclassed, injured, or receiving excessive punishment and cannot safely continue.

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Abstract:

Background and Study Aim: Boxing is a combat sport where repeated brain trauma can increase the risk of escalating neurological and mental disorders. High scores on certain negative personality traits in young, healthy individuals are associated with health problems in adulthood. The aim of the study was knowledge regarding the mental health of amateur boxers.

Material and Methods: Seventy-eight boxing male athletes and seventy-eight boxing female athletes were examined by psychological test. The ages of the athletes in both groups ranged from 19 to 23 years. A personality profile was determined using the Five Factor Inventory (NEO-FFI), also known as the BIG FIVE, which includes scores on five personality traits: Neuroticism (Nu), Extraversion (Ex), Openness to Experience (Op), Agreeableness (Ag), and Conscientiousness (Co). Furthermore, the level of Trait Anxiety (TA) was assessed. The level of mental health expressed by the MHI was calculated using the formula: $MHI = Ex/48 + Op/48 + Ag/48 + Co/48 - Nu/48 - Ta/80$. Intergroup comparisons for each psychometric variable were performed using the Mann-Whitney test. Within each group, the relationships between variables were expressed using Spearman correlation coefficients. Statistical analysis was performed using the STATISTICA software package vs. 13.3.

Results: Statistically higher scores for Ex, Ag, and Co were observed in women. The level of mental health expressed by MHI was also significantly higher in female boxers, while TA and Nu levels were similar between genders. Different correlation coefficients were observed between the variables for both groups. Significantly fewer than one in three male participants (27%) reported a knockdown in the two years preceding the study, while none of the women reported such an incident. Based on sporting achievement, female boxers were somewhat more successful athletes than the male ones.

Conclusions: It has been observed that the gender differences in personality traits found in our study contradict the findings of other researchers, who have reported higher levels of negative traits such as TA and Nu in women. It was found that when interpreting the differences between personality traits and mental health levels in the groups we monitoring, one must take into account different sporting achievements in tournaments against foreign

opponents, and also the fact that women's punches are weaker, and therefore their exposure to punches directed at the head is lower than that of men. It seems that another possible factor differentiating the personality profiles of both sexes is the significantly smaller population of women practicing boxing, and consequently, it is easier for those with talent to achieve success without the risk of compensating for multiple blows to the head from their opponents. Further research into the health effects of boxing for women is warranted.

Keywords: comparison anxiety trait, the Big Five, personality profiles

1. Introduction

Psychological tests have been used for years to identify personality traits and temperament. These traits largely determine the quality of life of the subject. In individuals who do not practice sports, the relationship between mental and physical health, the quality of relationships with other people, and personality traits has been confirmed [1-4]. Among the numerous questionnaires used to assess personality, the most commonly used is the NEO-FFI, also known as The Big Five, which measures five components: Neuroticism (Nu), Extraversion (Ex), Openness to Experience (Op), Agreeableness (Ag), and Conscientiousness (Co) [5]. The diagnostic value of the 'Big Five' has been confirmed by numerous studies [6-8]. The results of these studies allow for the prediction of individuals' behaviour in neutral or stressful conditions. It has been shown that during the COVID-19 pandemic, greater manifestations of active coping with stress were noted in individuals with elevated levels of Op, Ex, Ag, and Co, while higher levels of Nu characterized individuals less well adapted to difficult situations [9]. Research has revealed that the BIG FIVE personality profile is not a constant but changes with age, and the direction of change depends on gender. In boys, Ex and Op decrease slightly over the years, while in girls, Ex, Op, Ag, and Co increase. These different directional changes in both sexes may be due to biological and emotional maturation and experiences related to psychophysical development. As a result, after the period of biological development is completed, a gender-specific personality pattern becomes established, but different life experiences determine the final personality profile [10-12]. Therefore, personality studies in different age and social groups are justified in conducting public health policy [13, 14].

Personality studies conducted on athletes practicing various combat sports are particularly interesting and relevant. This may stem from concerns that this type of sports competition may adversely affect personality, for example, perpetuating a tendency to generate conflict and aggressive reactions, which is socially unacceptable. Combat sports regulations permit the use of highly destructive techniques that ensure success but also carry the risk of serious injury. This hypothesis was not confirmed by studies of jujitsu and wrestling [15], but it was confirmed among four Far Eastern combat sports, where the highest level of aggressiveness was demonstrated by kyokushin karateka's, who use striking and kicking (full-contact), and the lowest by the less-contact style of shotokan karate [16]. However, particularly high levels of aggressiveness are manifested in 'brutal activity', such as MMA (neogladiators), where participants strive to physically destroy their opponent, and the referee stops the fight only when the life or health of one of the combatants is in danger [17]. A relationship between practicing combat sports and a tendency towards aggression has been noted in studies of adolescent judo athletes. Training of novice judokas increases their level

of aggression [18-20], and in older male judokas, aggressiveness is higher than in athletes whose competition is free.

Amateur and professional boxing is a sport in which the attacking athletes' task involves intentional and destructive blows to the opponent's head, while defence focuses primarily on protecting the head. During boxing matches, repeated blows increase the risk of developing neurological disorders [21, 22], inhibit the hormonal activity of the pituitary gland [23], and impair cognitive and executive functions [24]. Neurodegenerative changes in the brain caused by repeated blows to the head can, over time, lead to Alzheimer's disease, a symptom of which is dementia [25]. It is worth noting that not only boxers but also athletes from other disciplines are at risk of head injuries. Over time, they may develop Parkinson's disease, as well as neuropsychiatric and mental disorders such as depression, paranoia, aggression, as well as impaired memory, perceptiveness, and information processing speed [26, 27]. In neurological studies of athletes exposed to head injuries, the Trail Making Test (TMT) is an easy tool for assessing cognitive function. Boxing athletes perform worse on the TMT two weeks after the tournament and demonstrate longer reaction times [28]. A major, single brain injury unrelated to sports can alter the personality profile of adolescents [29] and adults [30], increasing neuroticism and decreasing Ex, Op, Ag, and Co. The cited studies suggest that high Ne levels are a symptom of poorer mental health. When analysing the relationship between head injuries in boxers and the personality profile, the contribution of other factors, e.g., biological and environmental, should be taken into account [31, 32]. Furthermore, personality traits are shaped by various life experiences [33-35]. It can be assumed that in athletes, the course of their sports career and achievements, as life experiences, may also modulate the personality profile.

The relationship between mental health and personality profile and physical performance is the subject of joint research by physiologists and psychologists. As might be expected, high physical performance is associated with better mental health indicators [36-38]. Studies conducted on boxers also revealed certain correlations between the level of motor indicators such as results of squat jump, countermovement jump, hand grip strength, and abdominal endurance (sit-up test) and the Big Five personality traits. The strongest positive correlation ($r = 0.72$) found between Ag and the sit-up test result [39]. Boxing requires high anaerobic and aerobic capacity and a high tolerance to blood acidification. After three-round fights, high blood lactate levels were noted in both winners and losers of various weight classes [40]. Weight limits in various weight classes sometimes require a short-term caloric restriction prior to competition, which increases blood cortisol levels during exercise [41] and lowers testosterone levels [42]. In combat sports, such hormonal changes can adversely affect the ability to compete effectively. Considering the psychophysical demands placed on boxers and the health risks associated with this sport, a decision was made to psychologically assess a group of amateur boxers. The aim of the study was knowledge regarding the mental health of amateur boxers.

2. Material and Methods

Participants and study design

Two equal ($n = 78$) groups of male and female boxers aged 19-23 years practicing competitive boxing were studied (total 156). According to the coaches, the female

athletes demonstrated superior athletic performance compared to their male counterparts.

As a criterion for mental health, we adopted the results the NEO-FFI questionnaire (Costa PT & McCrae RR 1992 [43]) and the Trait/State Anxiety Inventory by Spielberger 1983 [44] using Polish versions provided by the Psychological Testing Laboratory. A personality profile was determined which includes scores on five personality traits: Neuroticism (Nu), Extraversion (Ex), Openness to Experience (Op), Agreeableness (Ag), and Conscientiousness (Co). Furthermore, the level of Trait Anxiety (TA) was assessed. The level of mental health expressed by the MHI was calculated using the formula: $MHI = Ex/48 + Op/48 + Ag/48 + Co/48 - Nu/48 - Ta/80$.

The studies were conducted during the training and competition season (February–November), during breaks between competitions. In the morning, the study groups completed the NEO-FFI questionnaire and the Trait/State Anxiety Inventory by Spielberger. Each participant answered the question whether they had experienced a knockdown or RSC ('Referee Stops Contest') during an official competition in the year preceding the psychological assessment.

Statistical analysis

Statistical analysis was performed using the computer program STATISTICA SOFTWARE version 13.3. The Shapiro-Wilk test was used to test the normality of the distribution of each variable for each group, and the Mann-Whitney test was used for inter-group comparisons. Spearman's linear correlation coefficients were calculated between the variables separately for each group.

The estimation of the results is based on the following indicators: frequency (N, n); mean values, standard deviations (SD or $\pm$); range; minimum (Min); Maximum (Max); coefficients of variation (CV%). Moreover, it has been made the results of intergroup comparisons of means for each variable and the correlation coefficients (r) between variables, separately for each gender. He is being monitored significance level, probability (p); the significance level α is the threshold for p below which the null hypothesis is rejected even though by assumption it were true, and something else is going on (α). In Tables significant differences are marked in bold.

Effect size (ES) was calculated using the formula $ES = |Z|/N^{0.5}$, where: Z-score the standard score or is the number of SD by which the value of a raw score (i.e., an observed value or data point) is above or below the mean value of what is being observed or measured; N is the total number of participants (in this project $n=156$).

The study was approved by Ethic Committee at Institute of Sport-National Research Institute no KEBN-20-54-HM.

3. Results

These intergroup comparisons of personality variables revealed significantly higher mean scores for extraversion (by 10%), agreeableness (by 25%), and conscientiousness (by 11%) in women. Openness and agreeableness scores were very similar for both groups, while the mean anxiety score was slightly (by 4.3%) higher in male athletes (Table 1). Furthermore, significant inter individual variability was demonstrated for each variable in both genders, as expressed by the coefficients of variation (CV%). The highest value of this indicator in each group was observed for neuroticism.

Table 1. Descriptive statistics of the psychological traits (PT) and differences between male (M) and female (F) boxers (n = 156).

PT	Sex	Mean (SD)	CV%	Range	Min-Max	Z-value	p-value	Effect Size	
TA	M	38.3 ±7.2	18.8	35	24-59	0.752	0.452	0.060	very small
	F	36.7 ±7.0	19.0	32	23-55				
Nu	M	20.2 ±8.4	41.6	39	3-42	0.909	0.363	0.070	very small
	F	19.2 ±7.5	39.1	38	5-43				
Ex	M	30.1 ±4.7	15.7	21	19-40	-3.82	0.0001	0.314	moderate
	F	33.4 ±3.5	10.6	42	3-45				
Op	M	24.7 ±5.3	20.3	27	9-36	0.013	0.990	<0.000	very small
	F	24.9 ±4.6	18.5	24	14-38				
Ag	M	25.1 ±5.9	23.3	24	14-38	-3.40	0.0002	0.272	Small
	F	28.4 ±6.6	23.3	29	11-40				
Co	M	32.4 ±7.1	21.9	29	19-48	-3.54	0.0004	0.283	Small
	F	36.6 ±6.6	18.0	28	20-48				

Linear correlation analysis revealed significant correlations between selected personality traits. In each group, anxiety positively correlated with neuroticism, and agreeableness with conscientiousness. Neuroticism showed a negative tendency to correlate with selected other traits, and this phenomenon was more pronounced in women. Only in female athletes did the level of neuroticism significantly decrease with age, while anxiety negatively correlated with extraversion, agreeableness, and conscientiousness (Table 2).

Table 2. Matrix of correlations (rho) of the psychological traits for female (F) and male (M) boxers (n = 156).

PT	Sex	TA	Nu	Ex	Op	Ag	Co
Age	F	-0.120	-0.244*	-0.031	0.203	0.119	0.140
	M	-0.100	0.011	-0.092	0.173	0.094	-0.047
TA	F		0.643**	-0.311**	-0.098	-0.337**	-0.487**
	M		0.662**	0.034	0.034	0.082	-0.199
Nu	F			-0.342**	-0.206	-0.276	-0.284**
	M			-0.112	0.160	0.196	-0.257**
Ex	F				0.204	0.308**	0.371
	M				0.010	0.177	0.432
Op	F					0.228*	0.089
	M					0.130	-0.071
Ag	F						0.485**
	M						0.240*

*p<0.05; **p<0.01

4. Discussion

Many researchers have demonstrated differences in personality profiles between women and men. The first cross-cultural study of neuroticism and extraversion was conducted in 1997 using a questionnaire by Eysenck. In this study, neuroticism levels in women were significantly higher in each of the 37 nationalities examined, and extraversion levels were higher in 30 nationalities examined [45]. Research findings using the Big Five, published in other studies on neuroticism levels using the Big Five questionnaire, confirmed the aforementioned gender differences. Women demonstrated higher neuroticism scores, with psychological gender, defined by the results of questionnaires measuring masculinity and femininity, partially moderating neuroticism [46]. Another study revealed differences in personality profiles between women and men across a wide age range (24-74 years). In this study, women demonstrated significantly higher scores on neuroticism, agreeableness, extraversion, and conscientiousness, but lower openness to experience than men. Moreover, these women were more likely to report poorer mental health, as evidenced by frequent cases of major depression, anxiety disorder, and panic attacks [47]. A gender-specific personality profile among the younger population, i.e., university students, revealed significantly higher scores for agreeableness, neuroticism, anxiety, and perceived stress in women, as well as poorer sleep quality and a higher heart rate. However, the scores for openness to experience and extraversion were similar in both groups [48]. Higher levels of neuroticism in female students were also noted by other researchers [49]. Another manifestation of poorer mental health is high levels of trait anxiety. Studies conducted on large groups from 26 countries showed higher levels of this trait in women [50].

Personality profile analysis performed in competitive athletes revealed similar differences between men and women as in non-competitive athletes. Among volleyball players, women demonstrated significantly higher scores than men for extraversion and agreeableness, and lower scores for emotional stability, while no intergroup differences were found for anxiety and conscientiousness. Furthermore, in this study, extraversion positively correlated with agreeableness, and anxiety negatively correlated with emotional stability [51]. Among combat sports practitioners, women practicing karate kyokushin demonstrated higher levels of neuroticism by over 22% and lower levels of openness to experience and agreeableness by approximately 24% compared to men [52]. Gender-related differences in personality profiles were noted among students practicing volleyball, basketball, and judo. Higher levels of anxiety, extraversion, and emotional reactivity were observed in women [20]. The results of the cited studies may suggest that, regardless of sports activity, women pay a higher psychological cost due to their gender. Results differing from those cited in the studies were obtained in a group of junior archery athletes. In this study, no gender differences were observed for anxiety and temperamental traits [53]. In our study, women practicing amateur boxing demonstrated higher scores for extraversion, agreeableness, and conscientiousness, which is consistent with data reported by other authors above. However, we did not find gender differences for anxiety and neuroticism, which contradicts common knowledge. In our search for the causes of these differences, we considered two factors that could mitigate the intergroup differences in anxiety and neuroticism. The first is the varying degree of exposure to head injuries, and the second is differences in athletic achievement. The risk of brain injury in boxing depends on the force of the punch. Female athletes strike with a force

several dozen percent lower than males of similar body weight. This was demonstrated by indirect measurements using the 'shot put performance' test [54] and direct measurements using a punching bag equipped with impact force sensors [55]. Due to the significant difference in the force of blows delivered by male and female boxers, the differences between the sexes for the peak translational and rotational head acceleration values are smaller in women by 7% and 30%, respectively [56]. Furthermore, it has been shown that during sparring matches, female boxers deliver several times fewer significantly powerful blows, therefore their total exposure to brain injuries may be lower [57].

The relationship between sporting success and the level of the Big Five traits has been the subject of numerous studies. A large group of athletes from various sports who won medals ranging from gold to bronze in international competitions demonstrated significantly lower (2.7-fold) levels of neuroticism and significantly higher levels of other personality traits compared to athletes who achieved success only in national competitions [58]. Similar correlations were noted for team sports athletes [59]. In team sports, individual performance cannot be assessed based on team medals. For this reason, a multidimensional rating scale, assessed by coaches using the coach's rating scale, is used to determine the level and effectiveness of athletes. In female soccer players, significant negative correlation coefficients were demonstrated between the values of each subscale and the level of neuroticism [60].

In other studies of male and female sports players, multiple regression revealed significant predictors of agreeableness, conscientiousness, and openness to experience [61]. A study using the Big Five for female volleyball players from three volleyball teams from the first, second, and third leagues showed that the team's average level of neuroticism decreased and that of extraversion increased with the team's ranking in the league [62]. A similar relationship was observed for a group of 100 athletes from various disciplines classified into three different groups at different sporting levels. The higher the level, the lower the neuroticism score and the higher the scores for the remaining Big Five traits [63]. Our results of the analysis of the relationships between the Big Five traits are largely consistent with the findings of other authors in female players and to a lesser extent in male players, where extraversion, openness, agreeableness, and conscientiousness correlate positively with each other, while neuroticism correlates negatively with the aforementioned traits [64-68].

Furthermore, the level of neuroticism significantly positively correlates with indicators of aggressiveness [69], so it can be assumed that a high score on this trait negatively impacts the quality of social relationships. Our results should not suggest that amateur boxing practiced by women is safe for their health due to lower impact force and, consequently, lower exposure to brain injuries, but more so than for advanced judo athletes [70-72]. The force of blows to the head is not the only measure of health risk. The harmful effects of concussion, such as migraines, anxiety, and depression, are more severe and last longer in women [73]. For this reason, boxing should be considered harmful to the health of both women and men, as indicated by the lower levels of selected cognitive functions in boxers [24, 23].

We suggest that only complementary scientific research that considers not only psychological aspects but also fitness, physiological, and biochemical ones can more accurately explain personality traits and states [74] and influence the optimization of

the training process and competition results [75-79]. In addition to club coaches, this process should be supported by personal trainers [80, 81] and recovery system experts [82-85].

Our research was conducted in years when the population of female athletes was much smaller, the level of competition was lower, and the requirements were lower, making it easier to gain admission to the National Team than it is today. This was likely one of the reasons for the better results and mental well-being of female boxers compared to male boxers, for whom competition was a more serious challenge at the time. Currently, the level of competition for female boxers is much higher, so the risk of negative health effects has likely increased significantly. Knowledge about the long-term health effects of sustained blows to the head—even minor ones—is still too limited to recommend this sport to young people.

5. Conclusions

It has been observed that the gender differences in personality traits found in our study contradict the findings of other researchers, who have reported higher levels of negative traits such as TA and Nu in women. It was found that when interpreting the differences between personality traits and mental health levels in the groups we monitoring, one must take into account different sporting achievements in tournaments against foreign opponents, and also the fact that women's punches are weaker, and therefore their exposure to punches directed at the head is lower than that of men. It seems that another possible factor differentiating the personality profiles of both sexes is the significantly smaller population of women practicing boxing, and consequently, it is easier for those with talent to achieve success without the risk of compensating for multiple blows to the head from their opponents. Further research into the health effects of boxing for women is warranted.

Data Availability Statement: The data supporting this study's findings are available from the corresponding author upon reasonable request.

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