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Comparative analysis of the level's aggression of women and men training Brazilian Jiu - Jitsu in the light of the possibilities for therapeutic purposes

Analiza porównawcza poziomu agresji kobiet i mężczyzn trenujących Brazylijskie Jiu - Jitsu w świetle możliwości zastosowań terapeutycznych

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1. Summary

Aim: Compare the level of aggression of women and men training Brazilian Jiu-Jitsu (BJJ) with average aggression from a randomly selected control group and analyze the results in terms of therapeutic value.
Material and methods: A group of 38 women and a group of 43 men practicing Brazilian Jiu-Jitsu were examined using the questionnaire to determine the level of aggression "Aggression Questionnaire" by Buss, Perry, the "Amity" Institute in the Polish adaptation. The collected data was compared with the results of women (35 people) and men (40 people) from the control group.
Results: Lower levels of total aggression were observed among women and men training Brazilian Jiu-Jitsu relative to the control group. There was also a lower level of aggression in the group of women than in the group of men, and a decrease in the level of total aggression along with the increase in the training experience.
Conclusions: The long-term training of Brazilian Jiu-Jitsu reduces the level of aggression. Training this sport can be one of the ways to reduce the level of aggression. Psychologists may recommend the training of Brazilian Jiu-Jitsu as a form of reducing aggression for people who are manifesting excessive and uncontrolled aggression in social relations.

2. Introduction

2.1. The definition of aggression and its regulatory role

Aggression is an intentional action, aimed at causing physical or psychological damage. Eliot Aronson writes: "Human is an aggressive being. Except of some rodents, no other vertebrate kills with such a consequence and fancy of individuals of their own species. " Aggression is instinctive, but it can be modified through the learning process. The term aggression derives from the word aggression, which comes from Latin and means an attack, an assault. This is a behavior that intends to intimidate or injure another individual through a physical attack. It is also a genetically conditioned type of behavior, aimed at forcing an opponent to flee or surrender. According to K. Lorenz, aggression is an innate and spontaneous readiness to fight, which is necessary for survival. In the animal world, it is often expressed in the form of impressive and threatening opponents, which avoids direct fighting. The weakness turns submissive, surrenders, which suppresses the stronger attack. To inhibit such proceedings, among others belonging to the same herd. In international relations, aggression manifests itself as an armed or economic attack of one or many countries on another country or states, which often causes the beginning of a war [1] [2] [3].

2.2 Biological bases of aggression

Aggression has its biological basis. The amygdala is an area in the cerebral cortex that controls the manifestations of aggression [4]. Aggression is used to survive the best. It is regulated by the number of neurotransmitters and endocrine systems - serotonin, whose deficit was increased, and the key role is played by testosterone, and hormone involved in dominant behavior. By the latter men are more aggressive than women.

In the neurobiological context, we can distinguish two types of aggression: emotional - which is a reaction to the threat of "fight or run away" and rational - in which we engage the intellect, which is used to achieve the most effective way. On the example of sport, social factors may be a given moment, for example, the behavior of the audience during sport competitions. These types of aggression have different anatomical and neurobiological backgrounds and interact with each other [5].

2.3. Typology of aggression

There are divisions of aggression made in the literature depending on the adopted situational, motivational, purposefulness and other criteria [6]. The purpose of hostile, otherwise antagonistic aggression is to hurt someone. It can also be useful when it reduces the level of cumulated energy. This is often the case in sport. Instrumental aggression is used to achieve a non-aggressive goal. Most of the aggressions observed in sport are of such a nature. Instrumental aggression is an accepted aggression - emotion and anger motivates the player to take action in accordance with the rules of sports competition. The hostile aggression is unacceptable aggression and this happens when the player in the emotions of anger stops to follow the rules. In the scientific community there is a discussion on whether aggression is an innate propulsion or learned behavior. Aggression has a specific adaptive meaning, it was used for survival, so most psychologists accept the opinion that aggressive tendencies have developed during evolutionary development. Simultaneously, human have extensive control mechanisms that reach stressful or aggressive impulses and depending on his own resistance to stress. One also can modify behavior depending on changes occurring in the environment [7] [8].

Fromm divided aggression into natural aggression of self-proclaimed instinct and malicious aggression as: instincts, urges, passions and destructiveness, cruelty. Aggression may be occur in people whom has developed the type of character susceptible to it [9].

Buss distinguished hostility from aggression as only verbal reaction. He divided aggression into direct and indirect, which consists of: verbal and physical aggression, irritation and negativism. He defined physical aggression as an action directed against human, involving every brawl but not involving the destruction of objects [10].

In the Aggression Questionnaire (BPAQ), authors A. Buss and M. Perry extracted four factors of aggression: Physical Aggression, Verbal Aggression, Anger, Hostility. They have drawn attention to that both kind of aggression: physical and verbal aggression indicates a behavioral component of behavior. Anger connects with physiological stimulation, so it reflects the emotional component of behavior. Hostility is a feeling of regret, reluctance and injustice, which represents the cognitive component of behavior [11].

Inventory "Moods and whims" by A. Buss and A. Darkee was created before the questionnaire described above. This questionnaire assesses the intensity of seven types of aggressiveness: malice physical, verbal and indirect, negativity, suspicion, resentment and irritability, and additionally guilt [12] [13].

2.4. Causes of aggression and areas of aggression

Much attention is paid to the causes of aggression. There are many reasons for this phenomenon. These include poorly developed communication skills as well as social situations that can also lead to aggression. According to the theory of frustration-aggression of John Dollard - the appearance of obstacles on the way to achieving the goal increases the probability of aggression. One of the reasons is relative deprivation, or the feeling of an individual (or a social group), having less than it deserves or understands than was allowed to be expected or less than people similar to it. In this thread it should be also mention direct provocation, retaliation and the presence of objects associated with aggression. According to the social learning theory, the main source of aggression is social learning, it means watching and imitating aggressive activities. The issue of genetic determinants of aggression is not fully explained.

The expression of aggression therefore depends on the interaction between such factors as: biological endowment of the human, innate and learned models of behavior and the social situation. However, it should be noted that there are social and situational factors that increase the probability of aggressive behavior, and modify the severity and manner expression of aggression. In other words, aggressive behavior is not just an instinctive reaction and can be changed.

There is a negative influence of social media on the aggressive behavior. Watching violence increases the tendency to display aggressive behavior, which may weaken reactions in case of encountering authentic aggression. The war situation is undoubtedly one of the causes of aggression. There were observed phenomena of hostility directed at the enemy and citizens of their own state. Alcohol also causes an increase in aggression. The causes of aggression are also pain , discomfort and inadequate temperature [4] [7] [8] [14] [15].

Aggression also occurs in the public, family, school and sports spheres [8]. Typical manifestations of particularly dangerous aggression are: road aggression and the aggression of aircraft pilots, which pose a direct threat to life. Organizations dealing with employee health protection indicate that there is a specific vulnerability of some jobs or professions to the appearance of aggressive attacks, as in the case of people involved in education and providing help and care or people involved in the trade of tangible goods. It should be added that about 90% of nurses and employees of the services sector (postal and transport services) declared their aggression over the last year.

Aggression and violence in dysfunctional families is quite a common occurrence. It occurs especially in families with alcohol problems and in criminal families as unintended or intended actions of physical or psychological aggression, using the advantage of strength,

directed against a close relative (spouse or children), violating its rights and personal rights, at the same time causing suffering to people in the family [16] [17] [18] [19] [20].

2.5. Selected socio-demographic factors and aggressive behavior

2.5.1. Age and aggressive behavior

Researchers devoted attention to socio-demographic factors to aggressive behavior. One of them is age. In a study of men and women between the ages of 10 and 79 years, it was shown that the level of general aggression decreases with age, which is caused by the decrease in the level of Verbal Aggression and Hostility. The level of Physical Aggression decreases with age to about 55 years, and then increases. The level of Anger proved to be the highest in the youngest study group (10-15 years) and the oldest (56-79 years) [21].

2.5.2. Gender and aggressive behavior

Sex is related to aggressive behavior. The Aggression Questionnaire by Bussy and Perry on a sample of 1253 American students (641 women and 612 men) aged 18 to 20 years and 182 people from the Polish group (95 women and 87 men) aged 18-24, showed dependence between test scales and gender. Physical Aggression, Verbal Aggression, Hostility and the General Index is at a higher level in the group of men, while the results of Anger are similar in the groups studied, and the differences are not significant [11].

2.5.3. Other selected factors of aggressive behavior

There are factors influencing aggressive behaviors other than age and sex. These are biological factors such as testosterone levels that have been described above, as well as level of education, alcohol consumption and mother's age. The level of education is related to aggressive behavior. The lower education has got the unit, the higher level of manifesting general aggression [22].

Alcohol is one of the factors affecting aggressive behavior. Medical staff in the hospital emergency department are witnessing aggressive behavior on the part of patients several times a week. Aggressive behaviors are usually manifested by male patients, in a state of alcohol intoxication [23].

Mother's age is associated with a higher level of aggression of their children. A group of

boys aged 19, whose mothers were over 35 years old, were the most aggressive according to their self-esteem and peer nomination. It can have got a relationship with neurological damage during delivery [24].

Moreover, in a longitudinal study lasting 22 years, a group of 600 people and their parents and children showed a relationship between age and aggressive behavior. People who were more aggressive at the age of 8 were also more aggressive than others at the age of 30. The stability of aggressive behavior was be very similar to the stability of intellectual competence, especially for men. Early aggressiveness later envisaged serious anti-social behavior, including criminal behavior, abuse of spouse, road traffic offenses and spontaneous physical aggression. Furthermore, the stability of aggression crosswise the family generation measured at a comparable age was even higher than individual stability over the centuries. The authors of the study found that, regardless of the reason, aggression can be perceived as a permanent feature that can be influenced by situational variables [24].

2.6. The effects of aggression

2.6.1. Individual effects of uncontrolled or excessive aggression

Aggression has got negative impact on the physiological and psychological state of the aggressor. Aggressive behaviors are part of the etiology of somatic diseases [25]. Many scientific reports pay attention to connection between personality traits and ischemic heart disease. It was shown that the factor influencing the emergence and development of disease is a characteristic type of functioning called the Type A Behavior Pattern. It is characterized by aggression, relatively lasting tendency to dominate and rivalry, need for achievement, haste, impatience, excitability, excessive vigilance, facial muscle tension, a sense of time pressure and excessive responsibility. People with Type A Behavior Pattern often suppress irritation, impatience, aggression, which causes a long-lasting state of strong internal tension [26].

2.6.2. Selected social effects of aggression

Aggressive behavior undoubtedly harms the environment, for example, employee and family. Aggression towards children causes adverse effects on them, which affect to adult life, so it is worth mentioning a few of them. It is a distortion of perceiving oneself as a valuable person, capable to take various life tasks. There are also difficulties in establishing and maintaining

interpersonal relationships and perceiving the environment as hostile. As a result, a young person can isolate themselves in an unreal world of fantasy or the Internet, and also behave aggressively or self-destructively and apply frequent lies. The next effects are emotional sphere disorders. There may be aggression, impulsivity, hyperactivity or the opposite - apathy, fears, anxieties that often lead to neuroses. Inconsistent reactions are also intertwined in children: agreeableness with negativity, respect, attachment with reluctance, disgust. Researchers also noted disorders of speech, sleep and defecation disorders, psychosomatic complaints. The consequences of aggression directed at children also cause a lack of a sense of security, depression, self-importance and attention disorders, depression, egocentrism and in later life alcoholism, drug abuse and using physical violence towards own children [27] [28].

Undoubtedly, the most extreme form of destructive aggression is murder. According to A. Montagu, any personal aggression, regardless of whether it is an early discarnative variety or a later hostile, is almost always a response to frustrated love and expression of claims towards others to ensure this love [29].

Regardless of the profession, exposure to aggression at work brings many negative effects in the sphere of physical and mental health and in their social and professional functioning. This consequently affects the efficiency and productivity of the whole company.

Aggression in the workplace can be visible, but it can also have a hidden form like tormenting, harassment. Aggression on the road is a threat to the health and life a participants of road traffic and pedestrians [20] [30] [31].

2.7. Prevention and therapy of increased states of aggression

2.7.1. Cognitive behavioral therapy of aggression

There are various therapies aimed at reduce the level of aggression. Elements of cognitive-behavioral therapy are effective in process of dealing with aggression. This therapy should include training in coping with a specific stressful situation, learning to ask questions and focusing on the best solution to the problem, learning how to respond to other people's aggressions are effective. Relaxing techniques are also effective for combating stress, which may be the cause of aggression, such as music therapy, neuromuscular relaxation, hyperventilation and others. There are also techniques based on organizing and managing time to avoid stressful situations [32].

Examples of preventing aggressive school behavior indicate that anger should be revealed

in the right way and in the right circumstances. Another way is training of communication skills and strategies of solving problems. Education is therefore effective in terms of constructive expression of criticism and anger, negotiating and seeking compromise and also developing empathy and sensitivity to the needs of others. The tendency for empathy prevails over the tendencies to aggression. Empathy prevents the tendency to dehumanize another human being [33].

One of the effective methods of aggression therapy, among patients staying in forensic psychiatric centers, is training of controlling aggressive behaviors in virtual reality (VRAPT) [34].

2.7.2. Sport competition as a therapy for aggression

Another way of preventing or treating excessive aggression is participation in sports competition. Men developed the pursuit of winning in the martial art so that sport could be a social neutralizer of the drive of aggression. To get rid of negative emotions people can participate in forms of physical activity. William Menninger argued that "sports games create a unique opportunity to reveal the instinct of aggression." However, this dependence in strength sports has not been observed. It should be remembered that watching other people participating in sports games or taking aggressive actions does not cause catharsis and even increases the probability consequences of acts aggression in the future [35].

Sports, including martial arts, can also fulfill educational functions and information, which can lead to the reduction or elimination of the frequency of aggressive behavior [36] [37] [38].

Martial arts trainings teach forms of aggression appropriate to the situation and level of threat. People who train have the ability to deal with emotions in effective way, do not fall in panic.They resolve conflicts better - combining cooperation with competition, rivalry. The authors assume that the presented comparative analysis of male and female environments in the same sport discipline will indicate whether the training mechanism causes changes that may be useful in the therapy of aggression and whether in the same way the training of Brazilian Jiu-Jitsu stimulates a favorable level of aggression in men and women.

2.8. The Brazilian Jiu-Jitsu system

Brazilian Jiu-Jitsu (BJJ) is a Brazilian martial art originating from ju-jitsu, wrestling and

judo, which accentuates the fight on the ground. It also includes fighting in a standing position and in clinch. The basic two formulas of fighting in BJJ are: fight in gi (kimono), and fight no gi (in shorts and a rashguard - without a kimono). Brazilian Jiu-Jitsu is focused on fighting with one opponent. The goal of the fight is to take control, defeat the opponent by putting levers or strangling. The impact does not apply. There are also throws aimed at bringing the opponent to the ground floor. The grips on the ground floor are often made with legs by hooking or wrap the opponent's body. The Brazilian Jiu-Jitsu system is constantly evolving. It is not limited to grips and levers on the ground, but also prepares to defend against sharps. Competitors training for sports competition do not practice certain techniques that are brutal but used in self-defense. They also do not train against many opponents. In BJJ, it is necessary to divide the levels of advancement: white, blue, purple, brown and black. The competitions are played with the division into advanced level. Brazilian Jiu-Jitsu has developed its own tradition by rejecting Japanese patterns. For many people it is important that no equipment is needed for training [39] [40] [41]. There are reasonable grounds to undertake research to check whether the BJJ can significantly reduce the level of aggression. The authors assume that the presented comparative analysis of the male and female environment in the same BJJ sports discipline will indicate whether the training mechanism causes changes that may be useful in therapy or prevention of aggression. The research could indicate whether training of Brazilian Jiu-Jitsu stimulates in the same way the change of the level of aggression to lower in men and women.

3. Materials and methods

The research was carried out in 2018, and it was updated at the beginning of 2019 in Gdańsk, Gniezno and Bydgoszcz. Data for the research was obtained by filling in the "Aggression Questionnaire" by Buss, Perry, the "Amity" Institute (according to the Polish version - with the consent of the authors). The survey includes a question about the duration of the training career, and about the quality of a sports career (regional, national, European / world). It were tested 38 women and 43 men who train Brazilian Jiu-Jitsu (in the text: BJJ). 40 men and 35 women who did not train any form of physical recreation were examined for comparison. It were examined 156 people in total. Interviews were carried out with the subjects towards the existence of life factors that may be related to aggression, such as: life / family / unemployment failures, lawsuits, use of drugs, diseases and others. Persons declaring the above-mentioned problems were excluded from the research. The collected data was compared with each other, and referred to the data obtained from the study of control groups. The Excel 2007 and Statistica 6 programs were

used for statistical processing. The normality of the distribution of the results obtained by the Shapiro-Wilk method was checked. The mean values of the studied components of the phenomenon of aggression were marked (anger physical aggression, hostility and verbal aggression) for each group. The statistically significant differences were determined for different / equal variances ("t" tests for the variance response) and in the regression graphs a trend line with the equation f (x) and determination index R^2 and the Pearson's correlation coefficient for selected variables were presented. The relative change in the value of the studied component of aggression and total aggression was also calculated for the various groups that were expressed in percents.

The groups were compared in pairs without using the "post hock" tests by Tukey due to the introduction (by the test) of calculating the data changing the test result, and not having a logical connection with the studied problem - (e.g. the comparison of the group of non-training women with the group of training men and groups non-training men with a group of training women).

The relative difference of each component of aggression and total aggression in the group of BJJ training versus the appropriate control group - was calculated according to the following formula:

$$D = -(\frac{S_1 - S_0}{S_1}) * 100\%$$

Equ.1

S_1- value for the control group

S_0- value for the researched group

And

The relative difference of each component of aggression and total aggression in the BJJ training groups and control groups counted against men - calculated according to the formula:

$$W = -(\frac{C_1 - C_0}{C_1}) * 100\%$$

Equ.1

C_1- value for the group of men

C_0- value for the group of women

The minus sign was introduced to accentuate the change level of component aggression to lower. Results are presented in tables Tab.1-5 and in charts Fig.1-5.

4. Results

Tab. 1. Basic sociometric data of men and women in all studied groups.

Group	Age (years)	Range (years)	Training experience (years)	Range (years)	The quality of a sports career		
					regional	national	European/ World
BJJ men n=43	26,3 ± 7,1	15-42	7,1 ± 4,9	1-16,5	46,5% n= 20	48,8% n=21	4,7% n=2
BJJ women n=38	25,7 ± 5,8	17-39	6,2 ± 3,7	1-13,5	50% n=19	44,7% n=17	5,3% n=2
Control men n=40	26,4 ± 7,3	15-42	-	-		-	
Control women n=35	26,5 ± 11,3	14-51	-	-		-	

The data presented in Table 1 indicate that there are no statistically significant differences between the groups. Subjects are at similar age, the training participants have a similar training period and a similar distribution (percentage) of the quality of a career in the competition. It can be assumed that the above data do not positively affect the results of the study of the level of aggression.

The groups of surveyed people are suitable for direct comparison.

Tab. 2. Results of examination of components of aggression and total aggression in all studied groups of men and women.

Group	Anger	Range	Physical aggression	Range	Hostility	Range	Verbal aggression	Range	Total aggression	Range
BJJ men	18,0 ± 4,9	11-33	23,4 [a] ± 4,8	16-36	17,7[a] ± 4,6	11-30	16,1[a] ± 3,6	10-24	75,2 [a,b] ± 14,5	58-120
BJJ women	17,7 ± 4,1	9-27	18,7[a] ± 4,8	10-35	18,1[b] ± 6,3	9-30	14,2[a,c] ± 2,9	7-20	68,6 [a,c] ± 14,7	35-106
Control men	19,1 ± 4,6	11-28	22,5 ± 4,1	16-33	22,1[a] ± 3,1	17-28	17,1[a] ± 4,0	10-24	80,7[b] ± 10,2	62-101
Control women	18,9 ± 2,8	14-26	19,1 ± 3,2	10-26	22,6[b] ± 3,2	16-28	15,6[c] ± 2,7	12-24	76,2 [c] ± 5,7	65-87

[a,b,c] - statistically important differences on the level $p<0,05$ compared in the same columns of the table

The values of the components of aggression and total aggression were not compared between groups that had no logical connection to the subject of the work (a group of non-training women / a group of men training, and non-training men / a group of training women).

Tab. 3. The significance of differences between mean values of components of aggression and total aggression calculated in all studied groups and Pearson's correlation between age and training experience of women and men training BJJ.

Anger Range Physical aggression Range Hostility Range Verbal aggression Range Total aggression Range

Group	Anger	Physical aggression	Hostility	Verbal aggression	Total aggression
BJJ men/BJJ women	0,7532	**0,0000***	0,7699	**0.0108***	**0,0482***
BJJ men/Control men	0,2933	0,3609	**0,0000***	**0,0239***	**0,0488***
BJJ women /Control women	0,1358	0,7201	**0,0002***	**0,0331***	**0,0050***
Pearson's correlation indicator between age and training experience	women BJJ - 0,2903 lack			men BJJ - 0,1633 lack	

* - statistically important differences on the level $p<0,05$

Data on the significance of differences (Tab.3.) show that women and men who train BJJ are differ significantly in the level of physical aggression and verbal aggression, which also results in a difference in the level of total aggression. In these cases, women training BJJ present a lower level of the above-mentioned aggression than men. There is also lack of correlation between the record age and training experience both among men and women training BJJ. People start training BJJ at different ages and continue training, so any changes in the level of aggression are not caused by the natural process of biological aging but by the length of the training experience.

Comparison of the significance differences in the data on the level of aggression of people training BJJ with appropriate persons from control groups shows that the level of aggression in training people is significantly lower in the sense of hostility and verbal

aggression, which also results in a lower level of total aggression. This phenomenon concerns woman and men from the BJJ training group. This suggests that BJJ training has the same role regardless of gender. However, this requires further verification.

Relations between aggression (and its components) and the length of the training experience are shown in Fig. 1-3.

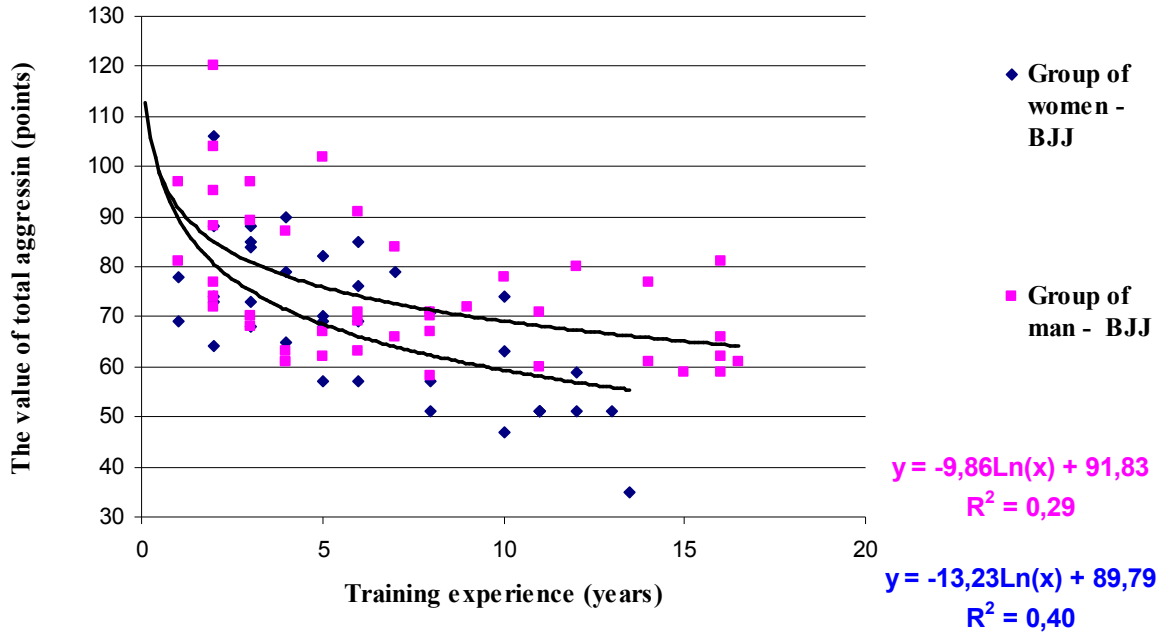

Fig. 1. The relationship between the length of the training experience and the total value of the level of aggression in the group of studied women and men training Brazilian Jiu-Jitsu.

The course of the trend curves shown in the graph in Fig. 1 indicates a decrease the level of total aggression with the increase of the training experience. This trend is visible through determinate indicators, at a statistically significant level ($R^2 = 0.29$) in the group of men and ($R^2 = 0.40$) in the group of women.

In addition, the logarithmic equations of the trend line indicate that the greatest decrease in the level of aggression occurs at the stage of the first 2-3 years of BJJ training.

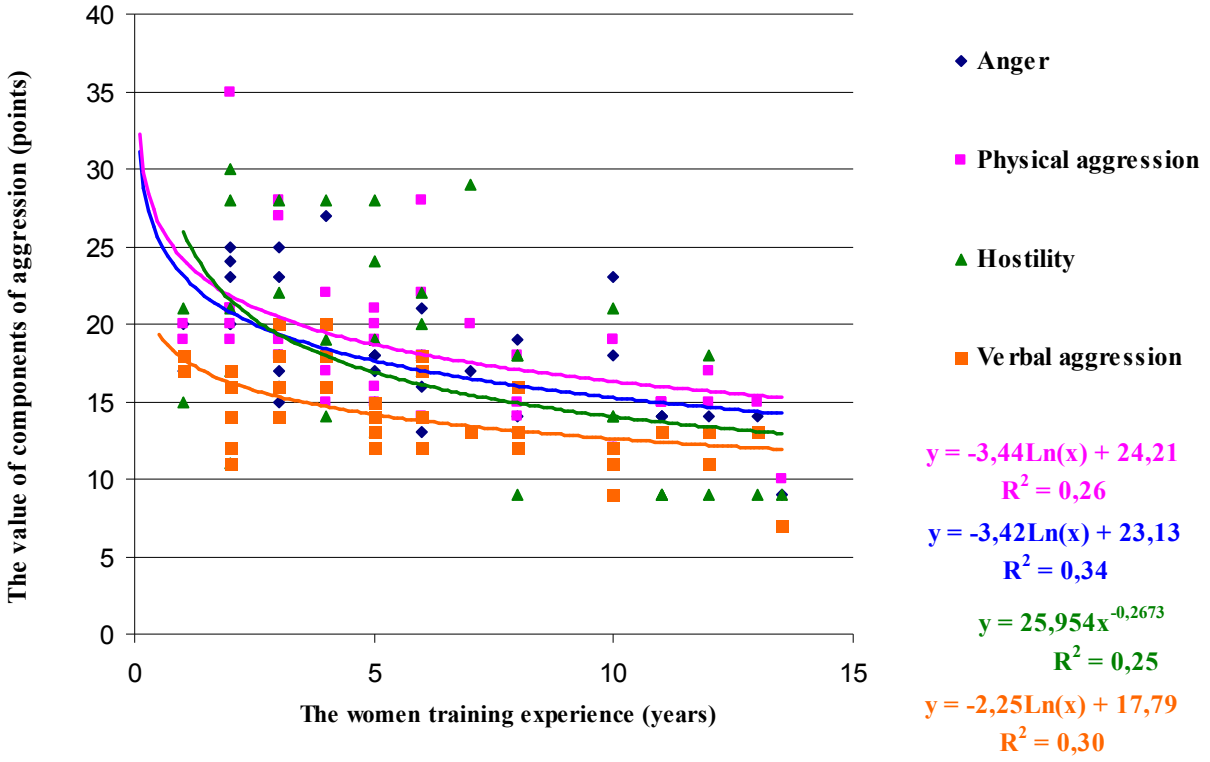

Fig. 2. The relationship between the length of the training experience and the components of the aggression in the group of women training Brazilian Jiu-Jitsu.

The course of the trend curves presented in the chart on Fig. 2 shows a decrease in the level of three components of aggression (anger, hostility, verbal aggression) along with an increase in the training experience. This trend is visible through determination indicators at a statistically significant level ($R^2 = 0.27$, $R^2 = 0.28$, $R^2 = 0.25$). The level of physical aggression does not show any trend along with the increase in the length of the training experience.

It should be noted that the value of the component of aggression, which is anger for the BJJ group, does not differ statistically from the value of the control group, but it shows a downward trend in the BJJ group, along with the increase in the length of the sports internship.

In addition, the logarithmic equations of the trend line indicate that the greatest decrease in the level of the listed components of aggression occurs at the stage of the first 2-3 years of BJJ training.

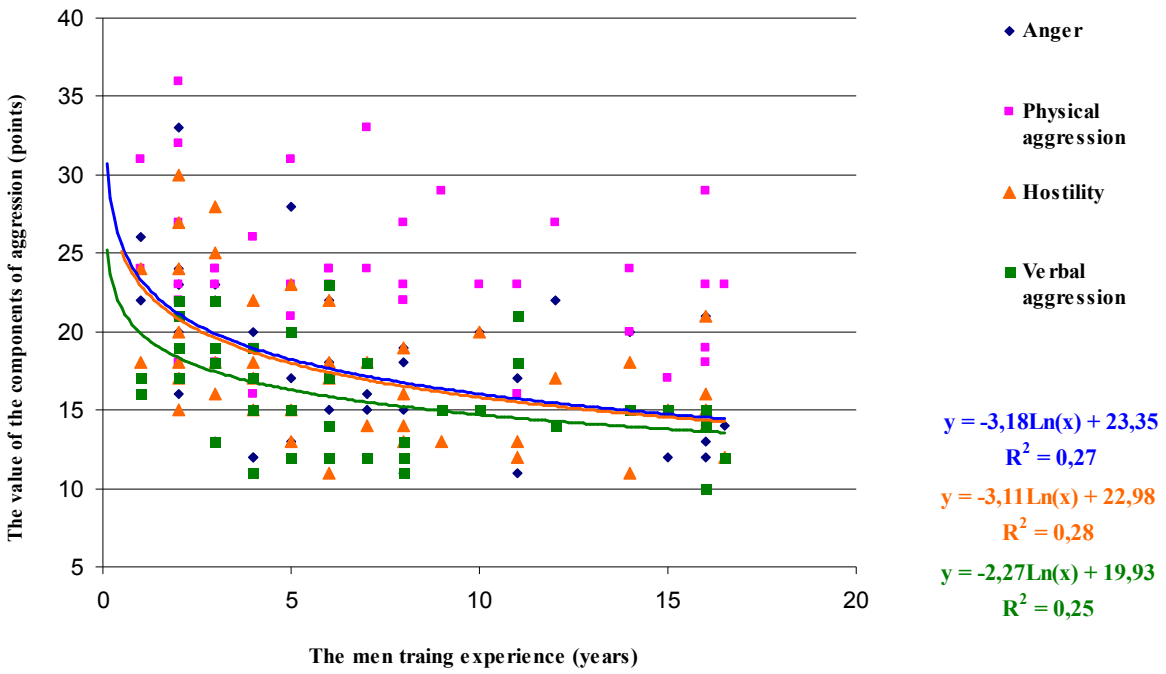

Fig. 3. The relationship between the length of the training experience and the components of the aggression in the group of men training Brazilian Jiu-Jitsu.

The course of the trend curves presented in the chart in Fig. 3 shows the lowering of the level of all components of aggression (anger, physical aggression, hostility, verbal aggression) along with the increase in the training experience. This trend is visible through determinants at a statistically significant level ($R^2 = 0.26$, $R^2 = 0.34$, $R^2 = 0.25$, $R^2 = 0.30$).

In addition, the logarithmic equations of the trend line (with the exception of the hostile trend lines) indicate that the greatest decrease in the level of exchanged components of aggression occurs at the stage of the first 2-3 years of BJJ training. The hostile trend line indicates a gentle, steady decline in hostility depending on the length of the training experience.

Due to the need to find components of the phenomenon of aggression, which in the most readable way are decreasing as a result of the training process BJJ calculated relative differences.

The results are shown in Tables 4-5

Relative differences of the values (D) of the components of aggression and total aggression in the groups of women and men training BJJ, calculated against the appropriate control groups (women in relation to women and men in relation to men).

Tab. 4. Relative differences of component values of aggression and total aggression in the group of women and men who train BJJ in relation to control groups.

Relative difference of values (%)	Anger	Physical aggression	Hostility	Verbal aggression	Total aggression
Group BJJ Women	-6,6	-1,8	-20,0	-9,2	-9,9
Group BJJ men	-5,8	4,0	-19,8	-5,8	-6,8

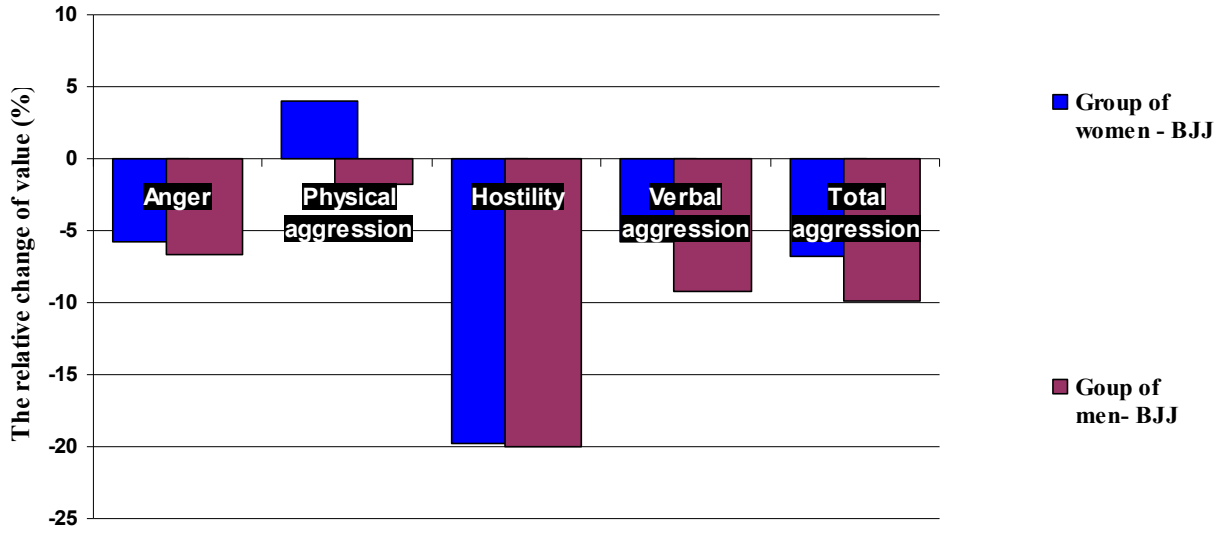

Fig. 4. Graphical presentation of the relative change in component values of elements of aggression and total aggression in both studied groups of BJJ training counted relative to the respective control groups.

The data presented (Tab. 4, Fig. 4) indicate that there is a dominant relationship of lower level of total aggression through a lower level of sense of hostility.

Table 5 presents the analysis of relative differences on the basis of data in Tab.

Tab. 5. The relative difference of the (W) values of components of aggression and total aggression in groups: BJJ - women counted against men, and in the control group - women counted against men.

Relative difference women/men (%)	Anger	Physical aggression	Hostility	Verbal aggression	Total aggression
BJJ Group	-1,7	-20,1	2,3	-11,8	-8,8
Control Group	-1,0	-15,1	2,3	-8,8	-5,6

Figure 5 shows the graph of relative difference values based on the data in Tab.5.

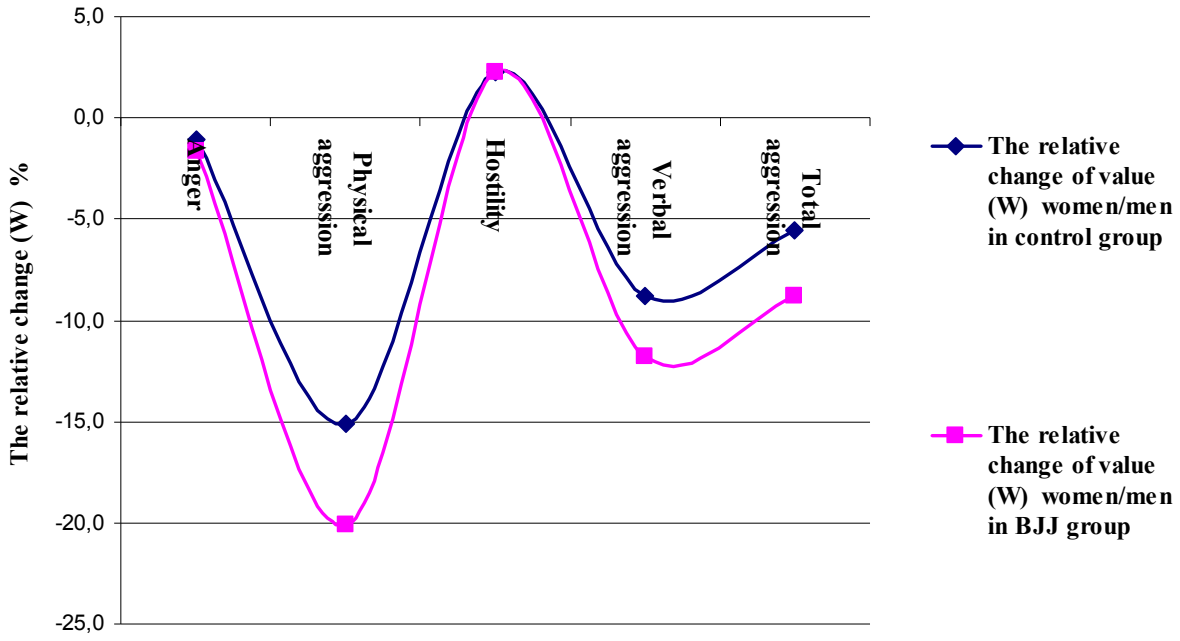

Fig. 5. The graph of differences in the relative value (W) of components of aggression and total aggression in groups: BJJ - women counted against men, and in the control group - women counted against men.

The presented data show that differences in the components of physical aggression (aggression, verbal aggression and total aggression) between non-trainers women and men in comparison with the same differences for women and men training BJJ are increasing. This is a phenomenon to considered separately.

5. Discussion

The figures presented in Table 1 indicate that the studied groups of men and women who train Brazilian Jiu-Jitsu are in a similar age, have got a similar training experience and similar quality of a sports career. It should be noted that people from control groups are at similar age as

people from the BJJ training groups. All intergroup differences are statistically insignificant. This entitles us to state that groups of people are suitable for a direct comparison in the subject of the level of aggression. One can also say that with appropriate conditions of research methodology, external factors will not affect to level of aggression. It can be expected that the measurements of the level of aggression of women and men in control groups will oscillate in the scope of other studies of this phenomenon in Polish society - which was also noted [41].

The data presented in Tab. 2 shows that the level of aggression of men practicing BJJ is higher than in women who are training BJJ, while in the control group this phenomenon does not occur at a statistically significant level. However, without delving into neuropsychological considerations, it should be noted that aggressive behaviors are implicated by the level of testosterone (concentration in men about 10x higher than in women) as well as by the level of serotonin in the brainstem nuclei. Considering that the synthesis of serotonin depends on the level of exogenous (provided in the diet) amino acid - tryptophan, you can see the role of environmental conditions (eg diet, alcoholism, etc.) related with serotonin levels.

It is indicated that when a man with a high testosterone level is frustrated in his attempts to achieve a dominant position then serotonin begins function. Decreased serotonin activity is associated with an excessive reaction to aversive stimuli and thus a higher probability of a strongly negative emotional reaction is created. Then the threat of aggressive behavior increases. Furthermore, it is known that testosterone is undergoing in the human body, two basic transformations, one of which - aromatization (the aromatase enzyme is found among others in the female gonads) leads to an increase in the level of estradiol. There is much evidence that most of the effects of testosterone leading to aggression occur after the aromatization process [42].

Summing up this thread, it should be noted that although research combines high levels of testosterone with aggression, the hormone itself is not responsible for aggressive behavior. In fact, successful athletes and businessmen tend to have high testosterone levels without being more susceptible to violence than their counterparts with low testosterone levels. Testosterone can not act alone in promoting aggression. The discovery that biological factors - such as testosterone and serotonin - are important for shaping predispositions, but do not determine aggressive behavior and impulsive, indicates that even in neurochemically adverse situations, the psychiatrist has great chances for effective therapeutic actions [43]. Measurements of the level of aggression in the group of people who are training in BJJ indicate a lower level of aggression than in the control group (Tab.2.).

However, due to the fact that the conducted research was not longitudinal, one should still refrain from concluding about the effectiveness of the BJJ training in counteracting aggression until demonstration of the dependence of the level of aggression on the length of the training experience, which may confirm this relationship. Otherwise, it may turn out that people who have a naturally lower level of aggression are predestined for BJJ training. There are other studies on athletes that show that sports training is conducive to lowering aggression, including martial arts training, for example footballers, judokas, karats, orienteering racers [44] [45] [46]. Studies have also shown a relationship between gender and aggression. Results on women and men practicing football, handball, judo showed that women in each these disciplines presented a lower level of aggression than men [47] [48]. At this stage, it can be concluded that the result of the measured level of aggression in the BJJ community, suggests usefulness of this sport in the process of counteracting aggressive behavior and prompts further considerations.

The data presented in Tab.2 and Tab.3 show significant differences in the structure of the level of aggression in the compared groups. The sense of anger is at the same level in all groups. It affects the level of total aggression, which is higher in the group of men training BJJ, than women training BJJ. However, when analyzing world reports with caution, one should approach the thesis that women are less aggressive than men. It should be assumed that the hypothesis that various aggressions of both sexes are biologically determined has not been proven [49].

Other studies combine life aggression with instrumental aggression expressed in sports in a negative way. According to them, athletes with a high level of life aggression are more likely to have a high level of hostile sporting aggression, but at the same time a low level of sport instrumental aggression. Simultaneously demonstrated in some studies the lack of differences between men and women in total life aggression denies earlier works eg. (Bredemeier, 1994) [50] (Gardner and Janelle, 2002) [51], which was also signaled later (Keeler 2007) [52]. The one of the presumptions about the level of aggression depending on sex seems to be the dynamism of changes. This is perhaps due to the increasing presence of women in social life and so in sport.

Men and woman who are training the BJJ have a significantly lower level of hostility and lower level of verbal aggression than their counterparts in the control groups. It also significantly affect on reduce level of total aggression. Similar relationships were demonstrated in self-esteem research and the level of aggression in young martial arts performers. A lower level of verbal aggression was also observed. However, they showed lack of hostility relation to the level of total aggression, which is contradictory to the results of this research [53]. Interestingly, in other studies, it was shown that young people practicing individual sports manifest a lower level of hostility and verbal aggression (and total aggression) than the representatives of team games. This was also confirmed by the studies cited earlier in the adult judokas environment [54] [47]. Data presented in Tab. 4. and in the chart Fig.4 indicate that the dominant value concerning the lower level of aggression of people who are training in BJJ is a significantly lower sense of hostility (about -20%). This applies equally to men and women. A lower level of verbal aggression is important, but not so dominant (up to -10%).

In the next step, it was analyzed whether long-term BJJ training has a real relationship with the lower level of aggression, or maybe in a natural way people with congenital lower level of aggression start and continue their BJJ training. For this purpose, a linear regression analysis was used between the level of aggression and its components and the length of the training experience of the subjects. From the study of men in many 15-42 years and women aged 17-39, it appears that the level of aggression initially increases and decreases with age. This process is not the same for both sexes. The level of aggression reaches the highest values for the average age of 26.3 years for men and 25.7 years for women [41]. It should be noted that the lack of correlation between the register age and training experience indicates that the natural aging process and the related decrease in aggression is not related to years of training (experience) so it can not be associated with the recorded decrease in the level of aggression. Graphs of the change in the level of aggression along with the training experience shown in Fig. 1-3. With the exception of physical aggression in the group of men training the BJJ, all other components of the level of aggression and total aggression took significantly lower values with the increase of the training experience in the group of women and men. The most statistically significant fit of the trend line (R^2 determination index) occurs in all cases for the logarithmic curve. Line equations indicate the greatest decrease in the level of aggression in the first 2-3 years of BJJ training in both women and men.

Considering all the above data, it can be concluded that the only reason for the decline in the level of aggression is long-term BJJ training, not the natural aging process. In the prevention and therapy of the phenomenon of aggression, various methods of combating this phenomenon are applied, ranging from biochemical [55], pharmacological [56], including the use of sports training [36]. However, it should be noted that the role of sport in the prevention of aggression, promoted by the so-called The "White Book" of the European Commission was undermined in Germany by research, which indicated the lack of a significant connection between aggression and participation in sport [57]. In turn, the results of research conducted by South African scientists including Taekwondo players and hockey players turned out to be very similar to the results of the authors of this work. They showed a decrease in the level of total aggression (mainly verbal) among competitors combats (Taekwondo) both in relation to hockey players and the control group [58]. Earlier reports indicating the effectiveness of training of some combat sports in the prevention of the phenomenon of aggression and concerning both children, adolescents and adults were also signaled in Poland [5] [7] [36] [59].

From the measurement data of the level of aggression components and significance of differences (Tab.2-3), it can be noticed that long-term BJJ training results in a lower level of two components of aggression: a sense of hostility and verbal aggression - to the same extent among men and women. This suggests the same intensity of impact on people who train, regardless of gender. However, the data presented in

Tab.5. and a graph in Fig. 5. indicate that the values of differences between women and men calculated separately for the control group and separately for the BJJ group increase for 3 components of aggression and remain on the same level only for a sense of hostility. This observation should be taken into account by further researchers in the aspect of the diverse impact of BJJ training depending on gender. This suggests that BJJ training stimulates the change in the level of aggression in different ways in men and women. This phenomenon indicates the need for further research of a longitudinal character.

6. Conclusions

1. The long-term training of Brazilian Jiu-Jitsu (BJJ) fulfills the requirements of a significant reduction in the level of aggression for women and men. This training is suitable for preventive and therapeutic applications of prevention and treatment of excessive and uncontrolled aggression in social relations.

2. The long-term training of Brazilian Jiu-Jitsu (BJJ) used as a therapy has structural and temporal limitations, which, according to the authors, do not allow it to be the only one therapy in the case of advanced high states of aggression.

3. The impact of BJJ training on changing the level of aggression depending on the patient's sex has not been solved unequivocally and should be the subject of further long-term studies.

Conflict of interest

Authors declares there is no conflict of interest

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