UNIVERSITY OF MEDICINE AND PHARMACY "CAROL DAVILA", BUCHAREST
DOCTORAL SCHOOL PHARMACY FIELD

The influence of psychobehavioral factors on injuries in contact sports

ABSTRACT OF THE DOCTORAL THESIS

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Content

ABREVIERI

A-trait - Trait Anxiety
AEs - Athletic exposures
ANOVA - Analysis of Variance
BJJ - Brazilian Jiu Jitsu
BMC - Body Mass Composition
BRS - Brief Resilience Scale
EMAS - Endler Multidimensional Anxiety Scales
FPI - Factor Personality Inventory
GAD-7 - General Anxiety Disorder Scale
GC - Grappling Combat
HRSST - Heidelberg Risk Sport-Specific Test
IIRae - Incidence Rate athletic exposures
IRisk - Instrumental Risk
LCE – Lateral Collateral Ligament
LCM - Medial Collateral Ligament
LIA – Anterior Cruciat Ligament
MANOVA - Multivariate Analysis of Variance
MMA - Mix Martial Arts
NEISS - National Electronic Injury Surveillance System
R-TB - Risk-taking behavior
SC - Striking Combat
SCS - Stress Coping Scale
SMIR - Sports-Maxillofacial Injury Risk
SRisk - Stimulating Risk
WKF - World Karate Federation
ZKPQ - Zuckerman-Kuhlman Personality Questionnarie

INTRODUCTION

Sports traumatology is characterized by the musculoskeletal lesions which limit or stop the athlete from training or competing and it represent the most common health condition among athletes. The consequences of injuries can lead to long breaks with performance declines or to chronic conditions which can affect the athlete even after retiring from the sports activity.

Injury prevention among athletes is essential and has to be the main objective for the multidisciplinary team that guides the atlete in his career. Prevention supports performance and contributes to the athlete's sports longevity and, last but not least, to maintaining physical and mental health.

It is important to identify factors which can cause traumas among athletes and how we can act upon them to reduce or prevent sports traumas.

The psychobehavioral factors represent a major topic of interest for not only sports researchers across the world, sports psychologists mainly track the enhancement of sports performace by reducing stress, managing emotions, cognitive training, injury prevention, rehabilitation and returning to the sports circle.

In the specialized literature, sports psychology has approached a vast amount of psychological dimensions in relation to various characteristic aspects of athletes, proving that sports psychology's interventions are absolutely necessary and extremely beneficial for athletes from any level of performance.

The purpose of this research was to investigate to what extent can the examined variables predict the severity of injuries in contact sports.

This is the first study conducted in Romania which analyzes psychological dimensions in relation to the severity of the traumas suffered by martial arts or contact sports practitioners.

There are gaps in the specialized literature, regarding the level of rezilience and risk assessment among martial arts practitioners and their tie to the severity of the traumas, separately investigated depending on combat styles or sports disciplines.

Contact sports and martial arts are popular on a competitive level, but also as a recreation, as these sports involve a fight between two combatants who use specific techniques of striking, throwing or finishing, in a predetermined rule set. Because contact sports frequently imply striking, throwing, immobilizing and finishing the opponent, these techniques that rely on qualities like

strenght, accuracy and speed, acquired after sustained training sessions and sports experience, the risk of injury is high.

For this study, not by chance, have been selected three completely different fighting styles, which encompasss a wide range of fighting techniques, both standing and on the ground. These styles have specific metabolical and mechanical requirements, having the potential to build different physiological profiles, being determined by the perfomance's level. Each combat style has specific anthropometric characteristics, defined by types of somatic and corporal compositions (BMC).

The world of martial arts is divided into several fighting styles, three of them being represented by Grappling, Striking and Mixed Martial Arts (MMA). Grappling uses opponent throwing techniques, ground fixation, joints manipulation or chokes and striking, in any form, is forbidden. In Striking, limb strikes are used (fist, elbow, knee, leg) and techniques specific to Grappling are forbidden. The third category is Mixed Martial Arts which combines techniques from Grappling and Striking.

Throughout the sports career, martial arts practitioners face different types of injuries, depending on the practiced sport discipline. Injuries might occur during competitions or even during practice, and not necessarily after a contact with an opponent, they can occur after executing complex attack or defence techniques which imply combined moves, overloading the joints and muscles and can occur as a result of intentional and non-intentional actions.

There are sports that imply minimum, medium or high injury risks, these sports disciplines put athletes in unexpected or threatening situations, the physical and mental stress induced by these situations have significant consequences on their performance, but also on their long term physical and mental wellbeing.

Sports traumas are known as a major risk factor to develop psychological sufferings, athletes avoid talking about their emotional state when they are injured and believe that those who seek help for their psychological problems are seen as weak athletes. This continuous stress doesn't end when their professional career ends, as it can continue long after that.

Over time, sports traumas have been approached and treated from a purely physical perspective. Later on, it has been proven that psychological interventions are extremely beneficia land absolutely necessary in sports, both at junior athletes and at seniors, at any performance level. Constant psychological interventions significantly contribue through specific methods to reducing

stress, cognitive abilities training and emotional management, having an important role in injury preventions, rehabilitation and returning to the sports circuit.

The general methodology of the research

The present research started from the hypoteshis that there is a direct connection between the psychobehavioral factors and the traumas of martial arts practitioners.

The study's attendees are martial arts practitioners or contact sports in Romania, enlisted in different professional clubs and who practice these sports disciplines at a high perfomance level.

The athletes practice martial arts for at least 4 years, had at least 12 fights/matches per year in each of the two years investigated and suffered injuries in competitions, in the researche time period.

The purpose of this research is to investigate four psychological dimensions (Anxiety, Resilience, Aggresion and Risk Assessment in sports) and to what extent they predict the severity of injuries in contact sports.

The study has been revised and approved by the local ethics committee of the National University of Physical Education and Sports in Bucharest, with the assigned authorization number ID:946. The data have been approached confidentially and full anonymity of the participants has been assured. The pacients/participants provided their informed written consent to participate in this study and could, at any time, withdraw from the study.

It is a retrospective research based on an inquiry with a ex post facto design, the analysis has begun after the facts took place (the inquiries have been applied online). Martial arts and contact sports practitioners already suffered certain injuries (in the investigated time period) and got certain results in sports competitions.

The questionnaires for evaluating the psychological dimensions, the injury reporting form, data regarding the severity of injuries and socio-demographic information have been applied using Google forms (Google LLC, Mountain View, CA, United States) between March 2022 – September 2022.

For the statistic analysis, the IBM SPSS Statistics 27.0/SPSS 20 (Armonk, NY, IBM Corp) has been used.

II. ORIGINAL PART

Study 1: A-trait and risk-taking behavior in predicting injury severity among martial arts athletes

Objectives and research hypotesis

- Knowing the level of anxiety and risk assessment among athletes practicing martial arts and contact sports (Grappling, Striking and MMA).
- Identifying the connection between the two measured psychological dimensions (anxiety and risk assessment) and the severity of the traumas among martial arts practitioners.
- Establishing the differences between the levels of anxiety and risk assessment (RTB) in relation with the severity of traumas among martial arts practitioners.
- Identifying the predictors of severe injuries among martial arts practitioners.

a) There are significant differences among martial arts practitioners depending on the sports discipline (Grappling, Striking and MMA), regarding anxiety and risk assessment.

b) There are significant corelations between the severity of traumas and the levels of anxiety and the assumed risk among martial arts practioners.

c) The investigation of athletes who suffered minor, moderate and/or severe injuries and athletes who only suffered minor/light injuries, reveals significant differences between the two groups regarding anxiety and risk assessment (R-TB)

d) Risk assessment results represent a better predictor of the severity of traumas among martial arts practitioners than the results obtained for anxiety.

Participants

154 Romanian martial arts practitioners have participated in the study, who are affiliated to several Romanian clubs, 132 men and 22 women, with ages spanning from 20 to 32 (Mage=24.6, SD=4.12). Athletes had at least 4 years of competitional experience and practiced martial arts averaging 8.39

Questionnaires used and data collection methods

For the evaluation of the anxiety trait the Romanian adaptation of Endler multidimensional anxiety scales (EMAS) has been used, to be exact, anxiety in new or unusual conditions and anxiety in physically dangerous situations. While applying the questionnaire, we collaborated with the psychologist Predoiu Radu, for accessing the Cognitrom online platform (CAS++ battery).

For the evaluation of risk assessment the Romanian adaptation of the questionnaire regarding instrumental and stimulating risk from Makarowski.

Results

Regarding the preliminary data analysis (stem-and-leaf), outliers have not been recorded (all the information have been evaluated) and no data is missing.

Firstly, we wanted to know if there is a significant association between the level of performance of athletes and the severity of injuries, separately analyzing the sports disciplines (Striking, Grappling and MMA).

We have analyzed the athletes performance levels (international/national and regional/local) and the severity of the traumas (only small/minor injuries, one or two moderate injuries, only one severe injury and one severe injury plus one or two moderate injuries).

Association degree - the Gamma coeficient between variables (sports performance and the severity of the injuries) has been insignificant: Gamma = 0.180, p=0.389 (Striking); Gamma =0.247, p=0.278 (Grappling); Gamma =0.199, p=0.323 (MMA).

As a result, no significant associations have been found between the level of sports performances and the severity of martial arts practitioners (separately analyzed depending on the practiced sports disciplines).

In the case of Anxiety as a trait, the raw calculated scores have been transformed into T rates, eliminating the differences between gender and ages (the statistic processing has been realised depending on the T rates).

Using the multivaried variable analysis (MANOVA), we tested if there are significant differences between the athletes who practice martial arts from the disciplines of Striking, Grappling and MMA, regarding anxiety and risk assumtion. The two psychological dimensions with corresponding facets have been separately analysed (Instrumental Risk, Stimulating Risk,

Anxiety in physical danger and Anxiety in new, unusual situations) corresponding with the sports disciplines (Striking, Grappling, MMA).

There are weak and very weak positive correlations between the four dependent variables, the liniarity condition being assumed (in the MANOVA case). The value of the Box M test is insignificant (0.181), that's why we will refer to the values of the Wilks Lambda test = 0.918, F(8.296) =1.618, p=0.119.

The type I procedure has been selected for group inequality. Considering the Effect between Subjects Test, the sports discipline positively influences only the results regarding anxiety in physically dangerous activities (F=3.361, p=0.037, Partial Eta Squared =0.043).

The variations homogenity condition has been met p>0.05 (The Levene test), therefore, the Scheffe test has been interpreted post-hoc.

Significant differences between martial arts practitioners after the sports discipline have been found only in the case of anxiety in physically dangerous activities - p=0.039, between the disciplines of Grappling (MGrappling = 40.41, SD=5.66) and MMA (MStriking and Grappling =36.78, SD=6.57).

Further, we have identified the existing relations between the severity of injuries, the obtained scores for anxiety and risk assessment among martial arts practitioners, depending on the practiced sports discipline.

No significant correlations are highlighted between the severity of injuries and the results for anxiety and the risk assessment (p>0.05) both in Striking athletes and Grappling athletes. However, a positive significant correlations has been observed (r=0.643, p<0.001, the determination coeficient/ size of the effect r^2=0.41 in Striking sports; r=0.761, p<0.001, r^2=0.58 for Grappling sports) between anxiety in new situations and physically dangerous situations. In the case of mixed martial arts practitioners a significant relation between the severity of injury and anxiety in physically dangerous situations has been identified (r=0.408, p=0.020, r^2=0.16).

A bigger score for this facet of anxiety is associated with more severe lesions.The relationship between the severity of the lesion and anxiety in physically dangerous situations is moderate to strong. The trust interval 95%, inferior limit =0.15 and the superior limit =0.614. Furthermore, the results highlight a significantly positive corelation between anxiety in physically dangerous situations and the risk as a stimulus (r=0.441, p=0.012, r^2=0.19) respectively anxiety in new situations (r=0.416, p=0.018, r^2=0.17).

In the next stage, knowing the instrumental risk and anxiety in new, unusual situations are are important psychological variables, considering the severity of injuries among martial arts practitioners, we checked to what extent the two psychological dimensions predict the severity of the injuries. To reach this objective, there have been issued two separate logistic regressions (binomial).

The models are statistically significant ($p<0.05$, Omnibus test-Model). In the case of Hosmer and Lemeshow test, $p=0.698$ (for the instrumental risk) and $p=0.141$ (for anxiety in new situations).

The logistic regression models have been statistically significant: instrumental risk $\chi^2(1)=4.44$, $p=0.035$; anxiety in new/unusual conditions $\chi^2(1)=4.76$, p=0,029.

In the case of martial arts practitioners, the results concerning anxiety in new or unusual situations represent a worse predictor of the injury severity than the values for the instrumental risk (the differences between the two of them are small), both psychological factors having the capacity to predict the severity of injuries among martial arts practitioners.

The models correctly classified 56.7% (instrumental risk), respectively 58.4% (anxiety in new/unusual circumstances) of the cases. The contribution of the two psychological phenomenons in predicting the severity of injuries is important, representing valuable resources for athletes, sports psychologists, physiotherapists and coaches.

Nagelkerke R^2 (the effect size index) shows a moderate to weak relationship between the psychological dimensions and the severity of the trauma.

We can state that a moderate or below average level of anxiety in new/unusual situations and a higher instrumental risk level are associated with a low probability of serious injury among martial arts and contact sports practitioners.

Study 2: Type of sport-and gender-related personality features in the case of injured martial arts athletes

Research questions

a) What are the personality traits tied to the type of sports and gender (resilience, aggression factors and risk assessment have been investigated) specific to the practitioners of martial arts who suffered moderate and/or severe injuries?
b) What are the existing corelations between the investigated personality traits of injured martial arts practitioners and the athletes who suffered only minor injuries?

Participants

111 senior martial arts practitioners have partipated in the study (89 men and 22 women), registered at different sports clubs in Romania.

The participants practice martial arts for an average of 11.3 years (in the entire sample). The inclusion criteria were: athletes with a minimum age of 18 yo; who suffered injuries in competitions, in the investigated period of time; who have at least 12 fights/matches per year, in the last two years, since March 2021 until March 2023.

In the present study, the athletes were divided in: Striking Combat sport (Karate, Kick-Boxing, Taekwondo and Box), Grappling Combat sport - GC (Judo and BJJ), respectively Mixed Marțial Arts (MMA).

Questionnaires used and data collection methods

The instrumental risk (IRisk) and the stimulator risk (SRisk) have been examined with the Romanian adaptation of the Makarowski Questionnaire for risk assessment.

For the aggression evaluation has been used the Romanian adaptation of the Makarowski Questionnaire for sport aggression, investigating the following 3 factors: persevereance, violent play and assertiveness.

Results

Significant differences have been found, starting from the type of practiced sport and gender:

- For resilience (p=0.029), between the injured male athletes, practitioners of MMA (men practitioners of MMA = 4.00, SD = 0.70) and women athletes who only suffered minor/small injuries (women who suffered minor injuries = 3.29, SD = 0.61);
- For persevereance, the aggression factor (p = 0.017), among men MMA practitioners, who suffered injuries (men who practiced MMA = 20.06, SD = 2.08) and the injured women athletes (injured women who practice martial arts =15.30, SD = 3.43), respectively Grappling practitioners (male sex) = 15.31, SD = 3.19;
- For assertiveness (p = 0.024), among male MMA practitioners (men who practiced MMA = 20.38, SD = 3.79) and the women athletes who only suffered minor injuries (practitioners of martial arts who suffered minor injuries = 15.50, SD = 3.70);
- For the instrumental risk (p = 0.004), among injured male athletes from Striking (men from Striking = 15.25, SD = 2.04) and women athletes who reported minor injuries = 18.17, SD = 1.46.

The effect size index (f values) shows, in general, moderate to strong differences between the results. In the case of persevereance, the difference between groups is really strong.

Continuing, the existing corelations between investigated personality traits among martial arts practioners who suffered injuries and athletes who suffered only minor injuries have been examined.

In the case of martial arts practitioners who suffered moderate and/or severe injuries, has been found a significantly positive relation between resilience and: persevereance ($r = 0.564$, $p = < 0.001$, $r2 = 0.32$), violent play ($r = 0.311$, $p = 0.025$, $r2 = 0.10$) and stimulative risk ($r = 0.352$, $p = 0.011$, $r2 = 0.12$). A negative correlation between resilience and instrumental risk has been found ($r = -0.457$, $p < 0.001$, $r2 = 0.21$). Moreover, it has been observed that there is a positive connection between persevereance and violent play ($r = 0.498$, $p < 0.001$, $r2 = 0.25$) and a negative correlation between IRisk and SRisk ($r = -0.371$, $p = 0.007$, $r2 = 0.14$).

The determination coeficient (the r2 effect size) shows small and moderate associations between the investigated personality traits, in the case of injured martial arts practitioners.

When it comes to athletes who reported only minor/light injuries, a significantly positive correlation between resilience and persevereance has been found ($r = 0.283$, $p = 0.030$, $r^2 = 0.08$), and between persevereance and violent play ($r = 0.284$, $p = 0.029$, $r^2 = 0.008$).

Study 3: The role of psychological resilience and aggression in injury prevention among martial arts athletes

Objectives and research hypotheses

- Establishing the level of resilience and aggression among martial arts practitioners
- Knowing the connections between the level of aggression, resilience and the severe injuries in contact sports.
- Identifiying the differences between athletes, when it comes to resilience, aggression, taking into consideration the severity of injuries suffered by martial arts practitioners.
- Knowing the psychological variables which can predict severe injuries in contact sports.

a) There are significant differences between martial arts practitioners depending on the specificity of the practiced discipline (Striking, Grappling and MMA), when it comes to resilience and aggression;
b) There are significant correlations between the severe injuries and the level of resilience and aggression among martial arts practitioners;
c) Investigation of martial arts practitioners who suffered light, moderate and/or severe injuries and those who only suffered minor injuries reveal significant differences between the two groups when it comes to the level of resilience and aggression;
d) The results for aggression represent a predictor of severe injuries in contact sports.

Participants

154 Romanian martial arts practitioners attended the study, registered to different profile clubs in Romania, men (n = 132) and women (n = 22), with ages spanning from 20 and 32 years old.

The sample's characteristics are: competitional experience (M = 8.39, SD = 3.10 – in the entire sample); the minimum age of 20 years old; minimum of 4 years competitional experience, at least 12 official matches/fights per year and without severe injuries suffered before the investigated period of time (January 2018 – December 2021). It's important to mention that 34

athletes have been removed from the study following the inclusion-exclusion criterias (188 athletes have completed the questionnaires in the initial phase of the research).

Questionnaires used and data collection methods

Aggression has been measured with the Romanian adaptation of the sports aggresion questionnaire by Makarowski.

For the evaluation of resilience, the Romanian adaptation of Brief Resilience Scale (BRS) has been used.

The athletes completed an injury reporting form and at the same time, we collected data regarding age, sex, practiced sports discipline, competitional experience, the biggest sports performance, as well as the number of official fights/matches per year (January 2018 – December 2021).

Results

Through the MANOVA unidirectional, we verified the significant differences between the martial arts practitioners from Striking, Grappling and MMA, when it comes to resilience and aggression.

The liniarity conditian has been assured (for the multivaried analysis), the corelations between the investigated variables have been observed to be weak and very weak.

The Box M Test value is 0.064 (insignificant), therefore, the value of the Wilk's Lambda Test has been reported: $F(8.296) = 2.701$, $p = 0.007$, Wilk′s Lambda = 0.869.

When it comes to the Between-Subjects Effects test, the sports discipline significantly influences the resilience results ($F = 4.683$, $p = 0.011$, Partial Eta Squared = 0.058) and violent play ($F = 4.122$, $p = 0.018$, Partial Eta Squared = 0.052).

In the case of violent play, taking into consideration the homogenity of the variations, $p < 0.05$ (Levene test), the Tamhane Test has been interpreted post-hoc, as the results of the Scheffe Test have been presented for the other dependent variables.

The next step was to check the existing associations between the injuries severity and the level of resilience and aggression among athletes. When it comes to severe injuries suffered by the

martial arts practitioners: 4 = athletes who suffered 1 or 2 moderate injuries + 1 severe injury, 3 = athletes who suffered only a severe injury, 2 = athletes who suffered 1 or 2 moderate injury and 1 = minor/light injuries.

A significant link between the severity of injuriy and assertiveness (in Striking disciplines), respectively between the severity of the injury and resilience (in Grappling disciplines) is highlighted.

A bigger score of assertivity is associated with severe injuries in Striking disciplines (the size of the effect ($r^2 = 0.17$), and a bigger score of resilience (the athletes recover faster after a difficult moment) is associated with severe injuries in Grappling disciplines ($r^2 = 0.20$).

When it comes to the trust interval (95%), the inferior limit = 0.184 and the superior limit = 0.596 (Striking disciplines), as the inferior limit = 0.158 and the superior limit = 0.671 (Grappling disciplines).

Furthermore, the results highlight a significant positive correlation between the violent play and persevereance, in the case of the 3 investigated disciplines.

Because the athletes obtained bigger scores for persevereance, this thing is tied to a bigger probability of violent/aggressive behaviours in competitions (the athlete can break the rules and as a result could lose points and be disqualified).

Moreover, a positive correlation between resilience and the persevereance scores have been found, both in the disciplines of Grappling and MMA.

To verify the 3 (c) hypothesis the test t Independent sample has been used (the dependent variables have been normally distributed, the asymmetry in absolute value was lower than 1).

The bynomial logistic regression analysis highlights the fact that the model is significant: Omnibus test-Model $p < 0.01$, chi-square value - $\chi^2(1) = 17.219$.

Taking into consideration Hosmer and Lemeshow goodness of fit test, value *p* is 0.995 (chi-square = 0.394), which means the model does not represent a weak match. In the case of martial arts practitioners, the aggression violent play factor can predict the severity of injuries during competitions.

The model correctly classified 63.6% of cases (total percentage). The effect size index (Nagelkerke $R^2 = 0.142$) shows a moderate connection between the violent play and the severity of injuries among athletes.

For example, according to the PRE_1 column (generated automatically in SPSS while running the logistic regression), an athlete who has 12 points for violent play has 85.7% probability of suffering a moderate injury and/or severe/serious injury while competing, a martial arts practitioner who gets 6 points has a probability of 42.8%, while 5 points decrease the probability.

It has been highlighted the fact that a low level of violent play is associated with a low probability of moderate and/or severe injuries among martial arts practitioners.

S-a subliniat faptul că un nivel scăzut al jocului violent este asociat cu o probabilitate scăzută de leziuni moderate și/sau severe la practicanții de arte marțiale.

Conclusions and personal contributions

The enrolled athletes from this case study are martial arts and contact sports practicants from Romania, affiliated to different sport clubs and who are also practitioners of these sport disciplines at a proffesional level. Following the inclusion/exclusion criteria that was applied, only the athletes that suffered accidents in competitions in the analyzed period were selected.

The results from the actual research are extending the previous studies and addressed the gaps from specialized literature. The relation between psychological dimensions from this case study and severity of contact sports injuries was less addressed in the specialized literature.

This case study brings contribution regarding the level on how psychobehavioral factors can predict the gravity of injuries in contact sports.

In the first case study we are highlighting that a moderate or a slightly below moderate level of anxiety in new, unusual conditions and a higher level of instrumental risk are associated with a lower probability of severe injuries at practicant athletes of martial arts and contact sports. In Mixed Martial Arts (MMA), a higher score on anxiety in dangerous situations, from a physical point of view, is associated with severe injuries. Practicants of Mixed Martial Arts with higher scores on anxiety in dangerous situations, from a physical point of view, are analysing in a less rational manner the situations in a competition, they are looking for more adrenaline and they are engaging more in risky actions while athletes from Striking disciplines (Box, Kick-Boxing, Karate,

Taekwondo) who are more anxious in new, unusual situations, are looking for more adrenaline and are finding more satisfaction in execution of the technique regarding the result.

Martial Arts and contact sports athletes (the entire group) who suffered minor, moderate and/or severe injuries are looking for situations that are strongly stimulating in competitions and they are using a mindset that is less rational when evaluating the result of the technique executions, compared to athletes who suffered only minor injuries

In the second case study we highlighted significant differences between male athletes from MMA disciplines who suffered moderate and/or severe injuries and female athletes who suffered only minor injuries in a matter of a resilient and assertive behaviour.

Mixed Martial Arts male athletes who suffered moderate and/or severe accidents in the period of the research are more resilient and have a more assertive behaviour compared to female athletes who reported only minor injuries. Therefore, a higher result on assertiveness and resilience at male athletes from MMA disciplines is related to moderate and/or severe injuries.

The instrumental risk is differentiating the male athletes from Striking disciplines injured by female martial arts practicants who declared only mild injuries. It looks like female athletes who declared mild accidents would rather rationally analyze their technical-tactical executions and they are assuming more thought-out risks in competitions with the purpose of winning.

The bigger resilience scores, stimulating risk, violent play, persevereance and the smaller scores for instrumental risk are associated with a larger probability of suffering severe injuries among martial arts practitioners.

In the 3rd study, we highlighted that a low level in the case of violent play (aggression factor) is associated with a lower probability of getting moderate and/or severe injuries among martial arts practitioners (in the entire sample).

At the same time, a lower or above average level of assertiveness ist ied to a lower probability of severe injuries in Striking disciplines, whereas in the disciplines of Grappling, a below average resilience score is correlated with a low probability of severe injuries.

Therefore, resilience and assertiveness represent psychological variables which can predict the severity of injuries in contact sports.

When it comes to limitations and future directions, studies could focus on the separate investigation of sports (Box, Judo, Karate, BJJ) and not on disciplines/styles like in the present study. An equal number of fights/matches/competitions can be taken into consideration across a year for each athlete.

In the 2nd study, we can observe the relatively small number of male participants and a small number of female participants, which has not allowed to investigate them depending on the practiced sports discipline.

The study is a retrospective one, prospective researches (longitudinal investigations) being necessary to follow athletes over time, to determine the way in which the investigated psychological dimensions in the present study affect the rate of injuries in competitions.

Furthermore, other aggression factors, like rage, physical and verbal aggression should be eliminated in relation to the traumas severity in contact sports, but also the variables like nutrition and sleep quality. Last but not least, future researches could concentrate on the injuries suffered by athletes during training sessions, in relation to the psychological dimensions investigated in the present study.

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