

EÖTVÖS LORÁND UNIVERSITY
FACULTY OF EDUCATION AND PSYCHOLOGY

THESIS OF DOCTORAL (Ph.D.) DISSERTATION

TRAUMA-RELATED NEUROBIOLOGICAL EFFECTS AND
RISK FACTORS OF PHYSICAL INJURIES AMONG
PROFESSIONAL DANCERS

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INTRODUCTION

During my doctoral studies I focused on the effects of traumatic experiences and the possible connection to physical injuries. The research work started with an preliminary study, which was a qualitative interview with health professional working with dancer. That followed by a literature review which was conducted on the bases of bio-psycho-social model. Later, I worked on the primary results including qualitative studies on professional dancer using Interpretative Phenomenological Analysis. After that I used questionnaires and numerical data to analyze the phenomenon quantitatively and finally I implanted the outcomes into an animal model where further details could be clarified.

TOPICALITY OF ABUSIVE ATMOSPHERE IN PROFESSIONAL DANCE

While we have seen that the abusive atmosphere has a historical and transcultural background, this doctoral research theme has an outstanding international topicality that must be mentioned. Since #MeToo the launch of the #metoo campaign in 2017 in the United States, the professional theatrical communities have been eagerly working on self-purification. Vienna State Opera's ballet academy was one of the first European institutions facing an abuse crisis, where students raised their voices as victims of physical, emotional and sexual abuse (Henley, 2019). The Danish choreographer Jan Fabre and artists have been accused by twenty dancers of his company with multiple abuses and toxic work-environment, one in which sexual acts were exchanged for performance time, or 'no sex, no solo' as one performer explained it (Bradshaw, 2021). While we can assess an increasing number of activities in opening up abuse-cases, there are a few earlier examples, such as the Bolshoi Ballet prostitution: "*Volochkova, who was sacked in 2003 under Iksanov's tenure for being "too fat", alleged that female dancers were forced to sleep with Bolshoi's rich patrons or lose their job*" (Bacchi, 2014).

Hungarian examples could also be mentioned, where the former director of Operetta and Musical Theater was accused with physical, mental and sexual abuse (Víg, 2021), or when several ballet teachers' names working at Hungarian Dance Academy were published online in accordance with sexual, physical and psychological abuses (Galavits, 2020), victimizing former ballet students. The above-mentioned cases mostly reached the press, causing severe reputation decline to the accused persons and victimization to those who raised their voices. To our current knowledge, there are only a few cases where legal steps were made and even less cases ended with court decisions. Currently, there is no institutionalized therapy available for dancers who experienced trauma during their work or education, and no validated method to eliminate the toxic components of the work and educational environment in the dance industry. We have

found only a few scientific papers dealing with professional dancers' trauma experiences, abuse or psychological difficulties in regards of their working or educational background and found no scientific results published about its possible connection with physical conditions.

RESULTS OF THE PRELIMINARY STUDY

In the interview, interviewees summarized the basic principles of what pre-professional education should look like. They concluded regular, well-established kinetics, appropriate mental health and general well-being, and mentioned the lack of injuries. As they have described the ideal way of training a ballet dancer, they introduced the high number of traumatized teenagers in the educative system. It seems to be a problem that individualism is pushed to the side. Students have no right to be creative and explore themselves, which might be a consequence of how they cope with stressors and pressure. Students and professional dancers have fully packed schedules and repetitive movement structures in general. Repetitiveness was highlighted by all of the interviewees, since they mentioned this to be a probable cause of losing lost of motivation during the years. Over the lack of individuality, they mentioned that ballet teachers have limited anatomical, biomechanical and preventive knowledge, with a very high number of misconceptions on certain medical and health related issues. According to the interviews, this might have a great impact on injuries too. While individuality is seemingly not to be respected, the personal space is also not appropriately managed by the dancers and teachers. One of the interviewees was referring to her own experience that she – as a worker of the institute – had to subordinate her personal needs and decrease her personal space during the time she was working there to fulfill the hidden curriculum of dance. *“Subordinate everything to the goal, or it can easily turn into the source of constant conflicts.”* Students and health experts experience exhaustion, constant pressure, and infinite energy investment with minimal returns. The very high number of physical injuries have a great link to psychological demand and the low level of mental well-being, they said. Although the physical injuries get well-demarcated attention; body perception, nutritional and digestive pathologies are also very frequent but certainly not recognized as important as the locomotor issues within this population. Dancers feel like they must fulfill all the requirements that the ballet teacher has established, even though they might go against their physiological demands. According to the dance medicine experts, parents are usually a part of the abusive atmosphere since they hide the signs of possible harmful factors under a concept that *“a superordinary talent (their child) need to bare some harm to achieve success”*.

During the interview, we asked the participants about the word: ‘humility’. Considering the personal involvement, we believed that this expression may be a concept of an

overestimated acceptance of abuse. All of the interviewees recognized the expression immediately as a commonly used term within dance institutes and they have all clarified that the expression has an alternative, hidden meaning in professional dance, in which the boundaries can be expanded, the personal space is narrowed and the general attitude is to subordinate the dancer to fulfill the requirements.

While the number of injuries may have connections with the mental status and the constant state of readiness, the interviewees all mentioned that - in case of dancers - injuries are sometimes meant to be an escape from an emotionally unbearable situations. The physiotherapist of this study has exclusively highlighted the so-called “*silent treatment that has empirical proof to be a source of physical injuries*”, and which appears regularly against those dancers, whom the ballet teachers a have problem with. The most abundant physical injuries according to the physiotherapist are stress-related fractures and ligament ruptures. However, chronic pain and chronic inflammation at certain extremities are also widespread. Regarding the physical injuries, chronic overload and the lack of time for regeneration are also risk factors along with the severe qualitative malnutrition and high prevalence of Body-Dysmorphic Disorder in this community.

We have asked about three general types of abuses, and whether our interviewees have ever experienced any of them during the time they spent in professional or pre-professional dance. We have also asked them to differentiate the directly told by the dancers they were treating from the abuses they might have personally experienced. The results are concluded in the table below:

1. Table shows the results of the preliminary study (N=3)

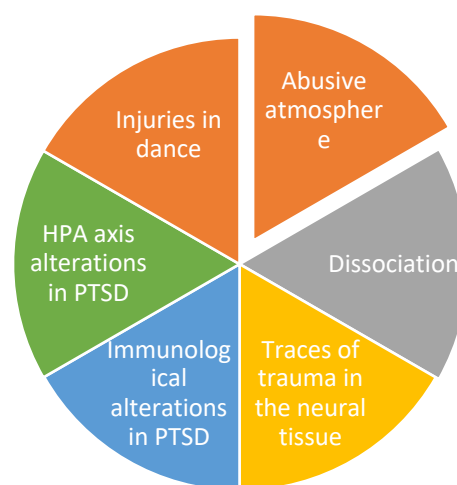
Type of Abuse	The interviewee personally experienced	The interviewee was directly told by the dancer
Verbal Abuse	yes	yes
Physical Abuse	no	yes
Sexual Abuse	no	yes

The frequency of the abuses was mentioned to be extremely high in verbal manifestation, while physical and sexual abuses had lower rate of appearance. Within this category, the experts reported that these abuses mostly contained some ‘professional’ content and usually they had a

threat component, which concluded the possible options of not being recruited for a show or “the dancer will have problems on the exam”. Physical abuse appeared several times, in the form of throwing objects during class to enforce silence or “to motivate dancers to work harder”, hitting or touching to cause pain “to better feel how a certain movement should be done”. Sexual abuse was only mentioned by one of the three interviewees, who clarified that these atrocities were not containing sexual intercourse; however, the intention of the verbal or sometimes physical abuse was filled with sexual content. All the interviewees highlighted that verbal abuse and most commonly the emotional abuse is the most abundant, and the emotional trauma probably has the most significant long-term impact on dancers.

LITERATURE REVIEW

In the literature review, the most relevant results were collected using the Bio-psycho-social approach (Frankel et al., 2003; Gatchel et al., 2007) to understand the social and psychological background of traumatic experiences and to summarize the scientific results of the psychological traumas’ physical manifestation. The topic has a huge literature either from a psychological or a neurobiological point of view, so the following summary was made: Abuse that was documented and analyzed by scientific papers among dancers; aspects, that might play a role in the abuses within the dance world; the relation of trauma and dissociation. Moreover, a summary was made about the biological aspects of post-traumatic stress disorder (PTSD), such as neural, hormonal and immunological traces. Later on, in this chapter, the Stress-Injury Model and documented dance injury rates and etiology is being described. Although the dissertation is not aiming to include all aspects of PTSD research, during the literature review we found numerous data about genetic, epigenetic results, cognitive and gut-brain-microbial data, which were exciting, but did not serve the further investigation discussed in this thesis.



1. Figure shows the distribution of the literature review. I used the Bio-Psycho-Social Model (N=448)

RESEARCH QUESTIONS

1. Do professional dancers, who were educated and worked in Hungary experience emotional abuse from their occupational atmosphere?
2. If so, is emotional abuse a systemic problem that may be associated with pedagogical strategies and follows generations of dancers or are these individual cases?
3. Does professional dancers suffer from pathological dissociation?
4. Do dancers injure at least once during their career? Are these injuries in a relationship with emotional abuse experienced in their occupational atmosphere?
5. Can traumatic experiences increase the risk of connective tissue injuries? Can trauma make the connective tissue more vulnerable?

QUALITATIVE STUDY

BACKGROUND

Classical ballet artists use one of the most complex combinations of motor skills, often under high pressure (Guss-West & Wulf, 2016). Working under pressure develops the ability to self-regulate, which, for well-being, is an important skill among both athletes and professional dancers (Balk & Englert, 2020). Although the rate of injuries is high among professional dancers (Jacobs et al., 2017), the body's ability to self-heal, including regeneration, may be impaired. The body's ability to self-heal can be defined as identifying an individual's current state and desired future state, implementing measures that minimize the discrepancy between the two states during the recovery phase (Balk and Englert, 2020).

Interpersonal relationship has a crucial role in the everyday life. Not only familiar but professional relationships can result in difficult situations, that people may succeed or fail to cope with. Interpersonal difficulties can be easier solved when the involved individuals are motivated (Erozkan, 2013). If power difference exists between the participants, difficulties may arise and less opportunities are given to solve the appearing problem (Danner, 1990, Jo et al., 2018). In tutor-student, coach-athlete, or master-dancer relationship unequally powered roles can be found (Wong et al., 2016; Ibrahim et al., 2020), that raise the question, whether the subordinate role can cope with the interpersonal difficulties.

Methods

Semi-structured interviews were combined with a photo elicitation qualitative interview model. Photo elicitation is a method to use images for exploration, it gives voice and reaction to

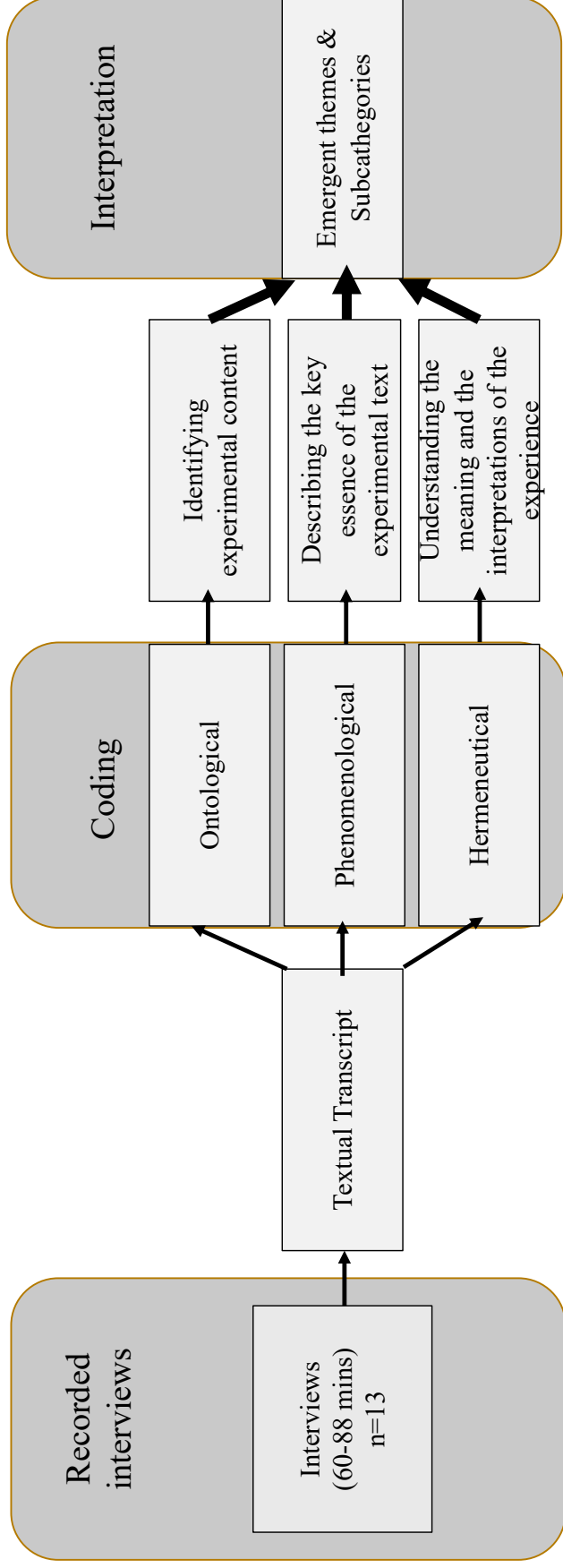
subjects (Harper, 2002). We have chosen this method based on the preconception that professional dancers might have difficulties with pure verbal recall of their experiences (Starkes et al., 1987). For the analysis we have used Interpretative Phenomenological Analysis (IPA), which is a recently developed and rapidly growing approach to qualitative inquiry (Smith et al., 2008). It is best known in the field of psychology. IPA is a phenomenological qualitative research approach committed to the examination of how people make sense of their major life experiences (Smith et al., 2008). IPA is dedicated to the detailed examination of the particular case, also called idiographic method (Smith et al., 2008).

Procedure

Recruitment for the study started in January 2021. We have published the research proposal and put online advertisements on social media platforms and dance specific social groups in Hungary. The inclusion criteria were that the participant had to have received professional dance education and they had to have at least three years of professional dance experience. We accepted classical ballet, modern and contemporary dancers, theatrical, performing artists' applications. Exclusion criteria included to be underaged (18 years), have less than three years of experience and not professionally trained dancers. We have also excluded those dancers who were under current psychotherapy. Out of 21 applicants, based on the inclusion and exclusion criteria at the pre-interviews, we selected 13 professional dancers. Each participant signed an informed consent form. The research was permitted by the Research Ethics Committee of the university. After the recruitment, dancers were asked to take pictures on their own techniques and activities that they apply in everyday life for recovery. We have not specified what this should focus on, but we asked to have at least 5 pictures that best describes how they recover. The dancers had two weeks to collect pictures before the interview was scheduled.

The interviews took place online via the ZOOM platform, where we recorded the conversations (mean time = 57 mins). The interviews were semi-structured. After the interviews transcripts were made based on the recordings, then analysis started. First, we have read and re-read the interviews, then we took initial notes involving the analysis of the speech, language and conceptual comments. After the descriptive notes, we have created emergent themes. The emergent themes followed the interviews' polarization, conceptualism and contextualization where we made subsumptions and numerations. Each of the interviews were transcribed in written form. After each of the analyses, we summarized the results and matched the mutual themes.

INTERPRETATIVE PHENOMENOLOGICAL ANALYSIS FLOW CHART



2. Figure Flowchart of Interpretative Phenomenological Analysis (own figure)

RESULTS

Based on the interviews we have made three emergent themes: 1) Sub-ordinate the self to dance and the attending leader, 2) Constant superiority, 3) Pattern following and seven subcategories. The results are summarized in a table below:

2. Table: Result 1: Cross-sectional results of the qualitative study (N=13) (own study)

Emergent themes	1.	Sub-ordinate the self to dance and the attending leader	2.	Constant superiority	3.	Pattern following
Subcategories	1.1.	Suppression of physical and spiritual needs	2.1.	Highlighting substitutability	3.1.	Isolation
	1.2.	Fear of dropping out	2.2.	Constant tension		-
	1.3.	Difficulties with saying no	2.3.	Star cult		-

We found three emergent themes: Hierarchy, Uncertainty and Perfectionism that are summarized in a table below with its subcategories.

3. Table: Result 2: Longitudinal findings of the qualitative study (N=13) (own study)

Emergent themes	1.	Hierarchy	2.	Uncertainty	3.	Perfectionism
Subcategories	1.1.	Showcasing power and constant superiority	2.1.	Lack of career model	3.1.	Constant exaggerated expectation
	1.2.	Total Submission	2.2.	Financial uncertainty	3.2.	No-pain, no-gain
	1.3.	-	2.3.	Unpredictable schedule	3.3.	-

DISCUSSION

During the interviews, it became clear that the dancers are facing high levels of stress from several sources. Based on the interviews, we created three emerging topics that we wanted to categorize as possible sources of stress levels for dancers. Hierarchy uncertainty, and perfectionism were found to be the most common themes. Hierarchy and uncertainty appear to be interrelated, while a number of factors are present in both topics. Although these factors are different, they appear to increase the vulnerability of dancers. The high-level hierarchy developed in the early stages of training creates a rigorous atmosphere where dancers are not allowed to be honest and express themselves or express their physical or psychological needs. Masters and their students engage in one-way communication that is demanding but not supportive. The majority of participants also mentioned that “this is the only way to achieve high goals in professional dance”. Dancers experience verbal abuse (belittling, humiliation, shame), which is partly incorporated into their daily professional instructions and feedback mechanisms. We have noticed that dancers experience an aggressive tone on a daily basis (Infante & Wigley, 1986) from their coaches and are conditioned to be accept and even respect them, and to be grateful for it. During their professional studies and working years, they experience the aggressive sound that is often present in the dance hall, in a professional environment.

According to the interviews, professional dancer instructions correlate with the definition of destructive voice: “voluntary disclosure of hurtful, critical, or derogatory remarks about the current state, aimed at challenging / destroying the status quo” (Maynes and Podsakoff, 2014, p. 91). As dancers work with a coach for months or even years, the regularity of aggressive messages can increase, leading to psychological abuse (Infante & Rancer, 1996). Because verbal instruction is a major source of feedback in professional dance (Guss-West & Wulf, 2016), quality and the assessed abusive role have a major impact on the lives of individuals (Ito et al., 1993). The general uncertainty puts the dancers in a vulnerable position as employees. The lack of a career model means that dancers’ employment as performers is limited and career opportunities are unclear. Interviewees did not mention any particular strategy, vision, or mission after years as an active dancer. As the number of theatrical years seems problematic for performers, this can increase the chances of becoming a perfectionist with regard to their own bodies and dance techniques, which can further increase the level of vulnerability. While the dancers are working hard on their current careers, they are worried about their future. While dancers have high expectations of themselves, the external expectations of their leader and

instructor are also significant. Pfeffer (1998) calls organizations that cause excessive stress to their members “toxic workplaces”.

Perfectionism can be associated with a toxic work environment as a kind of coping mechanism. While dancers are happy to perform to a high standard, there is a lack of a career path and a high degree of economic and organizational uncertainty, which can increase the level of perfectionism of dancers. The lack of safety, but the high demand for the leader, can be a stress-increasing factor for dancers, which is characteristic of a toxic work environment (Krumov, 2015). Toxic organizational culture contributes to discriminatory attitudes, low-quality working relationships, mutual mistrust, destructive conflicts and emotionally manipulative lines of communication (Härtel, 2008), which was not revealed in the interviews, although some dancers mentioned that they had suffered with their peers during their years of training and described the emotionally based patterns of communication they had often experienced. Toxic workplace atmosphere means toxic driving, which also appears in this case. The quiet treatment and repression of individuality, while setting ambitious goals, suggests that participants have faced toxic leaders throughout their dance careers. Toxic leaders can quickly confuse others and inexplicably move people out of the “penitentiary”. (Wasylyshyn, 2012).

Although it appears that participants are still operating in this toxic atmosphere, these are job conditions, especially the fact that their training begins in early childhood (at the age of 10), that certainly have a major impact on their mental health and well-being. According to the interviews, some of the participants felt traumatized during their training years, some denying that they had been harmed. Although later participants also mentioned personal stories of humiliation, interviewees were not traumatized, but rather emphasized that this was a “natural way to become a dancer”.

Based on these results, we judge that the dancers in the present study work in a toxic work and study environment that consists of the repression, humiliation, and humiliation of their individuality, which are common forms of abuse, including silent treatment and lack of employment security. Coupled with a high degree of uncertainty, which makes them more vulnerable to abuse. This finding correlates with other published articles evaluating toxic work environments where study participants may experience post-traumatic stress disorder (PTSD) as a possible outcome. Toxic leaders, like destructive leaders, demoralize employees with their behavior and negatively affect their mental and physical health. Many of their employees suffer from occupational stress and post-traumatic stress disorder (Leymann 1996; Olafsson and Johannsdottir, 2004).

QUANTITATIVE STUDY

AIMS

In the qualitative study, we have found that there are several factors which influence professional dancers' wellbeing, mental status, regeneration and stress level. We found that the educational and working environment is more toxic than supportive, where we assessed possible abusive acts embedded into professional instructions and pedagogical strategy. We considered to assess whether certain types of abuses (psychological and physical) are prevalent within the professional dancers' community in Hungary. During the qualitative research, we could conclude that regeneration in this population is impaired; dancers reported previous and current injuries. This result made us interested in quantifying and dividing the injuries and pathological musculoskeletal conditions; moreover, to assess complaints and symptoms regarding their body. Although the interviews had no diagnostic purposes, we found signs of possible psychopathologies appearing within this community. For this purpose we hypothesise that dancers may be affected by dissociative symptoms, reduced well-being and PTSD. Although we have found several victims of different kinds of abusive acts and toxic environment, we mostly found highly functioning individuals. Therefore, we are interested in resilience within this study population. For further assessment, we have established the quantitative studies with the following aims:

- Assess and quantify the level of stress dancers report,
- Assess and quantify whether pathological dissociation appears among professional dancers,
- Assess and quantify the injuries, with regards of the sites and rate,
- Quantify the abusive acts against professional dancers,
- Investigate the possible relationship between the certain stress factors and the health outcomes.

MATERIAL AND METHOD

STUDY POPULATION

In this study, we collected 191 Hungarian professional dancers to fill out the questionnaire. After the first review of the data, we have excluded those who did not fill at least 50% of the questionnaire; 16 answers made by male dancers, since the male gender representation was only 9%. In total we had 168 answers ($n=168$). Within the study population we found that the mean age was 32 ($\mu=32.43$ $SD=10.89$), 24.8% were classical ballet dancers, 51.2% modern dancers, 17.8% theatrical dancers and 5.9% folk dancers. The participants had more than 15 years of

professional experience within the dance industry ($\mu = 15.52$ years, $SD = 10.9$). The dancers who filled our questionnaire were 91.7% professionally educated, where 74.4% had university or college degrees in professional dance and 16.6% dance specific high school diplomas.

STATISTICAL ANALYSIS

For the statistical analysis we used SPSS 28.0.0. Distribution was tested with Kolmogorov-Smirnov Test and graphical methods. We used descriptive studies to assess mean (μ), standard deviation (SD), range and median (M) for some of the variables, as well as frequency analysis to summarize the data such as injuries/pathological musculoskeletal conditions and abuses. For the relationship analysis, we used regression methods, curve estimation, linear and logistic regression, Pearson and Spearman's correlation depending on the type and distribution of the variables. Pearson's correlation coefficient is the test statistics that measures the statistical relationship, or association, between two continuous variables. The assumption indicates independent of cases, linear relationship and homoscedasticity. Coefficient values can range from +1 to -1, where +1 indicates a perfect positive relationship, -1 indicates a perfect negative relationship, and a 0 indicates no relationship exists (Rosner, 2015 p.509-520).

Spearman rank-order correlation test is used for either ordinal variables or for continuous data that has failed the assumptions necessary for conducting the Pearson's product-moment correlation. We used relative risk and odds ratio to assess the relation between certain variables. For this procedure we created two-by-two tables of the tested variables. The relative risk can be expressed as the ratio of the probability of 'disease' among exposed subjects (p_1) divided by the probability of 'disease' among unexposed subjects (p_2) and the disease-odds ratio is the odds in favor of 'disease' for the exposed group divided by the odds in favor of 'disease' for the unexposed group (Rosner, 2015 p.668). For time to event variables we used Kaplan-Meier Survival analysis, Hazard Curves in case of univariate models and Cox-regression in multivariate models to assess survival or hazard outcomes. Statistical significance was set to $\alpha < 0.05$, confidence interval 95%.

QUESTIONNAIRES

According to the study aims, we have collected six validated psychometric questionnaires. *Dissociative Experience Scale* (Bernstein & Putnam, 1986): The 28-item self-administered questionnaire measures the frequency of dissociative symptoms in everyday life. Respondents rate the frequency of each experience on a ten-point scale (ranging from 0 to 100%) which is often used on both healthy and clinical samples. Carlson and Putnam (1993) distinguished

between DES 3 factors: amnesic symptoms, absorption / imaginary involvement, and depersonalization / derealization symptoms. The validity and reliability indicators of the scale proved to be very good, the internal reliability of the scale was found to be good (Cronbach's alpha = 0.88) (Simor et al., 2011).

Recovery-Stress Questionnaire for Athletes (RESTQ-Sport) (Kellmann, M., et al. 2001): is a questionnaire reported to identify the extent to which athletes are physically or mentally stressed and their current capabilities towards recovery (Kellmann & Kallus 2001). The RESTQ-Sport was developed through continuous bio-psychological research in the area of stress for the General Scale, and the Sport Scale was comprised of items observed to coincide with stress or recovery states in athletes (Kellmann & Kallus, 2001). RESTQ-Sport consists of 12 General Stress and Recovery scales along with seven Sport-specific Stress and Recovery scales (Kellmann & Kallus, 2001). The General Stress component includes three scales which measure general stress, emotional stress, and social stress along with their consequences. Three General Stress Scales are concerned with performance aspects (scales measuring conflicts/pressure, fatigue, and lack of energy). The scale "physical complaints", measures the physical aspects of stress. Cronbach- α values for each of the 19 separate subscales, comprised of hypothesized items, ranging from .72 to .93 (Kellmann & Kallus, 2001). Test-retest reliability of the individual Subscales achieving correlational values above 0.79 (Kellmann & Kallus, 2000; Kellmann & Kallus, 2001). The Hungarian translation and validation was made by Tóth et al., (2019).

Perceived Stress Scale (PSS) (Cohen & Williamson, 1988) PSSs an abbreviated but researchable 5-point Likert scale of 4 items from the original 14-item questionnaire (Cohen & Williamson, 1988). It asks about those thoughts and feelings which characterize the person's stress perception: "How much stress do you experience?", "How unpredictable, unaffected, overwhelmed their everyday life is?" (Stauder et al., 2006). The three versions of the questionnaire (PSS14, PSS10, PSS4) are highly correlated ($r = 0.99$ and 0.93), all three have very good internal reliability (Cronbach's alpha 0.88 ; 0.85 ; 0.79), and the reliability of the test-retest is also excellent ($r = 0.90$) (Stauder et al., 2006).

The Mental Health Test (Vargha et al., 2019): The basic concept of the test is to obtain a comprehensive picture of the subject's mental health in relation to the five pillars using a short questionnaire of no more than 20 items (Oláh et al., 2018; Vargha et al., 2019). It has two subscales we analyzed and the results are used in our study: well-being and resilience.

Self Estimated Functional Inability because of Pain questionnaire (SEFIP) (Ramel et al., 1999) The basic structure of the SEFIP consists of 14 items representing body parts: neck, shoulders, elbows, wrists/hands, upper back, lower back, hips, thighs (front), thighs (back), knees, legs (front), calves, ankles, and feet. Points on the SEFIP scale are calculated as follows: “*I am entirely free of pain*” = 0 point; “*I have slight pain but it is no problem*” = 1 point; “*I have quite a bit of pain but I can dance if I am careful*” = 2 points; “*I have a lot of pain and have to avoid certain movements*” = 3 points; “*I have great difficulty and cannot take part in the production*” = 4 points. Values of reliability ($\kappa \geq 0.40$, intraclass correlation coefficient = 0.91), internal consistency (Cronbach's $\alpha \geq 0.81$), and correlations ($r_s \geq -0.376$) of the total SEFIP-sport score with the numerical rating scale (Jodimar et al., 2021).

Body Responsiveness Questionnaire (BRW) (Daubenmier, 2005, Tihanyi et al., 2016): Body responsiveness is assessed using a 7-item questionnaire that “assesses the tendency to integrate body sensations into conscious awareness to guide decision making and behavior and not suppress or react impulsively to them” (Daubenmier, 2005). There are two subscales: The Importance of Interoceptive Awareness subscale (I-subscale) assesses the importance of using interoceptive information to regulate behavior and self-awareness (items include “*It is important for me to know how my body is feeling throughout the day*”, “*I am confident that my body will let me know what is good for me*”) and the Perceived Disconnection subscale (PD-subscale) measures the extent of perceived disconnection between psychological and bodily states, including suppressing and reacting impulsively to them (items include “*My mind and my body often want to do different things*”, “*I suppress my bodily feelings and sensations*”, “*My bodily desires lead me to do things that I end up regretting*”). Cronbach α 0.82 and 0.83 for I-subscale, 0.72 and 0.63 for PD-subscale respectively (Tihanyi et al., 2016).

Over of the validated questionnaires, we used demographic and specific abuse reporting questions. The questions were carefully created by the PhD candidate based on the interviews and the preliminary data and reviewed by the supervisor Dr. Boros. We created these questions since we have not found a validated psychometric test focusing on the assessment of professional dance abusive experiences or toxic environment.

The questions were Hungarian adaptations that were implanted into an online questionnaire platform (Qualtricks), where we collected the data anonymously. The study was approved and supervised by the IRB at ELTE PPK with the presence of Research Ethic Review Board (Approval number: 2021/419).

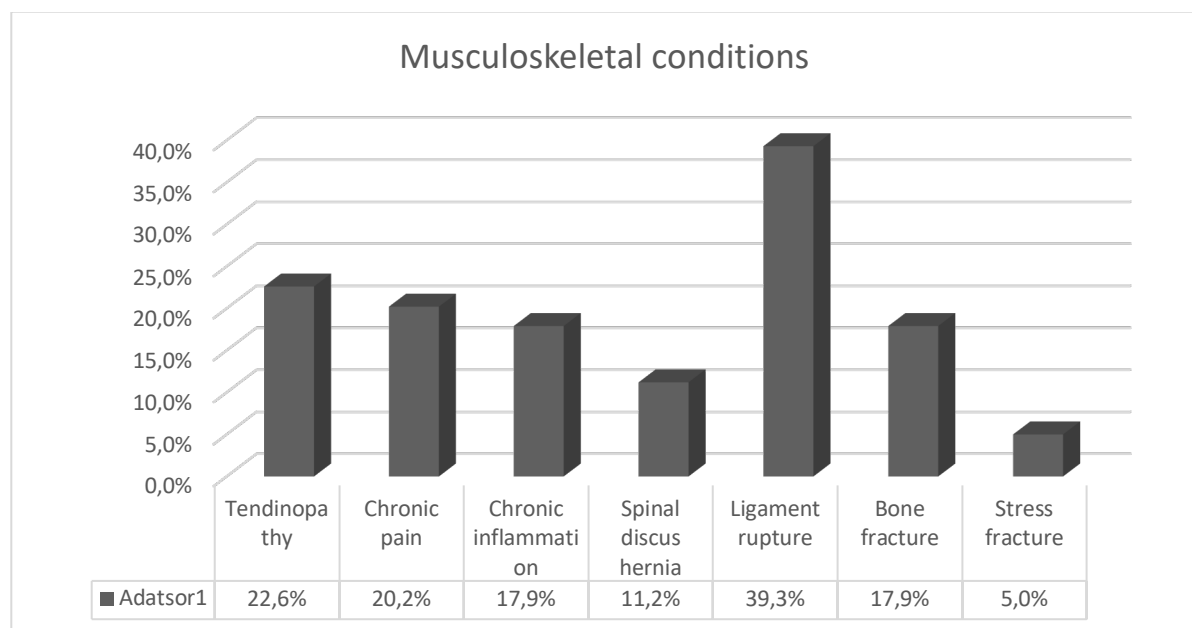
RESULTS

RESULT 1

4. Table shows the reported abuses and their frequencies (N=168) (own study)

Abuse frequency			
	Mean Frequency	Subscale	
Aggressive voice	79.9%	Shouting at him/her	78.1%
		Verbally forcing the dancer to do something	81.7%
Silent treatment	55.6%	-	
Body shaming	45%	-	
Belittling	68.6%	To speak contemptuously	67.5%
		Mock nickname given	33.1%
		Ashamed	55.6%
Physical abuse	52.1%	An object thrown	37.9%
		instructive touch, that was painful	52.1%

RESULT 2



3. Figure shows the prevalence of musculoskeletal conditions (N=168) (own study)

RESULT 3

5. Table shows the risk assessment of certain chronic musculoskeletal conditions and the reported abuse types (N=168) (own study)

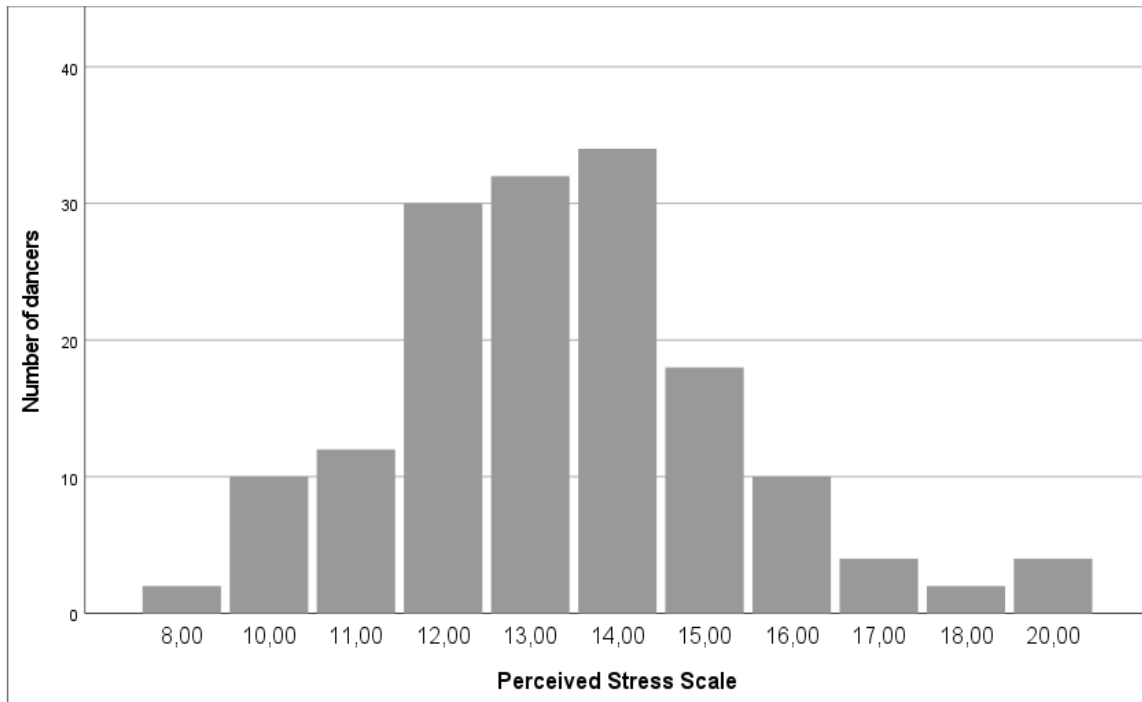
	Chronic Pain		
	Relative Risk	Confident Interval	Odds ratio
Silent Treatment	1.617	1.312-1.994	5.939
Physical Abuse	1.972	1.604-2.425	16.552
Belittling	1.243	1.086-1.423	4.891
Body Shaming	1.213	1.022-1.440	2.705
	Tendinopathy		
Silent Treatment	1.002	0.744-1.349	1.004
Physical Abuse	1.229	0.925-1.633	1.688
Belittling	1.279	1.083-1.510	3.512
Body Shaming	1.043	0.851-1.279	1.193
	Chronic Inflammation		
Silent Treatment	1.111	0.810-1.524	1.333
Physical Abuse	1.204	0.872-1.661	1.611
Belittling	1.152	0.936-1.419	1.915
Body Shaming	0.995	0.774-1.279	0.980

RESULT 4

6. Table shows the Time to Event and Regression analysis (N=168) (own study)

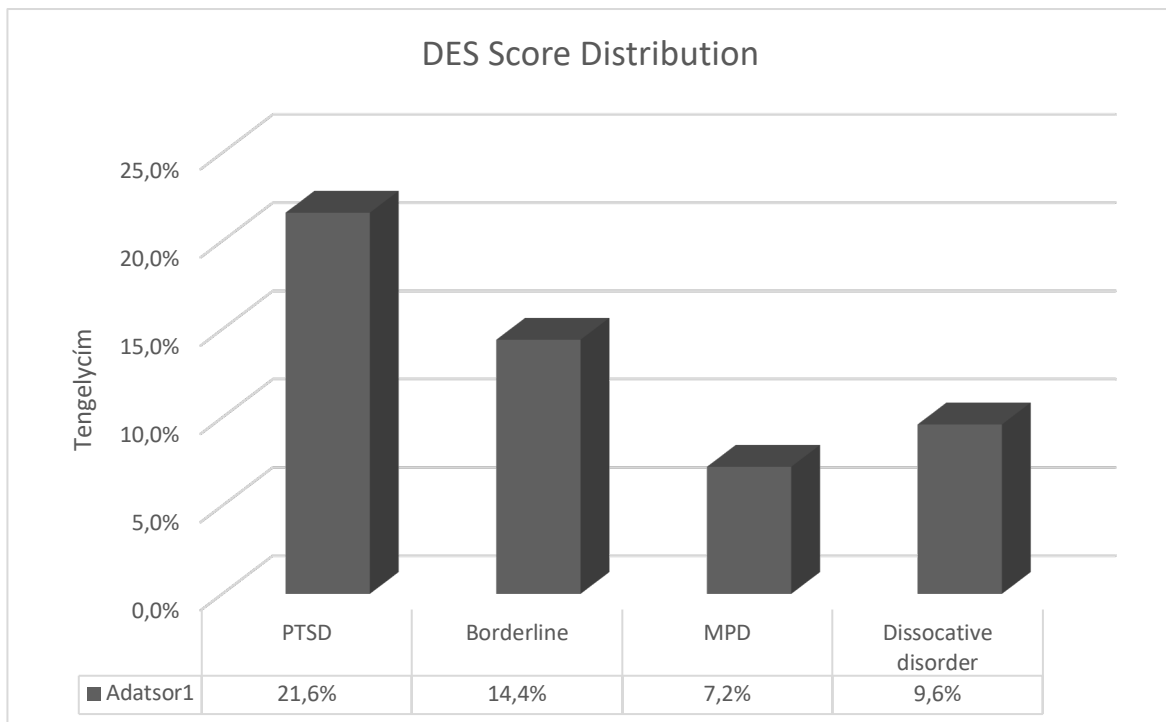
Kaplan-Meier Univariate Analysis			
Condition	Covariate	Estimation	Confidence Intervall
Chronic Pain	Aggressive voice	14.125	10.9-17.3
	Physical Abuse	16.556	11.6-21.5
	Belittling	13.615	9.7-17.6
	Body Shaming	13.857	10.2-17.6
Tendinopathy	Aggressive voice	16.00	13.2-18.8
	Physical abuse	15.2	10.7-19.8
	Belittling	16.125	13.1-19.1
	Body shaming	16.071	12.7-19.4
Chronic inflammation	Aggressive voice	14.455	11.1-17.9
	Physical abuse	14.143	9.6-18.7
	Belittling	15.400	11.9-18.9
	Body shaming	16.333	12.9-19.7
Cox Regression Multivariate Analysis			
Condition	Chi-square	Significance	
Chronic pain	8.873	p < 0.001	
Tendinopathy	7.973	p=0.001	
Chronic inflammation	3.142	p=0.172	

RESULT 5



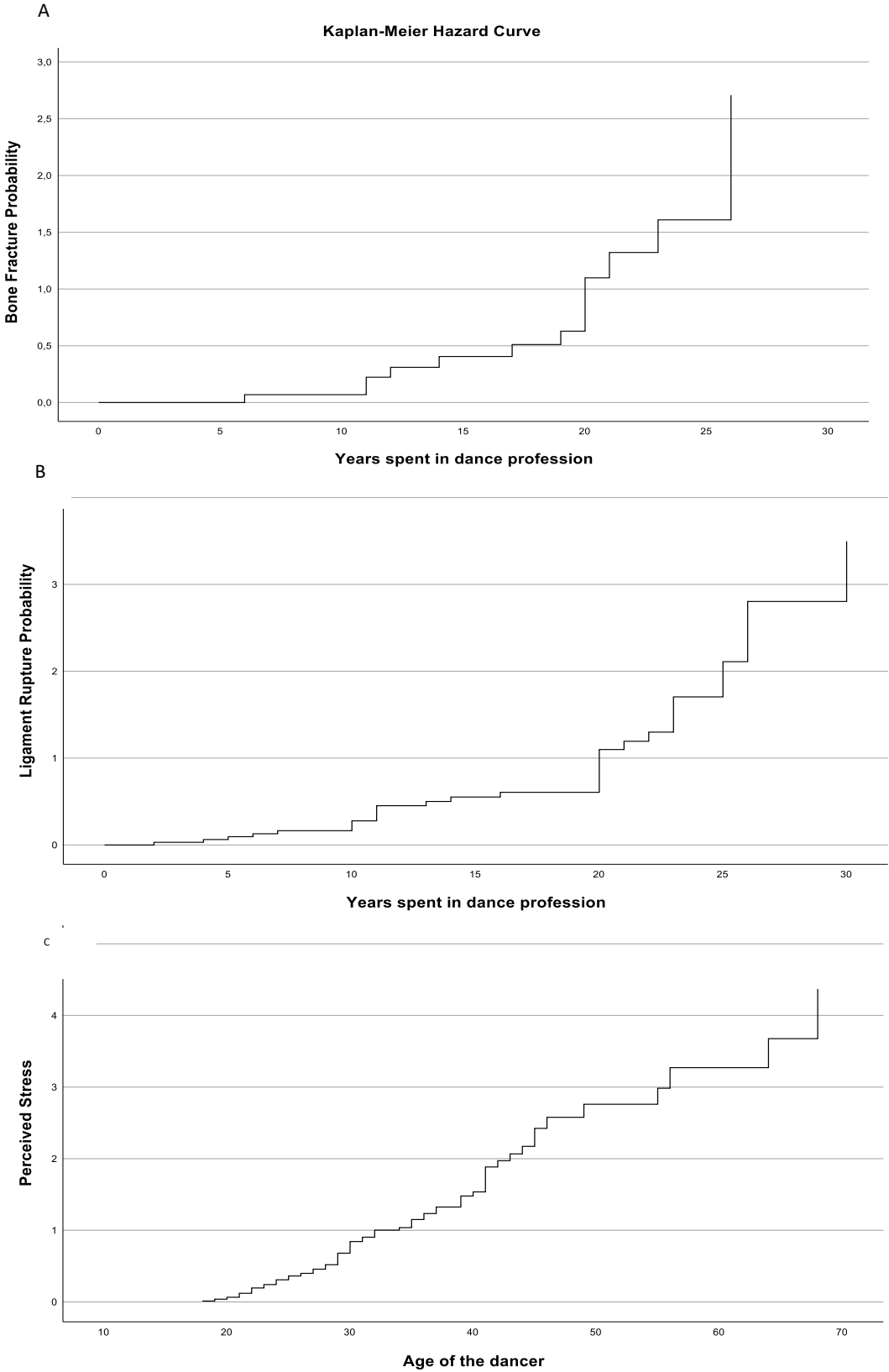
4. Figure shows the Perceived Stress Scale results among the dancers (N=168)
 Relationship: lower back pain ($p=0.012$; $r=0.203$), hip pain ($p=0.042$; $r=0.142$), ankle pain ($p=0.045$; $r=0.146$)

RESULT 6



5. Figure shows the distribution of the Dissociative Dissociative Experience Scale (DES) score mean was ($\mu = 26.82$). 56.90% scored above 20 points on the scale
 Relationship: chronic inflammation ($p=0.02$; $r^2=0.03$; $\beta=7.413$); chronic pain ($p=0.028$; $r^2=0.029$; $\beta=6.890$); tendinopathy ($p=0.04$, $r^2=0.025$; $\beta=1.191$).

RESULT 7



6. Figure shows Kaplan-Meier Hazard Curve A) Years spent in the dance profession as a working dancer, plotted with Bone Fracture Probability; B) Years spent in the dance profession, plotted on a hazard curve with Ligament Rupture Probability.

DISCUSSION

In this research, we aimed to assess the level of stress dancers experience, to evaluate the degree of dissociation, quantify the pathological musculoskeletal conditions, with regards of their sites and rate, to investigate the abusive acts against professional dancers, and to evaluate the possible relationship between the certain stress factors and the health outcomes. Our main goal was to raise attention to an understudied scientific area which is the emotional abuse in professional dance and its relationship with psychological and physical conditions. The novel concept that helped as designing our study was The Stress and Injury Model (Williams and M. B. Andersen, 1998) which describes that stress is a risk of injuries among athletes.

The prevalence of general pathological musculoskeletal conditions among professional dancers were slightly higher (78.6%) than what was found in previous investigations, where global musculoskeletal conditions at all skill levels reached 47.1 - 69% (Jacobs et al., 2017; Bronner et al., 2018). Although their results did not mention the ratio between chronic and acute conditions, in other studies researchers collected found 42.1-77% injured among ballet students aged 9–20 years. These dancers reported to be injured at least once during their training, which correlates with our results too (Gamboa et al., 2008; Laenderson et al., 2011; Ekerger et al., 2014). The ligament and tendon pathology frequencies are similar to literature data (Ekerger et al., 2014, Emery et al., 2006; Gamboa et al., 2008, Yin et al., 2016). Although we have not found data about chronic pain and chronic inflammation reported specifically on professional dancers in scientific researches, our data shows high prevalence (11.2% - 22.6%) among them. Both the musculoskeletal condition rate and the reported abuse frequency is very high among the dancers participating in our study. Within this group, the psychological abuses represented with the highest rate ($\mu = 62.3\%$), although physical abuse (causing pain and throwing objects) was experienced by every other dancer ($\mu = 52.1\%$). These results correlate with our qualitative and preliminary studies, where we hypothesized that most of the dancers experience some kind of harassment, and the reported abuses are not an individual experience, but rather a systemic problem within the dance community. Among the psychological abuses, we found body shaming the least abundant (still almost every second dancer reported in the questionnaire), while aggressive voice and belittling are highly prevalent (7 out of 10 dancers experience it). To evaluate physical abuse, we emphasize that these cases are not considering the general definition of physical abuse (National Clearinghouse on Child Abuse and Neglect. 2003), where beating and severe injuries may occur, rather to cause transient, physical, mild to moderate pain in order to increase performance or quality of movement serving as an additional tool of verbal

instructions. In the subscale we asked about a common habitual act in the dance room, which is throwing objects, which is also considered as a pedagogical strategy to strengthen the weight of the teachers' word. We have not found statistically significant relationship between the years spent in dance and the abuses. This phenomenon is considered to be a reason of either 1) the abuses prevalence is not diffused during the whole career path but temporalized between a certain period; or 2) the resilience is increasing and the repeated diffused abuses are not reported constantly. The earlier concept correlates with our previous qualitative results, where individuals have mentioned that the abuses they suffered most often happened in their educational or early career years.

Dancers scored high on the dissociative scale. More than half of the study population (56.9%) is considered to belong to the high dissociation group (above 20 point), and almost a quarter of the dancers (21.6%) belonged to the PTSD subscale group (26-41 point). This result can be compared with another data of this study, where we found that $\frac{3}{4}$ of the study population (72.6%) has good mental health and almost half of the population (48.9%) scored higher than their peers within the resilience subscale. Although the general mental health is high, 19% of the dancers reported very high general level of stress, and this group can be associated with PTSD group.

DES score has a statistically significant relationship with chronic pathological musculoskeletal conditions such as chronic pain, inflammation and tendinopathy. Although the results are significant, r^2 shows that only 3% of the chronic pathological conditions are completely explained by the DES score. This result is similar to the abusive experiences, (where silent treatment seems to have the highest r^2 value with 7%) so we conclude that abuses truly have a significant effect on the chronic musculoskeletal pathologies, but do not fully explain the conditions' existence. Regarding the three highest reported chronic conditions, the strongest correlation appears to be between abuses and chronic pain. As literature suggests, these conditions have multifactorial etiology roles (Williams, 1998; Shapiro et al., 2020; Thomson et al., 2020); we summarize that psychological and physical abuse is currently appearing as one of the factors. Pain is defined as unpleasant sensory and emotional experience associated with actual or potential tissue damage (Merskey et al., 1994, p. 210), although it is necessary to distinguish between pain and nociception because there is a lack of absolute correspondence between pain and tissue damage (Chapman & Nakamura, 1999; Craig, 2003; Eccleston & Crombez, 1999). Findings suggest the there is a possibility that an experience of pain can originate exclusively within a subject's brain or mind rather than

being necessarily dependent on the pathology of peripheral tissue (Derbyshire et al, 2004). Pain is closely related to consciousness and there is also evidence that pain experiences may be modulated by cognition (Coghill et al., 1999; Eccleston & Crombez, 1999; Tiengo, 2003; Villemure & Bushnell, 2002). Furthermore, it is commonly associated with anxiety disorders (Asmundson et al. 2002; Van Loey, et al., 2003) and PTSD (Asmundson, et al., 2002; Sharp & Harvey, 2001). Patients with chronic pelvic pain were significantly more likely to use dissociation as a coping mechanism and significantly more likely to have experienced severe childhood sexual abuse (Badura et al., 1997; Walker et al., 1992). Our study showed significant correlation between chronic pain and dissociation, which is similar to the results found in literature (Fishbain et al., 2001; Frances & Spiegel, 1987; Livengood et al., 1994; McFadden & Woitalla, 1993; McFadden, 1992).

Psychological and physical abuse seems to be not only an etiological factor, but an undeniable risk to suffer from chronic pain, chronic inflammation or tendinopathy. Risk estimation and odds ratio show that chronic pain has the highest risk to form in a population where the individuals are exposed to certain abuses in which physical abuse (causing pain) has the highest influencing factor of the exposures.

Survival analysis has shown that dancers have high probability to suffer from chronic pain, inflammation or tendinopathy if they spend 13-16 years continuously in the toxic dance industry, experiencing psychological and physical abuses. As Kaplan-Meier is a univariate analysis, we performed a Cox regression where time-dependent variable analysis was done to see the difference of uni-, and multivariate abuse experiences, since dancers are not exclusively experiencing a type of abuse, but rather several of them at the same time. We found that the survival time drastically changes to half in the multivariate model, which means that the more types of abuse the dancer experiences, the earlier the probability to have chronic musculoskeletal pathologies arises. These calculations are estimations based on our study results, which cannot be extended to a general dancer population. Chronic inflammation shows the earliest outcome probability of the multivariable model. Trauma exposure resulting in chronic inflammation has several literature results. There are pro-inflammatory factors increased in case of PTSD: C-reactive Protein which not only elevates as a result (Spitzer C, et al., 2010, Miller Rj., et al., 2001) but is suggested to be used as an indicator factor of PTSD (Michopoulos V., et al., 2014), Interleukin-6 (Maes M, et al. 1999, Devoto et al., 2017), IL-1 β (Fukata et al., 1989, Spivak B, et al., 1997,) TNF- α (Kim et al., 2020), IFN- γ (Woods., et al., 2005; Groer., et al., 2006). Chronic inflammation and tendinopathy are often examined

associations. A study found that tissue and cells derived from tendinopathic and ruptured Achilles tendons show evidence of chronic (non-resolving) inflammation (Dakin et al., 2018). As we have plotted on the relationship map, we can assess that not only are the certain abuses in a relationship with the chronic conditions, but chronic conditions are also in relationship with each other, which correlates with their pathophysiology; we could also see that certain types of abuses are also in a relationship with each other, suggesting our earlier hypotheses to accept that dancers experience mixed types of abuses.

Within the acute conditions, we found that ligament rupture was the most abundant injury among our study population. This absolutely correlates with the results found in the literature (Lindsay et al., 2017; Gamboa et al., 2008). Ligament rupture correlates with the time spent in professional dance with 23% explaining its existence. That is a much higher correlation than any of our stress related factor produced. Kaplan-Meier Hazard curve shows the positive correlation between the probability of bone fracture and ligament rupture with the years spent in dance. Perceived Stress Scale gave us an extremely high stress level, which fits our preliminary and qualitative study results. We must consider that the PSS score is an acute stress perception report scale and it was filled out during the COVID pandemic. The pandemic pandemic has not biased the chronic stress and traumatic experiences scales, although the acute stress factors must have been influenced by the current situation. As the pandemic created a global crisis, dancers may have experienced higher level of uncertainty regarding their economic and career status; this was already found a possible risk factor regarding their vulnerability of certain abusive acts. As it is a possible bias, we have not matched the results of perceived stress data to abusive experiences and chronic conditions, we rather established and acute status check protocol. Although perceived stress may be influenced by the pandemic circumstances, we found positive correlation with the age of the dancer plotted on a hazard curve (figure 12.).

According to the pain questionnaire, more than the half of the population (64.45) was free from any current pain symptoms, which we also considered to be confounding due to the global pandemic. Dancers during this time had less working hours and less physical activity, which provided two possible interpretations: 1) the reported current pain symptoms were remaining from earlier injuries, 2) there is a correlation between stress and pain symptoms. Although our questionnaire did not investigate the first possible interpretation, our data research showed significantly positive relationship between lower back and leg pain with PSS, while ankle and foot pain were also in a relationship with PSS, but the significance was above 5%. The

relationship was not strong, since it varied between 4-11% to be fully explained by the exposure, the plotted graph shows, the perceived stress relation with the pain severity. Lower back pain was associated with the existence of a neural mechanism where the specific modulation of brain activity enables manipulation of affective and sensory dimensions of pain experience (Coghill, et al., 2003; Croft, 2000; Derbyshire et al., 1997, 2002; Gracely, et al., 2002; Rainville et al., 1997). Abnormal activation within the pain network (Gracely et al., 2002) show close relationship between pain and detecting cognitive conflict in the anterior cingulum that implicates interconnection of stress (Shackman et al., 2011).

Lower back pain and stress level relationship was found by other researchers (Choobineh et al., 2021; Faymonville et al., 2003). Electromyography results indicate that with chronic back pain, the paravertebral musculature show abnormal muscular reactivity only when discussing personally relevant stress (Flor et al., 1985), moreover there are indicating results that mindfulness techniques can be used to relieve lower back pain (Anheyer et al., 2017).

ANIMAL MODEL

BACKGROUND

Earlier we have found that dancers experience abuses during their professional career which we identified as a toxic environment. Toxic environment may contribute to their high general stress level that may lead to certain musculoskeletal alterations. We found that abuse may act as a risk factor of chronic pain, tendinopathy and chronic inflammation. Since not only chronic musculoskeletal conditions had a high prevalence, but acute ligament ruptures too, we were interested in whether there is indeed a causative relationship between trauma and connective tissue injuries and if so, what can be the molecular details of the possible pathomechanism. We had difficulties establishing a human experimental model due to ethical reason, lack of biological samples (no access to professional dancers' tissues) and several possibilities to bias and confounding (such as dancers have different teachers, leaders, educational background, working hours and load, genetic background).

Therefore, we have chosen to use animal models. Mammals show biologically preserved behavioral and neurobiological responses to valent stimuli which emphasize the use of rodent models of PTSD (Verbitsky et al., 2020). Extensive comparative neuroanatomical studies support the rodent models in stress investigation (Verbitsky et al., 2020), because parallels can be found in regional vulnerability and functional consequences (Semple et al., 2013; Paximos et al., 2019). There are different rodent PTSD models in the literature (Richter-Levin et al., 2019) that can be categorized to physical, social defeat or predator stress. From these models we considered to choose: Resident-Intruder Social Defeat, which takes 5-10 days, and there is a contact with a novel aggressive resident, then a 24-h housing with a resident, separated by perforated screen (Golden et al., 2011) but in this model the quality of aggression is hardly controllable (Verbitsky et al., 2020), which disadvantage appeared in the Predator Exposure Stress model (Adamec et al., 1993) as well. Based on the favourable control of stressor intensity, our attention turned to the physical stress models, where Single Prolonged Stress (SPS) became our choice, which combines three distinct stressors (Liberzon et al., 1997) at once. Although dancers do not experience such type of stress, the selection of this model was supported by our methodological suspicion, that a physical stress might induce more intensive alterations in the body, than a social or predator stress. SPS participant animals show altered behaviour such as sleep abnormalities (Vanderheyden et al., 2015) enhanced anxiety (Han et al., 2014; Liu et al., 2016), arousal (Khan & Liberzon, 2004), fear learning (Iwamoto et al., 2007) and impaired spatial awareness, recognition memory and social interaction (Kohda et al., 2007; Wen et al.,

2016). These changes are time dependent (Liberzon et al., 1999; Knox et al., 2016). Researchers have found alternation in certain brain areas such as: in the hippocampus in the form apoptotic markers (Liu et al., 2010), cell death (Lin et al., 2012), autophagosomes (Wan et al., 2016) enhanced oxidative stress and inflammation (Schiavone et al., 2013). In the amygdala, increased apoptosis and downstream signals were found, for example: phosphorylated extracellular signal-regulated kinases, caspase 3,9,12 (Liu et al., 2010, Xiao et al., 2015). In the prefrontal cortex, apoptosis and dysregulated autophagy appeared (Li et al., 2013; Wen et al., 2016), elevated levels of protein kinase RNA-like endoplasmic reticulum kinase (PERK) caspase 12, glucose-regulated protein (GRP) 94 (Li et al., 2013; Zhao et al., 2014); decreased level of glutamate (Know et al., 2010). SPS procedure was also used to assess HPA-axis alteration in regards of PTSD (Keller et al., 2015; Knox et al., 2012).

Although, we have not found scientific papers about Achilles tendon examination in rodents with PTSD model, we found studies, where the rodents' Achilles tendon's elasticity was assessed without PTSD. In these studies scholars measured mechanical, compositional and structural properties of post-natal mice's Achilles tendon, (Ansorge et al., 2011; Mikic et al., 2010), used 3D analysis to evaluate the collagen fibrils of the Achilles tendon (Santorini et al., 2021), or tested its tensile strength properties (Shi et al., 2012). We also found similar studies with human Achilles tendon samples (Hangody, 2016), which all helped us designing our study. Our aim was to measure the tensile strength difference between the stressed and the control animals. We wanted to assess whether traumatic experiences altered the quality of the connective tissue, so abuse could truly be a risk factor for certain musculoskeletal conditions supporting our previous findings.

METHODS

ANIMALS

Twenty C57BL/6 adult (14-18-week-old) male mice were used with a mean body weight of mean 29g. The animals were housed 3-6/group in standard polycarbonate cages (365 mm × 207 mm × 144 mm) at the animal facility of the Department of Pharmacology and Pharmacotherapy, University of Pécs in a temperature and humidity controlled room under a standard 12 h light/dark cycle (lights off at 18:00 h) with food and water available ad libitum. The animals were randomly assigned to experimental or control groups. The trauma as well as behavioural analysis was done during the early dark (active) phase of the animals between 19 and 23 h. During the trauma phase half of the animals were stressed (SPS group), while other half remained undisturbed except measuring their body weight (control group). Two

weeks later all the animals underwent behavioural testing and 72h later were sacrificed by overdose urethane anaesthesia. Their hindlimbs were collected immediately on dry ice. The experiments conducted on the animals were approved by the local committee for animal health and care and were performed according to the European Communities Council Directive recommendations for the care and use of laboratory animals (2010/63/EU).

STUDY DESIGN

Single-Prolonged Stress (SPS) was used to induce PTSD-like symptoms in mice (Maercker et al., 2004; Liberzon et al., 1997; Kohda et al., 2007; Konx et al., 2016). Although it is called a “single” prolonged stress, the procedure is comprised of successive, multi-modal stressors: two-hour immobilization, fifteen-minute forced swim, fifteen-minute rest and exposure to diethyl ether until loss of consciousness. The steps of the procedure is shown on the graph below:

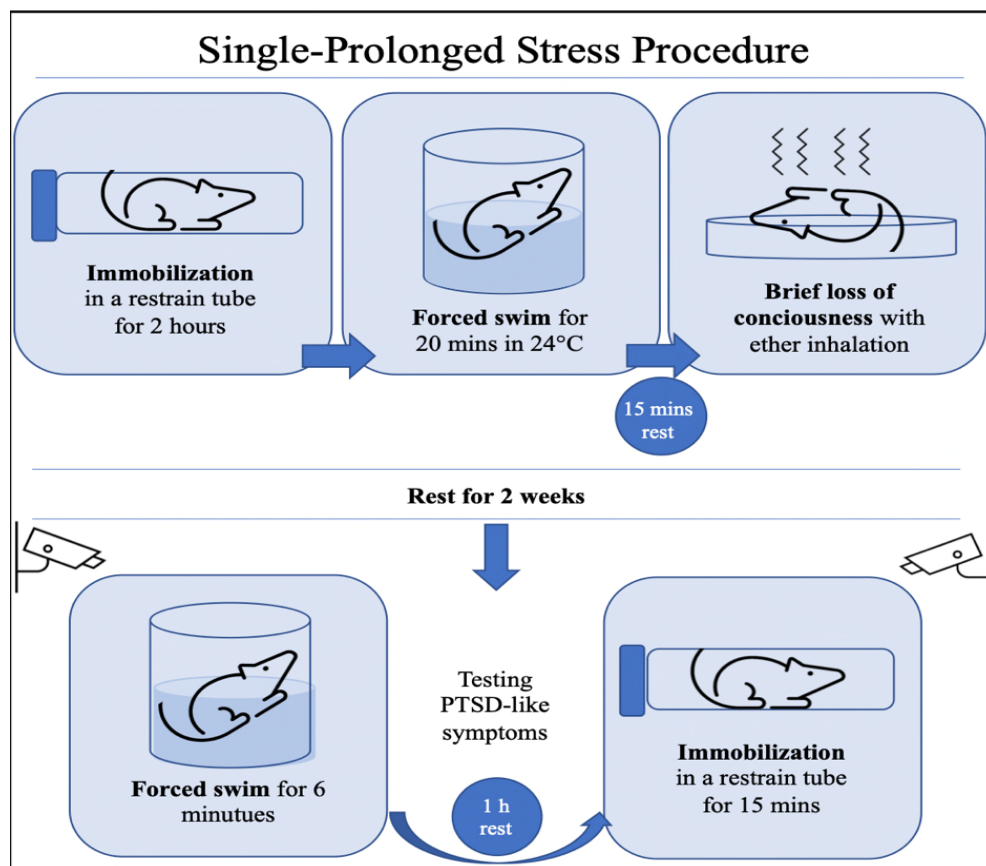


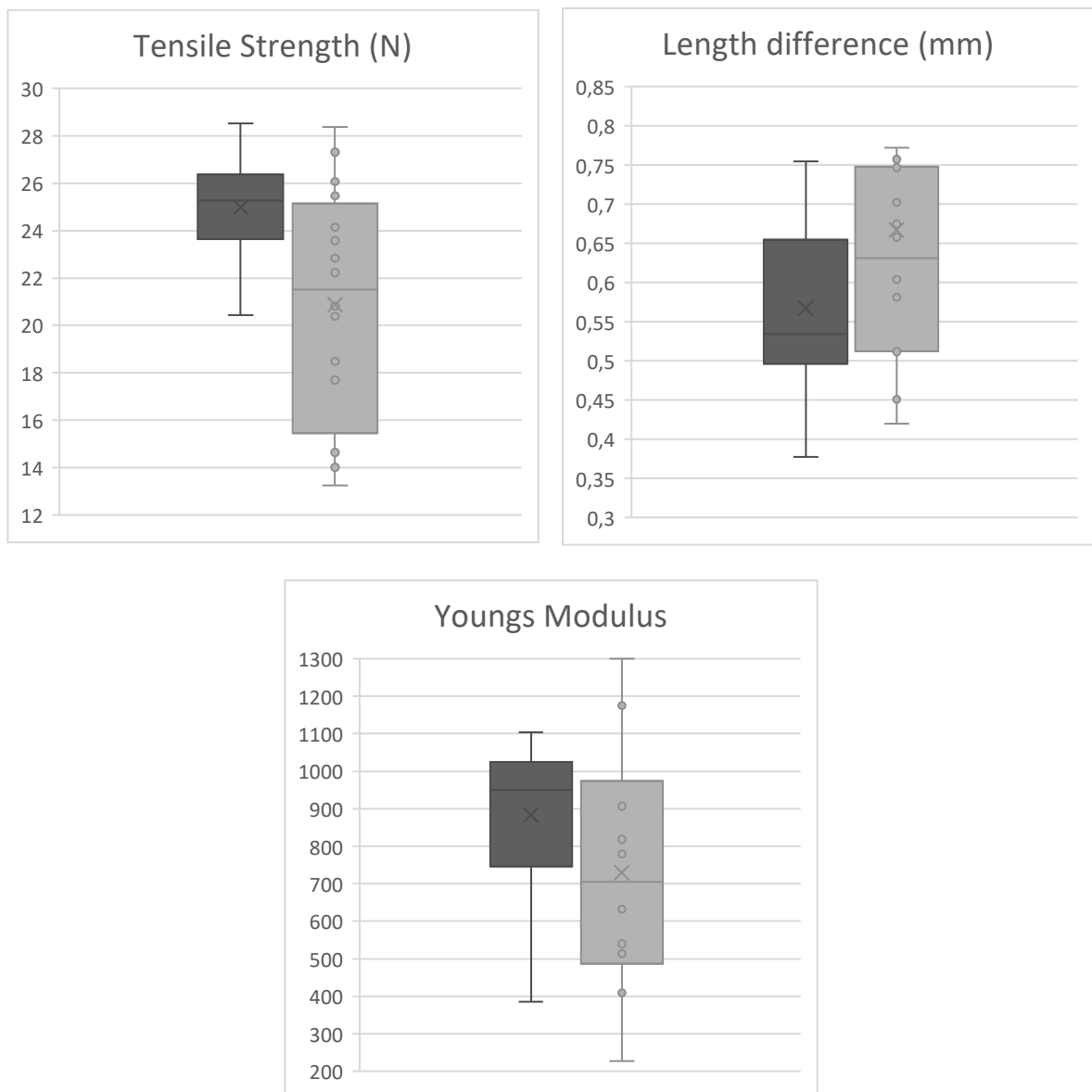
Figure 7: Single-Prolonged Stress (SPS) procedure steps we used in our study is described in this figure.

Stressed animals' restraint was performed in a 50 ml Falcon tube, into which mice were placed. After immobilization, we prepared 1400 ml, 24 ± 1 °C water in 2-liter-beakers to place the mice into them for forced swimming. Fifteen minutes later we took the mice out, dried them with paper towel and let them rest for 15 minutes. Ether inhalation was done under

fume cabinet one by one with controlling the overanesthesia. Each step was carried out simultaneously according to the original housing order, and each animal in a cage got the same treatment (either remained control or underwent SPS). To test whether PTSD-like symptoms appeared in the stressed animals we carried out behavioural tests: a 6 min forced swim and 15 min restraint with either stressed and control groups.

RESULTS

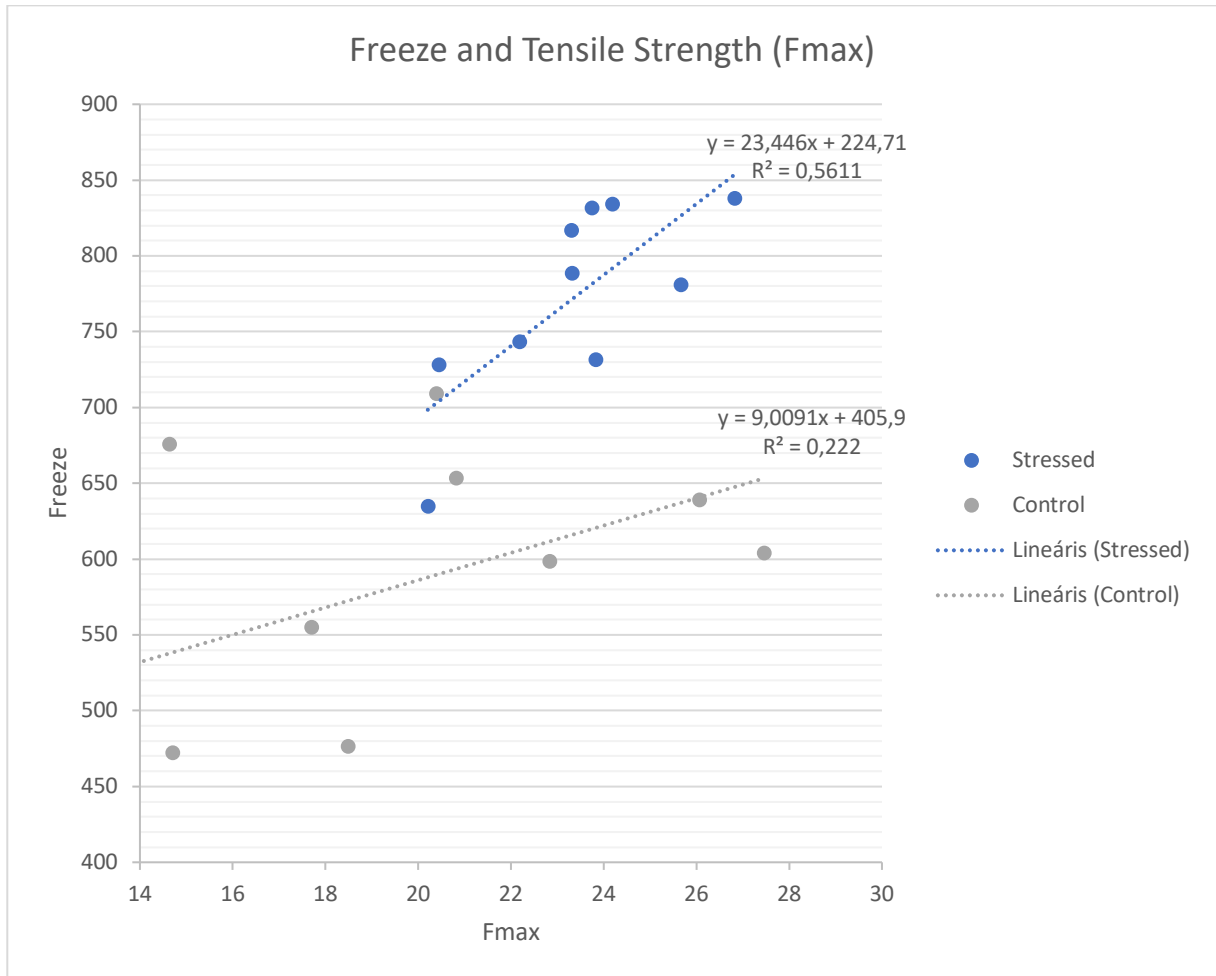
TENSILE STRENGTH TEST



8. Figure Comparison of Stressed and Control groups with the results of Tensile Strength, Length difference, Young's modulus. The data are expressed as mean and standard deviation. Tensile Strength (N) t-test: $p=0.0058$ F-test: $p=0.00083$; Length difference (mm) t-test: $p=0.15$ F-test: $p=0.0009$; Young's Modulus (MPa) t-test: $p=0.033$ F-test: $p=0.14$

RESULT 2

BEHAVIOURAL TEST



9. Figure Comparison of Stressed and Control groups with the results of Tensile Strength, Length difference, Young's modulus. The data are expressed as mean and standard deviation.

DISCUSSION

In our hands the SPS model worked as stressed animals spent significantly more time floating during FST and struggled more during Restraint than their control littermates. The behavioural tests proved that stressed animals developed PTSD-like symptoms. Our behavioural test results showed similarity to outcomes on SPS models in the literature (Nahvi et al., 2019; Souza et al., 2017).

There was no significant difference between the tensile strength of the right or left leg, that could alter our measured values in the tendon test. Thus, we used the average of the values on the two legs as a representative parameter for each animal. Moreover, the tensile

strength values of the control group were similar to the ones found in the literature (Ansorge et al., 2011), which further confirmed the validity of our measurement. However, there was a significant difference in the mean values of tensile strength and the Young's modulus between the two groups. The Young's modulus was significantly higher in stressed animals, and the higher the Young's modulus the stiffer the tissue is (Vaida et al., 2019). Thus, these results supported our hypothesis, that the tendon's flexibility may become impaired due to a traumatic stress and the tendon vulnerability may increase. We found that not only the mean difference, but also the variance was significantly smaller in the stressed animals than controls. This gave us the impression that not only the flexibility of the tendons differed, but the tissues' adaptation capability to certain exposures might be decreased. Our findings of altered connective tissue quality correlated with previously published data where bone alterations were found after 2 weeks of similar traumatic experiences (i.e. SPS) in rodents (Yu et al., 2014). We found high to moderate correlation between certain behaviours and tensile strength so as with the Young's modulus in the stressed animals' group. There are positive and negative correlations which can basically be grouped into motion (motion, struggle, swim) and non-motion (freeze, floating) behaviours, where non-motion positively correlated with the measured flexibility results, while motion behaviours negatively. These correlations further supported our hypothesis, that traumatic stress might causally contribute to the impaired tendons' flexibility and exclude the possible bias that certain motion factors or physical over-load would make the connective tissue more vulnerable.

Although the professional dancers injury rate is highly correlating with their physical over-load (Roberts, et al., 2013) and working hours (Leanderson et al., 2011; Gamboa et al., 2008), we suppose, that their connective tissue injuries might not only originated from overload. These finding stand for the previous published model describing the possible relationship of Stress and Injury in athletes (Williams and M. B. Andersen, 1998). This way our previous qualitative and quantitative results of chronic and acute musculoskeletal conditions (ligament rupture, tendinopathy) could be explained in humans with its relationship to abusive acts. This study did not explore the molecular details of the pathological changes in the connective tissue of traumatized animals, so further research is needed to this direction.

LIMITATION

First of all, we consider this study limited by the human sample size. Although the professional dancers' community has a low number of individuals in Hungary, and our quantitative sample size was appropriate by power calculation, we still hope for higher number of involvement to support future results. Regarding the selection, we would be interested in the gender differences of abuse experiences, and the duration and time points of these acts. In our questionnaire for the abuse reported, we did not find validated scales, which may also limit our study results. Moreover, the animal model has to be further analyzed with molecular biological methods in order to better understand the pathomechanism that was suggested in the results.

SUMMARY

Professional dancers commonly suffer emotional abuses originated from an impaired way of coaching that involves generations of dancers. Dancers' vulnerability to abuses is increased by several external factors, such as the uncertain financial status and the lack of employment security. Emotional abuse is a risk factor for certain musculoskeletal conditions, which is explained by the decreased flexibility in the connective tissue to tensile stress exposures. Although we understood the factors of the emotional abuse in the dancers' community, we have no exact suggestion how to exclude these acts from the everyday work, due to its multigenerational systemic existence, but we highly recommend the urgent change of the general atmosphere and working environment since emotional abuse not only has a mental health outcome, but it affects the physical health too.

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