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Original Article

Artigo Original

Prevalence of Pain and Psychological Distress in High-Performance Swimmers: Job Stress and Associated Factors – A Cross-Sectional Study

Prevalência de dor e sofrimento psicológico em nadadores de alto rendimento: estresse no trabalho e fatores associados – um estudo seccional

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Abstract

Introduction: High-performance athletes spend numerous hours per week training and therefore are more predisposed to suffer sports-related injury. Evidences show that depression and less severe degrees of emotional distress predict both: the onset of new episodes and persistence of pain.

Objective: To examine the association of swimming training routines, job stress (effort-reward imbalance), overtraining-related subjective markers, and biological and sociodemographic factors with prevalence of pain and with psychological distress, in high-performance swimmers from the highest-level competition.

Methods: Observational sectional study. Forty-two high-performance swimmers (N=42) from the most elevated competition level (World-class and Olympic) took part in the study as population census of the swimming athletes. Analyses were performed using χ^2 , simple and multiple logistic regressions (via generalized linear models).

Results: Prevalence of psychological distress was of 35.7%. Prevalence of pain was of 45.2% and there was significantly difference between men and women ($p<0.001$). Psychological, psychosocial, biological, socioeconomic and demographic factors were not associated with pain ($p>0.05$). Overtraining-related subjective markers and low reward were associated with psychological distress ($p=0.020$), but not with pain. Psychological distress and pain were associated with decreased performance and lower quality of life athletes.

Conclusion: Few studies focused pain in high-performance athletes. The present study indicated that further attention is required in training routines, inside and outside the pool to prevent pain in high performance swimmers.

Keywords: injury, athletes, mental health, overtraining syndrome, organizational stress, epidemiology.

Keypoints

- Prevalence of psychological distress was of 35.7%.
- Prevalence of pain was of 45.2% and there was significantly difference between men and women ($p<0.001$).
- Overtraining-related subjective markers and low reward were associated with psychological distress ($p=0.020$), but not with pain.

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Resumo

Introdução: Atletas de alto rendimento passam inúmeras horas por semana treinando e, portanto, estão mais predispostos a sofrer lesões relacionadas ao esporte. Evidências mostram que a depressão e graus menos graves de sofrimento emocional predizem ambos: o início de novos episódios e a persistência da dor.

Objetivo: Examinar a associação de rotinas de treinamento em natação, estresse no trabalho (desequilíbrio esforço-recompensa) e outros fatores com prevalência de dor e sofrimento psíquico em nadadores de alto rendimento. Além disso, examinamos a relação de sofrimento psicológico e dor.

Métodos: Estudo seccional observacional. Quarenta e dois nadadores de alto rendimento (N = 42) do nível competitivo mais elevado (World-Class e Olympic) participaram do estudo como amostra de conveniência. As análises foram realizadas usando χ^2 , regressões logísticas simples e múltipla (via modelos lineares generalizados).

Resultados: A prevalência de sofrimento psíquico foi de 35,7%. A prevalência de dor foi de 45,2% e houve diferença significativa entre homens e mulheres ($p < 0,001$). Fatores psicológicos, psicossociais, biológicos, socioeconômicos e demográficos não foram associados à dor ($p > 0,05$). Marcadores subjetivos relacionados ao excesso de treinamento e baixa recompensa foram associados com sofrimento psíquico ($p = 0,020$), mas não com dor. Sofrimento psicológico e dor foram associados com a diminuição do desempenho e menor qualidade de vida atletas.

Conclusão: É necessária maior atenção nas rotinas de treinamento, dentro e fora da piscina, para prevenir a dor em nadadores de alto desempenho.

Pontos-Chave Destaque

- Prevalência de sofrimento psíquico foi de 35,7%.
- A prevalência de dor foi de 45,2% e houve diferença significativa entre homens e mulheres ($p < 0,001$).
- Marcadores subjetivos relacionados ao excesso de treinamento e baixa recompensa foram associados com sofrimento psíquico ($p = 0,020$), mas não com dor.

Palavras-chave: lesão, atletas, saúde mental, síndrome de excesso de treinamento, estresse organizacional, epidemiologia.

Prevalence of Pain, Psychological Distress, Job Stress, and Associated Factors in High-Performance Swimmers: A Cross-Sectional Study

Introduction

High-performance athletes spend numerous hours per week training and therefore are more predisposed to suffer sports-related injury and pain is an indicator of injury(1). Swimming athletes commonly experience pain in specific body region. The most frequently affected joint is the shoulder, followed by the knee(2,3) and the lumbar region(3). The factors involved in the injury process may be anatomical and/or biomechanical(4).

Evidences show that depression and less severe degrees of emotional distress predict both: onset of new episodes and persistence of pain(1). In general population, symptoms of anxiety and/or depression are very prevalent in general population causing as much disability as cases with closed diagnosis and frequently people do not receive adequate treatment(5,6). Scientists have found that the association also occurs in the opposite direction: chronic pain

frequently precedes the development of psychological distress(1). The literature exhibits few studies that focused pain and mental health among active athletes – those who are not injured or under healing process(7,8). Besides physical and technical aspects of training routines, there are also intra- and interpersonal factors affecting athletes(9). Psychosocial factors are related to performance and well-being and are associated with increased sports injury risk(10).

A major concern in sports training is to balance workload application and athletes' recovery response. In that context, sports science researchers have considered the prevention of overtraining, which diagnosis is highly complex; very often requiring clinical, physical, psychological, and laboratory tests(11). Over-trained athletes may show symptoms of anxiety or depression, which relates to the physiological reactions that may arise as result of training-overload(11).

The association between stress, stressors and chronic pain is complex and sustained by biological, psychological and social factors(1). Besides physical stress, athletes may be susceptible to the organizational stress, which relates to emotional disposition and psychological symptoms. Additionally, best cognitive performances among professional athletes correlate negatively with stress and anxiety(12). There is a lack of studies regarding the relationship of psychosocial factors together with physical factors and mental health with pain in active high-performance athletes.

The purpose of this study was to examine the association of swimming training routines, job stress (effort-reward imbalance), overtraining-related subjective markers, and biological and sociodemographic factors with prevalence of pain and psychological distress, in swimmers from the highest-level competition. Furthermore, we examine if there was relationship between pain and psychological distress.

Methods

Design study and sample

All swimming athletes (*census*; N = 42) that represented Brazil at the 5th Military World Games, in 2011, were invited to take part in this cross-sectional study. The majority integrated the Brazilian swimming team for World Championship and Olympic Games.

Ethical issues

Ethical approval was obtained from the ethics committee of Rio de Janeiro State University. Written informed consent was obtained from all participants and all the ethical principles of research involving human subjects were observed (CAAE: 02799512.1.0000.5260).

Measures

Pain and psychological distress were the primary and secondary outcomes, respectively. Exposure variables were aspects of physical training and preparation, overtraining-related subjective markers, biological characteristics and psychosocial factors (sociodemographic characteristics and job stress). Data were collected using self-administered questionnaires.

To ensure the quality of the information collected, we conducted pre-test, pilot, reliability and reproducibility studies. The instruments returned a 0.70 level of agreement and were considerate appropriate for application in this kind of population. Methodology previously applied(13,14,15).

Pain

Pain was the primary outcome. A questionnaire that evaluates the occurrence of pain (dependent variable) comprising eight questions(13) was applied. Questions 1-4 referring to sex, height, weight and date of birth.

Question 5 presents two parts. The first one refers to pain occurrence inquiring if the participant feels any pain. If “yes”, there is five options to register body region(s). First four are closed-ended options: a) Shoulder; b) Hip; c) Elbow; and d) Knee. The fifth option is an open-ended answer type: e) Elsewhere (muscle, head, etc.). Where? – participant should describe in which body region he/she feels pain.

The second part investigates in what situations pain occurs: during swimming or during complementary activities: swimming and/or complementary training activities (weight training, stretching, jumping, and elastic band).

Question 6 asks about how many years participant has been training (open-ended question).

Question 7 asks about the style(s) and distance(s) of the competition events in which the athlete participates. Closed-ended answers.

Question 8 asks, the distance (km) per week, on average, that the athlete trains.

Psychological distress

Psychological distress was the secondary outcome and was examined as exposure factor to pain. The General Health Questionnaire (GHQ-12)(16) was used to evaluate for the presence of a group of less severe, non-psychotic, depressive, anxiety and somatic symptoms that impair people’s habitual activities, which are termed common mental disorders(16). Validated in Brazil(17), it is an instrument used in screening for psychological distress. Each item inquires whether, in the past two weeks, the respondent has

experienced a symptom or behaviour evaluated on a 4-point scale comprising the following response options: “not at all” (1); “no more than usual” (2); “slightly more than usual” (3); “much more than usual” (4). Each item was re-coded: responses 1 or 2 to code 0, and responses 3 or 4 to code 1. The points were sum and those scoring of three or more were classified as case of psychological distress. This variable was investigated in relation to the occurrence of pain.

Exposure variables

Exposure variables were occasion of training in what occurs pain; overtraining-related subjective markers; biological, socioeconomic and demographic characteristics; and job stress.

Training occasion

The investigated training occasions where pain occurs were at swimming and at the complementary activities (detailed above).

Overtraining-related subjective markers

Overtraining-related subjective markers, the set of four symptoms indicative of overtraining were: early fatigue, and diminished strength, coordination and performance(11). For the present study we included four questions into the questionnaire asking if, in training routines, the athlete was experiencing, early fatigue and/or diminished: strength; coordination; performance. It could be choosing how many options participant wanted to point out. The four mentioned symptoms were aggregated for further analysis.

Biological characteristics

Biological characteristics were age, sex and Body Mass Index (BMI), calculated by the formula: $BMI = \text{weight(kg)} / \text{height(m)}^2$ (18). The classification adopted was of the Centres for Disease Control & Prevention (CDC)(19): BMI 18.5-24.99 considered normal weight.

Socioeconomic and demographic characteristics

Socioeconomic and demographic characteristics considered were income, education (9 years or more) and type of contract (temporary or permanent).

Job stress

To evaluate job stress was used the effort-reward imbalance model (20). This instrument, translated, adapted and validated in Brazil (21), comprises 23 questions, and results are expressed in the form of scores. The ERI addresses three facets: effort (E) – 6 questions, reward (R) – 11 questions, and over-commitment (OC) – 6 questions. The correction factor applied was 0.5454(20). Results above one (>1) for ERI (the ratio E/R) indicate effort-reward imbalance (job stress). The total score (TS) from the instrument was taken to assess stress in the relationship between the athlete and the organization, where $TS = (E/R) + OC$. Higher scores indicated the presence of higher levels of stress.

Statistical analysis

Exploratory and descriptive analyses were performed. To evaluate the association between the exposure variables and the outcomes pain and psychological distress bivariate analysis. as exposure was conducted using χ^2 and simple logistic regression (via generalized linear models). The confidence level in the analyses was 95%. Missing data were withdrawn from the analyses.

Results

All athlete invited agreed to participate in the study. The study population comprised 42 elite swimmers, members of the military team representing Brazil in world-class competitions in 2011. Fifty two percent were men and the majority (95.2%) had normal weight. All participants had nine or more years of education, and mean age was 23(± 4) years (Table1). The majority (73.8%) was single (64.3%), received per capita family income of more than 10 minimum wages (64.3%), and has a temporary work contract (73.8%). Mean of years of training was of 14 (± 7). The prevalence of psychological distress was 35.7% (Table 1). Psychological distress was not associated with pain. Moreover, none of the socioeconomic and demographic variables were associated with pain.

None of the athletes presented the four overtraining-related subjective markers. However, presenting one or more symptoms

(40.5%) was associated with psychological distress ($p=0.020$) and was not associated with pain.

Ninety-eight percent had normal weight and BMI < 22.0 was associated with pain ($p=0.017$) (Table 2). Years of training and total weekly

Table 1 – Association of sociodemographic characteristics, psychological distress and overtraining symptoms with pain and with psychological distress

Characteristic	n	(%)	PsyD <i>P</i>	Pain <i>P</i>
<i>Conjugal status</i>			0.393	0.309
Single (never married)	27	64.3		
Married	8	19.0		
Divorced/Separated	7	16.7		
<i>Education</i>			1.000	0.579
Less than 9 years	0	0.0		
9 years or more	42	100.0		
<i>Income^a</i>			0.060	0.719
Over 10	27	64.3		
Over 5 to 10	6	14.3		
Over 2 to 5	1	2.4		
Up to 2	3	7.1		
Non-informed	5	11.9		
<i>Type of work contract</i>			0.676	0.081
Permanent	11	26.2		
Temporary	31	73.8		
<i>Psychological distress</i>			-	1.000
Yes	15	35.7		
No	27	64.3		
<i>Overtraining-related subjective markers</i>			0.020	0.112
None	25	59.5		
≥ 1	14	33.3		

^aIn minimum wages. *P*: p-value results from simple logistic regression and χ^2 test for associations with psychological distress and with pain; **PsyD**: Psychological distress.

Table 2 – Association of biological characteristics, training factors and job stress with pain and with psychological distress

Characteristic	Mean	Median	SD	PsyD <i>P</i>	Pain <i>P</i>
<i>Age</i>	22.9	22.0	4.4	0.933	0.541
<i>BMI</i>	22.1	22.8	4.1	0.294	0.017
<i>Years of training</i>	13.9	15.0	6.9	0.071	0.240
<i>Km/week in swimming training</i>	45.2	40.0	20.0	0.497	0.787
<i>Job stress</i>					
Effort	19.5	20.0	3.6	0.943	0.680
Reward	15.3	14.7	2.8	0.035	0.401
Overcommitment	15.8	16.0	1.4	0.063	0.552
ERI ^a	1.3	1.3	0.3	0.082	0.789
TS ^b	17.1	17.2	1.4	0.133	0.513

SD: standard deviation; **PsyD**: Psychological distress; **BMI**: Body Mass Index; ^a**ERI**: Effort/Reward; ^b**TS**: Total score = ERI + Overcommitment; *P*: p-value results from simple logistic regression for associations with psychological distress and with pain.

distance (km) covered per week in training showed no significant statistical association with the occurrence of psychological distress or pain.

Mean and median for the ratio Effort/Reward (ERI) was 1.3 and the majority (90.5%) presented job stress (ERI>1). There were no association of job stress with pain or with psychological distress. However, low reward was associated with psychological distress ($p<0.035$).

The overall prevalence of pain was 45% (Table 3). The prevalence in men was 18% and in women it was 75% and the difference was statically significant ($p<0.001$). Pain mainly affected women during swimming training when comparing to men ($p=0.032$). Twenty-six percent of the athletes reported pain in both situations: during swimming and during complementary activities and the difference according to sex was statically significant ($p<0.001$).

Table 3 – Prevalence of pain according to sex by physical training factors

Characteristic	Male		Female ^a		Total		Cf	P
	Freq	%	Freq	%	Freq	%		
<i>Sex</i>	4	18.2	15	75.0	19	45.2		<0.001
<i>Physical training factors</i>								
Swimming	3	13.6	9	45.0	12	28.6	2.603	0.032
Complementary training								
Strength	4	18.2	8	40.0	12	28.6	1.099	0.125
Stretching					1	2.4	18.622	0.998
Jumping					6	14.3	18.719	0.994
<i>Both</i>	8	40.0	3	13.6	11	26.2	1.440	<0.001

%; prevalence; ^aReference category; Cf: coefficient and P: p-value, results from simple logistic regression.

Discussion

This was one of the rare studies conducted among world-class swimming athletes competing at the highest level. Data collection took place one month away from the world-class main competition in 2011. Main findings were that prevalence of pain was high (45%), with significant difference between men and women. The prevalence of psychological distress was very high (35.7%) and it was not associated with pain. Similarly, psychosocial and sociodemographic characteristics showed no association with pain or with psychosocial distress ($p>0.05$), except for low reward that was associated with psychological distress. Overtraining-related subjective markers and low rewards were associated with psychological distress ($p<0.02$).

Pain in high-performance swimmers

In this study, besides the very high overall prevalence of pain, after stratifying by sex, women presented musculoskeletal pain more frequently (75%) than men (18%) and the difference was significant ($p<0.001$). Studies have shown that, in general population, similar

patterns of pain occurrence can be observed between men and women(1). Prospective population-based surveys (Germany and Nederland) found sex difference: prevalence of pain was systematically higher in women than in men(22). In swimming context, literature is not consistent on sex differences in pain(23). However, our results are in line with Sallis et al.(25), this indicates that further research is needed to clarify pain occurrence according to sex in swimmers.

Pain is an indicator of injury(1) and literature shows that the related factors swimming are biological and/or biomechanical factors, together with overuse(2,4). Biomechanical factors may be related to muscular imbalance due to swim technique details leading to injury processes(4). Our findings indicate that biomechanical aspects need to be observed in both situations: during swimming training and also during complementary activities, since the prevalence of pain was high (in both situations: 26,2%) (Table 3). Moreover, special attention should be paid to swimming techniques among women.

Recent study pointed out that pain in high-performance athletes is associated with less quality of life(14). However, there is still a lack of studies about the relationship of quality of life (health-related) with athletic performance. In addition, further studies should be conducted among high-performance athletes to diagnose pain, to classify severity and clarify its aetiology.

Psychological distress in high-performance swimmers

Mental and behavioural disorders affect 20–25% people in the world at some point of their life. These health problems are universal; affecting all countries and societies, and individuals at all ages(26). Literature shows that pain presents bidirectional association with mental health symptoms(1). Therefore, it was important to examine the mental health of high-performance athletes as well because negative psychosocial states play a very important role in performance competitions (9) and are associated with higher risks for injury among athletes(27). The results of the present study found a very high prevalence of psychological distress in high performance swimmers. Moreover, there was lack of association of psychological distress as aetiology factor to pain, which indicates that pain is due to physical issues.

Psychological symptoms are potentially related to abrupt decline in performance (28). A new finding was that overtraining-related subjective markers were affecting mental health and well-being: the prevalence of psychological distress increase if more overtraining markers exist (Table 1). Bresciani et al.(29) in a longitudinal study found that psychological symptoms appeared early before decline in performance and even before physiological markers of overtraining rise up, and suggested that monitoring the psychological aspects can contribute to prevent overtraining syndrome, injury and consequent pain. Therefore, in despite of the non-association of psychological distress with pain, there is a need of close attention from the technical/health team to mental health of competitive athletes.

Association of psychosocial factors with pain and psychological distress in high-performance swimmers

Similarly to psychological distress in relation to occurrence of pain, job stress (Table 2) and sociodemographic characteristics (Table 1) were not associated with pain. These results clarify that the aetiology of pain in elite swimmers relates to physical factors. Thus, dealing with pain in such population should focus on muscular balance, bones, suitable additional exercises and biomechanical aspects of swimming styles.

Nonetheless the elevated prevalence of job stress (effort-reward imbalance) (90.5%), it was not associated with pain nor with psychological distress, except for low rewards. Reward refers to financial, esteem and stability in the work environment balance between efforts and rewards are expected(20). This facet was associated with psychological distress in the athletes, which is consistent with literature: low rewards affects mental health(16).

To our knowledge, this was the first study to apply this model in athletes and this epidemiological instrument seems to be a useful tool to evaluate the psychosocial status of professional athletes; mainly, when the objective is to go beyond the performance, promoting health and quality of life. It is important to avoid organizational stress because it can lead to negative affective states and psychological symptoms(30) that contribute to decreased athletic performance and affect the health and well-being of athletes. Moreover, better cognitive performance among professional athletes is inversely associated with stress and anxiety(12).

Training aspects

Our study population swam about 42,200 meters per week – competitive swimmers swim from 10,000 to 20,000 meters per day in training, using crawl style for most of that distance. On average, they perform from 8 to 10 arm stroke cycles every 25 meters, which means that a swimming athlete completes more than a million shoulder rotations per week(31). In despite of this, in the present study neither years of training nor weekly volume of training were associated with the

occurrence of pain. These findings differ from the results of Aguiar et al.(32), who found both variables associated with the occurrence of pain. The study of Sein et al.(33) found a correlation between weekly mileage and the occurrence of supraspinatus tendinopathy. Certain aspects can explain these differences. On the one hand, in terms of the level of competition, the two samples are quite different. In the Aguiar et al.(32) study participants were not at World and/or Olympic competitive level as it was our study population. Accordingly, we hypothesized that lower levels in swimming technique can favour the occurrence of injuries as result of biomechanical factors. In other words, the greater the distance performed with low level of swimming technique, the higher will be the risk of injury. On the other hand, remaining the unfavourable biomechanical performance for many years is associated with higher prevalence of injuries(4). In that context, several authors investigated the causes of injury and/or pain among swimmers. Jobe et al.(34) formulated a hypothesis for the aetiology of shoulder pain among swimmers. They postulate that an overload activity performed repeatedly and forcefully causes a gradual stretching of the anterior ligament structures of the glenohumeral joint capsule, resulting in laxity, which in turn leads to pain as result of the impingement. Sein et al.(33) found that supraspinatus tendinopathy is the chief cause of shoulder pain in elite swimmers due to great volume of swimming training. They also state that considering only shoulder laxity, the association with impingement in the shoulder is minimal in elite swimmers. Therefore, we strongly recommend that physicians, physiotherapists, psychologists, physiologists and coaches, with a view to improving health, well-being and quality of life of the athletes, change the point of view that pain is inherent to high-level performance. There are two different kinds of pain: the acceptable (low) pain that can arise as result of increase in training workload (which is planned and in what the respective recovery period is included); and the chronic musculoskeletal pain. Both situations need to receive careful attention to diminish and

eliminate pain as possible favouring health and performance.

Body Mass index (BMI)

Our results showed that BMI lower than 22 was associated with pain. These results differ from other study conducted among adolescent swimmers, which found association of larger BMI with pain in swimmers(35). That divergence lies, again, on the technical differences and the mean of age of our study population was higher. These results are new and to better understand that relationship, additional studies are required.

Strong points and limitations of the study

The strong points are that this investigation was original and we identified no previous study who had examined psychological distress, job stress and sociodemographic factors in relation occurrence of pain in high-performance athletes. Although it is intuitive that pain in high performance athletes should not be associated with psychological or psychosocial factors, it would be necessary to explore it with scientific methods. The knowledge about pain among swimmers indicates that it is a problem that needs additional studies, and our analyses contribute to better understand the phenomenon.

Another strong point was the use of well established epidemiological instruments that are valid, reliable and available in the literature.

One possible limitation could be the sample size. However, World and Olympic athletes are a reduced and a difficult-to-reach population, however, we managed to access all members of the national swimming team at the time.

Conclusion

This was the first study that examined physical aspects together with other factors, exploring the relation with occurrence of pain and mental health in athletes at the highest level of competitive sport. Prevalence of pain in swimming and in complementary activities was high, and according to sex it was higher in women. Those results indicate the need of close attention in training routines: inside and outside the pool. Additionally, the prevalence of psychological distress (symptoms of anxiety

and/or depression) and job stress (effort-reward imbalance) were very high.

The non-association of the variables psychological, psychosocial, biological, socioeconomic and demographic factors with pain brings to light that pain in high-performance swimmers might be due to physical factors such as anatomical and biomechanical. Psychological distress and pain associates with decreased performance and lower quality of life athletes.

This was the first study to gather overtraining-related subjective markers to examine it in relation to pain and psychological distress. Those markers were associated with psychological distress. As psychological symptoms appear early before decline in performance and even before physiological markers of overtraining rise up. Our findings are relevant and pointed out that further attention should be paid to psychological and psychosocial states of the athletes. Monitoring those aspects should complement the technical evaluations in high-performance athletes so interventions can be designed to reduce prevalence of stress and other psychological symptoms with a view to improving not only these athletes' performance, but also their health and well-being.

Further studies need to be conducted aiming to clarify the aetiology of chronic pain and its relationship with psychosocial characteristics, and their association with athletic performance.

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Conflict of interests

There is no conflict of interest in relation to this study.

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