Finding of risk factors for injuries in high performance athletics

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ABSTRACT

The risk factors for installation of sports injuries have been researched to facilitate the understanding about the issue. However, for high performance levels, in the track and field events of athletics, the documents that approach the theme are scarce. Thus, with the possibility to collect information about the described condition, this study aimed the exploration of risk factors for sport injuries in athletics, by inquiring world elite athletes of the modality. The population was composed by 60 men and 60 women allocated in groups according to the specific modality (speed, resistance, throws and jumps). The interviews were made using a morbidity referred inquiry, approaching subjects on anthropometrics and training variables, as well as injuries. The technique of the analysis of parametric variance was used for the anthropometrics variables (age, weight, stature) and of the technique of the no parametric variance analysis in relation to the training variables (years of training and weekly hours). The Goodman's test was used in level of 5% of significance for the association between injury moment and specialties. The results showed an elevated frequency of injuries in the modality for both genders. The injury taxes for interviewed athlete were 0,92 (speed), 1,08 (resistance), 1,22 (jumps) and 1,20 (throws). There was not significant statistical difference for the anthropometrics variables and of training in relation to the proofs, except to the jumpers, that presented differences for stature and time of training; in that case, injured are the taller or those that practice athletics for less time ($P < 0.05$). In conclusion, for studied population, the risk of injury is accentuated, but without relationship between variables and presence of injuries, except for specialists in jumps, that presented stature and time of training as risk factors to the injury.

Keywords: Sports injuries. Athletes. Sport training. Anthropometric variables.

INTRODUCTION

Athletics should be highlighted for its importance in the sports history context and receive attention for the diversity of events in this modality, which are characterized by specificity in gesture and dynamic performance in training which increase in high performances[1-2].

Such condition determines the need for particular approaches concerned with each group of track and field event which presents technical characteristics and similar physiological demands, in order to reach physical performance and health maintenance, as well as the association of these conditions[3].

Nevertheless, despite scientific and technological advances, epidemiological data concerned with this modality reveal high frequency of injuries with multifactor profiles, which concerns the professionals involved, especially due to the time out from the activities which interrupts the process of organic adaptations, influencing performance and that in some cases, leads to permanent incapacity for sports[4-7].

Although the problem situation is clear, data on injuries within the modality are still scarce. Chalmers[8] highlights that the difficulties to their access are evident, resulting in lack of control concerning the reality of installations of health damage to the practitioners and therefore, compromising the quantification, identification of cause factors and especially, suitability of preventive methods processes.

Therefore, to investigate the occurrence of injuries and relate them to athletes' individual characteristics, such as anthropometric variables and its exposition to training, may contribute to the understanding process of possible cause effects for the occurrence of harm, especially in high performance.

Thus, the aim of the present research was to study the association of variables such as weight, age, height, and time of training with the presence of sports injuries, from a survey applied to world elite track and field athletes.

METHODS

Study population

A total of 120 (60 males and 60 females) high performance athletes from many countries, specialists in different events, participants of international championships promoted by the International Amateur Athletic Federation, were used as sample for this research. Thirty-six of the participants were sprint specialists, 36 endurance specialists, 18 jumps specialists and 30 throws specialists.

They were randomly selected. However, there was a balance between sexes and events and they represented approximately 10% of the possible universe for collection. Athletes mean age was 26.28 ± 4.36 years, weight 71.85 ± 19.34 kg and height 1.76 ± 0.11 m. Concerning time of practice, the mean was 11.81 ± 4.75 years of training and 23.07 ± 6.71 weekly hours.

Observational outlining

Data collection was performed during competitions promoted by the International Athletics Federation, as International Meet-

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ings and World Championship, with participation of the Brazilian Athletics Confederation. Since they are important events for the participants, the approach for data collection was conducted at moments distant from the preparation period for the event of each athlete, such as during their presence at the leisure areas, warm-up or competition track stands and cafeteria, as suggested by Pastre *et al.*[7].

Field techniques and procedures

The data used for the work execution were obtained through inquiry on referred morbidity. These data were derived from the elaboration of a specific questionnaire based on practical experiences with the modality. The collection instrument was previously tested.

The instrument was translated into English in order to standardize it to the interviewers. Three health professionals, fluent in English, French, Spanish, Portuguese and Italian in the technical jargons of the study, and with work experience in their respective national teams (Brazil, Spain and Cuba), after discussion and agreement on the issues present in the instrument, collected and registered the data.

Thus, the approach for the invitation to participation as well as the reports of the research were possible in five languages, which comprehended the majority of the approached athletes. Even if the athlete did not understand the languages offered by the study, there was always someone fluent in at least one of them in their teams, and hence, he/she would help in the translation process. According to Almeida Filho and Rouquayrol[9], such help, in the lack of conditions or understanding, is valid for collection in the inquiry model.

Description of the morbidity inquiry

The instrument consisted of questions on personal information concerned with the athletes such as: sex, age, weight, height and time of training in years and weekly hours, besides the event in which he/she is specialized. In order to obtain data concerned with sports injury, only two questions which defined presence or absent were included, besides the moment in which it occurred, namely, training or competition.

It is worth highlighting that the instrument used for data collection was based on the inquiry validated and described by Pastre *et al.*[7] as reliable for the data registration on sports injuries in this modality, especially for the methodological outlining proposed for the present research, which defines the search for injuries within a complete training and competition season.

Sports Injury (SI) was considered any pain or musculo-skeletal effect resulting from training and sportive competitions and which was sufficient to cause changes in the usual training, either in means, duration, intensity or frequency, according to what has been already used in other investigations[10].

Organization and description of the variables categories

The variables categories or subdivisions already described were grouped in more expressive blocks or outcomes, with the purpose to facilitate their analysis and presentation. Nevertheless, the essence of the study's origins or its conclusions has not been changed.

Initially, the variable event was highlighted in order to clarify the characteristics intrinsic to each participant. 'Velocity' is understood as the set of events which comprehend 100, 200 and 400 meters and 100, 110 and 400 meters with hurdles; its practitioners are called speeders. For the 'endurance' events, the ones who competed in the 800, 1500, 5000 and 10000 meters were considered specialists, also called mid-distance runners or distance runners. In the 'jump' events, we had the horizontal, triple and high jumps participants. Finally, the 'throw' events had the participants of weight, discus and javelin throws. Such classification is adopted by the International Athletics Federation, and had been modified and used by Laurino *et al.*[11] in their research with practitioners of the modality.

The injury moment was characterized only by two categories, training and competition. The first one comprehended the practice of activities during the preparation, general specific and pre-competition periods. The second only highlighted the competition moment in regional, national or international events.

The anthropometric and training variables were elected as possible risk factors for the installation of injuries. It was chosen to raise issues on age, weight, height, besides years of training and weekly hours, outlining the profiles of the subjects who suffered injuries or not, in order to identify some of the possible intrinsic or extrinsic causes described in the literature.

Legal aspects of the research

The research topic was sent to the Ethics in Research Committee of the Medicine College of São José do Rio Preto and the beginning of the collections started after its analysis and approval. Written consent was given by all participants to integrate the study population and to allow the use of the given data after having read and understood the free and clarified consent form.

Statistical procedures

The descriptive approach of the findings was performed through distribution of absolute and relative frequencies of reports occurrence, as well as through the calculation of relative rates concerned with the relationship between events and participants, with the purpose to add quantification elements to the literature about the topic.

The parametric variance analysis for analysis of anthropometric variables (age, weight, height) was chosen to be used for the analytical comparative study between athletes with and without injuries, as well as the variance analysis technique concerning training variables (years of training and weekly hours).

Concerning the association between moment of injury and specialties, the Goodman test for analysis within and between multinomial populations was used. In the analysis or association cases, all discussions of the outcomes were performed for significance level of 5%.

RESULTS

Table 1 shows the frequency of distribution of the participants as well as reports and injury rates according to sex. It was observed that the values are very close when genders are compared. Moreover, a high number of injury occurrences and rates for the universe investigated were observed.

In table 2, the athletes' distribution in the presence or absence of aggravation and the injury rates, both according to event, are presented. It is observed that for all events a higher number of

TABLE 1
Athletes' distribution concerning presence or lack of injuries, frequency of injuries reported and injuries rates, according to sex

Variables	Variables categories	Sex	
		Male	Female
Participant athletes	Injured	40 (48.2%)	43 (51.8%)
	Non-injured	20 (54.1%)	17 (45.9%)
	Total	60 (50.0%)	60 (50.0%)
Reported injuries	Total	65 (50.0%)	65 (50.0%)
Injury rates	Participant	1.08	1.08
	Injured athlete	1.62	1.51

Note: The injury rate per practitioner is obtained by the division of the total number of injuries by the total number of interviewed athletes and the injury rate per injured athlete is equal to the total number of injuries divided by the total of injured athletes.

injured athletes occurred, especially in the jump events in relative values. When the investigation is concerned only with the injured athletes, the most observed events are endurance and throws. Altogether, the majority of the interviewees mentioned to have suffered injury during the season.

TABLE 2
Athletes' distribution concerning presence or lack of aggravation and injury rates, according to event

Event	Athlete		Injury rates	
	Injured	Non-injured	Participant	Injured athlete
Velocity	24 (66.67%)	12 (33.33%)	0.92	1.37
Endurance	22 (61.11%)	14 (38.89%)	1.08	1.77
Jumps	15 (83.33%)	3 (16.67%)	1.22	1.46
Throws	22 (73.33%)	8 (26.67%)	1.20	1.63
Total	83 (69.17%)	37 (30,83%)	1.08	1.56

Note:The injury rate per practitioner obtained from the total number of injuries reported divided by the total of athletes in each even and, the injury rate per injured athlete,obtained from the division between the total of reported injures by the total of injured athletes in each event.

Table 3 shows the comparison between the anthropometric profile of the injured or healthy athletes according to each event. In the age and weight variables, there was no statistically significant difference from the analyses within events between injured and healthy athletes. However, for the height variable, it was observed that only within the jumpers, taller subjects, are more injury-prone ($P < 0.05$).

TABLE 3
Distribution of the mean and standard deviation values of the anthropometric variables of the participants, according to presence or lack of injury and kind of event

Variable	Injury	Event			
		Velocity	Endurance	Jumps	Throws
Age	Absent	25.6 ± 4.5	27.8 ± 5.2	25.7 ± 2.5	25.0 ± 3.2
	Present	25.8 ± 3.2	28.7 ± 5.2	24.1 ± 4.1	26.0 ± 3.9
Weight	Absent	68.8 ± 9.0	58.1 ± 9.3	66.7 ± 10.0	101.7 ± 10.3
	Present	65.5 ± 11.8	57.1 ± 7.6	73.5 ± 13.9	92.4 ± 20.2
Height*	Absent	1.76 ± 0.08	1.71 ± 0.11	1.71 ± 0.10a	1.81 ± 0.06
	Present	1.72 ± 0.11	1.71 ± 0.08	1.83 ± 0.11b	1.81 ± 0.10

* variable with statistical difference observed for the jumps group ($P < 0.05$), being a < b.

Concerning training variables (years of training and weekly hours) and their association with injury installation, from the findings, it is observed in table 4 that within the jump events, subjects who are not injured, have been training for a longer time in relation to the ones who are injured ($P < 0.05$). For the other specialties and variable (weekly hours), the distributions were casual, that is, with no significant difference.

TABLE 4
Distribution of the median values of the training variables of the participants, according to presence or absence of injury and type of event

Variable	Injury	Event			
		Velocity	Endurance	Jumps	Throws
Years of training	Absent	8	12	19b	9
	Present	10	14	11a	12
Weekly hours	Absent	16	26	20	21
	Present	20	24	24	28

* variable with statistical difference observed for the jumps group ($P < 0.05$), being a < b.

In table 5 the frequency distribution of moment of injury according to event is presented. One can observe that there was not difference among events concerning each moment. Nevertheless, for all specialties the occurrence of the majority of injuries in the training sessions is remarkable when compared with the competitions.

TABLE 5
Percentage distribution of the injury moment reports according to the event

Event	Moment		
	Training	Competition	Total
Velocity	81.81 aB	18.19 aA	33
Endurance	94.87 aB	5.13 aA	39
Jumps	77.27 aB	22.73 aA	22
Throws or shot puts	86.11 aB	13.09 aA	36

Note: Goodman Test for contrast between and within the multinomial populations. Statistically significant difference within each event ($P < 0.05$) between moments, being A < B. There was not significant difference between events for each moment, being a = a.

DISCUSSION

The high frequency of injury observed in the present research occurring in 9.17% of the interviewed athletes as well as the high injury rates per athlete, reflect the important risk of aggravation installation originated by athletics practice, specifically in high performance. These outcomes are close to the ones presented by D'Souza[3], (61.2%), Bennell and Crossley[10], (76%) and Laurino *et al.*[11] (76.7%) in epidemiological studies.

Watson and DiMartino[12] observed lower number of frequency of aggravation in relation to what is described by the majority of investigations on sports injuries. However, the observation period of the investigated population was considerably shorter (77 days) than the ones used in the remaining mentioned investigations, which varied from eight to twelve months.

Concerning the aggravation distribution according to sex, the findings of this investigation are similar to the ones observed by Mckay *et al.*[13], Baumhauer *et al.*[14], Beachy *et al.*[15] and Dane *et al.*[16], who did not observe differences in the injury distribution between genders. On the other hand, research has shown greater incidence for installation of SI in men, as in the case by Messina *et al.*[17] and Stevenson *et al.*[18]. Additionally, other investigations have concluded that women presented greater predisposition to aggravation, according to what has been observed by Gwinn *et al.*[19] and Bell *et al.*[20]. To sum it up, the hypothesis raised by the authors in order to explain differences referred to anatomical and hormonal differences between sexes, and not to chemical or biochemical causes. Due to scant studies with detailed analyses on such aspects, they have also suggested deeper investigations on the topic.

Concerning age and SI occurrences, Soderman *et al.*[21] and Wiesler *et al.*[22] found outcomes related with the ones verified in this research, that is, in their studies they did not observe association between this factor and the presence of aggravation. Nonetheless, for Murphy *et al.*[23], in a review on risk factors for lower extremities, older athletes would be more prone, once they are submitted to stress, training volume or intensity for a period of time longer than younger ones.

Concerning anthropometric variables, in the majority of observations between and within modalities, no association between presence and absence of injuries and a population profile was observed, according to what Wiesler *et al.*[22], Baumhauer *et al.*[14] e Bennell *et al.*[24] also described in investigations involving injuries and athletes.

However, for jumpers the group of injured athletes presented height profile stipulated by the mean, significantly higher when compared with healthy ones, a fact which Netto Jr.[25] also observed

in his study which explored muscular injuries in Olympic athletics athletes. For the studied modality, data which indicated the opposite of what has been studied were not found; however, Orchard *et al.*[26] when analyzing injuries in American football players, observed the opposite, that is, greater predisposition for injuries in shorter individuals.

The exact reasons for the occurrence of these facts are not defined in the revised literature; however, a raised hypothesis to explain them could be concerned with biomechanical aspects. In this context, Zatsiorsky[27] and Whiting and Zernicke[28] highlight that in jumps, the magnitude of strength applied to the body tissues may be considerable, especially when the movements are excessively performed or with coordination deficiency. Therefore, these movements present a resulting vector directed to muscle insertions or joints, favoring the installation of injuries. Moreover, different lever arms determined by biotypes, may represent different possibilities of loads distribution.

Another aspect considered a cause for injury, extrinsically though, concerns with the exposition of the athlete to sports practice or amount of work performed. Significant relationship between injury and training exposition profile was not observed for this study, except for jumpers. These outcomes corroborate the findings by D'Souza[2] who did not find difference between injured and not-injured groups. Nevertheless, Marti *et al.*[29] and Lysholm and Wiklander[30] observed straight relationship between training exposition and injury installation in their investigations, that is, the longer the time of sports practice or amount of work performed, the higher the risk for SI installation.

When discussing only the exception, specialists in jumping events showed greater trend to injury than the ones who practice athletics for a shorter time. As a hypothesis to explain this fact, one may suggest the experience factor, especially by the technical implication intrinsic to the modality, according to Whiting and Zernicke description[28]. However, despite the possible comparisons and hypotheses, one should consider as a limitation to the study, the small number of non-injured subjects for findings extrapolation, especially in the presentation of descriptive measurements of this variable in order to suggest them as an injury-prone factor.

In addition to what has been described, data on the moment of injury occurrence were explored, with emphasis on training as being the period more suitable for aggravation installation. A similar condition was observed by D'Souza[2] and Pastre *et al.*[7] in their investigations. A simplifying explanation for this fact could be concerned with the time of exposition to the activities, in which the training is more obviously seen concerning volume. During training, the main aim is to improve the levels of functional possibilities of the body and of necessary physical characteristics for the sport, as well as, to develop specific motor acts, according to the ideas by Barbanti *et al.*[31], Rhea *et al.*[32]. In this context, it enables greater exposition of the athlete to the conditions which cause injury.

Despite the findings, since it was not possible to state a correction factor over the time of exposition to the sports practices (training or competition) for the characteristic of the registered data, it may be early to affirm that training is the main moment for installation. It can even represent another limitation to the study, especially due to physical and mental stress levels, besides the obvious need for better performance which is more evident during competition sessions.

As main limitations for the study, besides height and time of training variables for jumpers, and moment of injury for all events groups, the reduced possibilities for results comparisons with others available in the literature are remarkable. Such comment proceeds not only for the small number of investigations found concerning this population, but also for the topic adopted in this paper. The lack of standardization in the data registration concerning injuries was another limiting factor. These conditions make a deeper discussion on the topic impossible and suggest an adoption of similar methodologies for data collection with the purpose to facilitate future comparisons.

Finally, it is worth remarking that the findings of the present study add up to the scarce literature concerning injuries in high performance athletics, especially in the worldwide context which it has been approached. Moreover, by the experience, the research shows the instrument and the collection methods as facilitators of quantification processes of injuries and exploration of risk factors for its installation in similar populations, favoring longitudinal follow-ups and even efficiency tests for prevention programs.

CONCLUSIONS

It was possible to conclude based on the findings that the risk for injuries installation in high performance practitioners of track and field events has no association among anthropometric variables or training time and occurrence of aggravation, except for height and sports practice time for the jump specialists.

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