ORIGINAL ARTICLE

Injury, Training Intensity, and Physical & Mental Exhaustion: Indicators of Overtraining Syndrome Among College Athletes – A Cross-Sectional Study.

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ABSTRACT

Background: Over training syndrome causes a variety of physical and mental symptoms that can have an effect on their performance as well as the overall health and well-being of the athletes. Understanding the risk factors of over-training syndrome and its impact on injuries might aid in identifying possible risk factors and developing effective preventative and management techniques. **Methodology:** A cross-sectional study was done to find the association between the risk factors of OTS by estimating the prevalence of injury, assess the perception of training intensities and determine both physical and mental fatigue levels among college athletes which are considered to be potential markers of OTS. **Results:** Our study shows a statistically significant association of injury, physical and mental exhaustion with those training more than 5days/week not only during the competitive season but also during non-competitive season which might lead to over training syndrome in these athletes if not addressed with a highly significant association. This implies the dire necessity for training load monitoring. **Conclusion:** It is necessary to recognize the signs of over training syndrome and rectify it early in order to reduce the negative impact and to promote optimal performance and well-being. Coaches and trainers should be aware of the indicators of overtraining syndrome and take appropriate precautions to avoid and manage the negative consequences of overtraining syndrome not only during the competitive period but otherwise too.

Malaysian Journal of Medicine and Health Sciences (2024) 20(SUPP13): 56-60.doi:10.47836/mjmhs.20.s13.12

Keywords: OTS, Sports training, Fatigue

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INTRODUCTION

Over training is the intensity, frequency and length of training, which surpasses the body's ability to recover(1). The Over Training Syndrome (OTS) a long-term fatigue condition, is defined as lowered physical performance for >2 months with severe symptomatology and maladapted physiology of psychologic, neurologic, endocrinologic and immunologic systems which takes several weeks, months or even years to recover. This might also be associated with non-training stressors, an additional stressor leading to unexplained decline in performance(2,3). OTS possess a significant risk on the health and performance of those athletes engaging in high-intensity training. It serves to be a source of variety of physical and mental symptoms that can have an impact on their performance. In addition to this there is also consequences observed with their overall health and well-being due to discrepancy in balance between training load and recovery(4). In these modern years, with a vision to achieve peak level performance, an immense pressure is built over the athletes to exhibit an intensified chase of athletic excellence in university sports. Study shows that psychological pressure among athletes is created unintentionally during matches and practices as well as intentionally by the coaches and athletes themselves. The athletes are pushed to the brim of overexertion due persistent demand of race and training thus inclining them to the risk of OTS. Comprehension on the fundamental mechanisms of overtraining and its sway on injuries might facilitate in identifying possible risk factors and developing valuable preventative and management techniques(5,6). Identifying the risk factors coupled with OTS helps in mitigating its detrimental effects on the athletes. The training intensity and training risk has a complex relationship, researches states that training maladaptation and overreaching are considered to be few elements pushing athletes towards injury. It is also observed that, as a cumulative result of strain

imposed on the over trained athletes' bodies, the risk of musculoskeletal injuries, stress fractures and other overuse related injuries is higher(1,7). Since the extreme volume of training and the recovery period being inadequate there occurs development of OTS, thus it is necessary to recognize the signs of over training and treat it promptly in order to reduce the negative impact and to promote optimal performance and wellbeing(8). There is a high risk of injury in over training syndrome which can twin with or occur as a secondary effect of over training syndrome. The stylemark symptoms of over training syndrome being physical and mental exhaustion leading to drop in performance. Following this there set in series of symptoms like lethargy, fatigue, irritability, decreased concentration and low motivation associated with, which not only impairs athletic performance but also have an effect on mental and emotional well-being(3,9,10).

It was stated that there are no definitely biomarkers to distinguish athletes with OTS as it is the unique interaction of the host genome with multiple risk factors and chronic stressors. Studies also suggest that the athlete's genome and training/workload history and persisting physiological demands influences the training-intensity volume threshold at which the OTS begins. The initial evidences presents with mood changes and decline in performance(11).

This study was done to assess the implications of OTS by estimating the prevalence of injury, assess the perception of training intensities by evaluating the average training days and hours, average number of competitions participating, history on training intensity and injury and determine both physical and mental fatigue levels by eliciting history of self-reported disinterest, physical and mental exhaustion among college athletes which are considered to be potential markers of OTS in this study.

MATERIALS AND METHODS

A cross sectional study was done among the college athletes in a private Physical Education College in the district of Kancheepuram. The study was done for a period of 3 months. Taking into consideration the prevalence rate of injury to be 91%(12) in a study done by Jean Lemonye et al., and using the formula 4pq/l2, the sample size was calculated to be 133, considering 10% non-response rate a total of 144 athletes were included in the study. A simple random technique was used to select the sample and all the athletes above 18 years of age and who were actively participating in sports activities for the past 12 months were included. Those who were not accessible even after 3 consecutive visits and those did not consent for the study were excluded from the study. The data was collected using a pre-tested, pre validated questionnaire comprising questions on basic demographic features, nature of sports involved, average training days and hours, average number of competitions participating, history on training intensity and injury, history of self-reported disinterest, physical and mental exhaustion. The questionnaire was administered by interview method and the data collected was entered in MS Excel. IBM Corp. SPSS software version 23 was used to analyze the data. Frequency and percentage were used to represent descriptive data.

The study was conducted after obtaining the approval from the institutional ethical committee. The purpose of the study was well explained and an informed consent was obtained from all the participants. The confidentiality of the data collected was explained and well maintained.

Ethical clearance

This study was approved by Research Ethics Committee, Saveetha Medical College and Hospitals, Saveetha Institute of Medical and Technical Sciences No. 177/04/2023/PG/SRB/SMCH

RESULTS

A total of 144 participants were included in the study of which 33(22.9%) female and 111(77.1%) male. In our study the mean age of the study participants was found to be 20.86±1.98 with a mean of 19.86±1.96 years among the male and 19.26±1.63 years among the female participants. The mean height and weight were 153±11.86cms and 52±4.7kgs in female and 162±15.86cms and 58±6.2kgs in males respectively. Mean training days per week was 5.05±1.75 days and 3.5±1.87hrs per day during competition season and 4.18±2.11 days per week and 2.77±1.7hrs per day during non-competitive seasons. It was observed that 77(53.47%) of the population underwent training for 1-5 days/week during competitive season and 67(46.53%) were found to be training more than 5 days a week during the same period. The prevalence of training over 5 days a week was comparatively reduced contributing to 53(36.81%) during the non-competition period. A mean of 2.55±1.65 days, 3.14±1.67 days and 3±1.77 days per week were spent for light, moderate and vigorous intensity exercise. The participants stated a mean 2.95±2.5 hours per week of leisure time physical activity. The mean competition per week was found to be 2.82±2.3 and the prevalence of chronic and acute injury reported among the participants in the last 12 months were found to be 76(52.78%) and 85(59.03%) respectively.

Among the participants mental exhaustion was reported among 93(64.58%) during competitive season and 92(63.89%) during non-competitive seasons while physical exhaustion was found to be 126(87.50%) and 93(64.58%) in the competitive and non-competitive seasons respectively. It was also observed that 79(54.86%) and 85(59.03%) of the participants felt

disinterested and apathetic during the competitive and non-competitive seasons.

(Table I) Though the training duration per day were higher in female and no of day training per week were slightly higher in male during the competitive season. Light intensity exercises were more common in female compared to male who had more of moderate and high intensity training days per week.

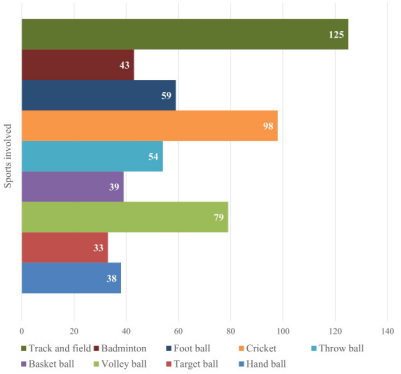

Fig 1: shows the common sports activity involved with by the players. Few were involved in more than one sports thus making track field the most common sports preferred, followed by cricket, volley ball, football and throw ball.

Table I: Mean(SD) of perception of training intensities

Variables	Male	Female
Competition season, Training days per week	5.68(0.43)	5.25(0.52)
Non competition season, Training days per week	4.68(0.86)	4.21(1.09)
Competitive season, Training hours per day	2.83(0.56)	2.93(1.23)
Non competitive season, Training hours per day	2.24(1.12)	2.53(1.56)
Leisure physical activity days per week	4.37(2.13)	3.78(1.56)
Light intensity days per week	1.42(1.19)	1.68(0.99)
Moderate intensity days per week	2.25(1.42)	2.19(1.02)
Heavy intensity days per week	2.42(1.63)	2.10(0.98)

(Table II) The prevalence of both acute and chronic injury was found to be higher in those who trained more than 5 days a week even during the non-competitive season and was found to be statistically significant. The physical exhaustion was also found to be significantly higher in those training more than 5 days a week during the competitive season while a significantly higher mental exhaustion along with distraction and apathy was observed in those training more than 5 days a week both during the competitive as well as non-competitive seasons. Though the effect of high training load (more than 5days/week) was significantly observed on the major markers of OTS, a highly significant association was found between those who trained more than 5 days a week even during the non-competitive season.

Table II: Association between over training and injury along with preliminary markers of OTS

OTS Markers		Competitive season			Noncompetitive season		
		Normal training	Over training	P value	Normal training	Over training	P value
Chronic injury	Yes	38	38	0.3777	38	38	0.0005*
	No	39	29		53	15	
Acute injury	Yes	43	42	0.2025	49	36	0.0488*
	No	34	25		42	17	
Physical exhaustion competitive season	Yes	62	64	0.0033*	77	49	0.0852
	No	15	3		14	4	
Mental exhaustion competitive season	Yes	41	52	0.0011*	46	47	<0.0001*
	No	36	15		45	6	
Distracted competitive season	Yes	36	43	0.0180*	33	46	<0.0001*
	No	41	24		58	7	
Physical exhaustion non-competitive season	Yes	47	46	0.1702	44	49	<0.0001*
	No	30	21		47	4	
Mental exhaustion non-competitive season	Yes	44	48	0.0354*	49	43	0.0005*
	No	33	19		42	10	
Distracted non-competitive season	Yes	29	56	<0.0001*	43	42	<0.0001*
	No	48	11		50	9	

p value <0.05 is significant and p value <0.001 is highly significant

Table II shows, those who over train only during competitive season has statistically significant physical and mental exhaustion along with distraction during competitive season and significant mental exhaustion and highly significant distraction even during the noncompetitive season. While considering those who over train even during the non-competitive season has a statistically significant occurrence of acute and chronic injury along with mental exhaustion and distraction during the competitive season and also tend to be distracted with physical and mental exhaustion during the noncompetitive season, which proves to be deleterious to their physical and mental health.

DISCUSSION

Though the term over training syndrome has been into use for quiet sometime, the diagnosis of OTS is challenging. A loose checklist comprising of drop in performance or ability, mood changes or mental health symptoms and physical health or injuries affecting performance can be used to predict over training syndrome(13). A valuable insight on potential indicators of overtraining syndrome was obtained by evaluating the college athletes, in addition to this, the relationship with occurrence of injury and training intensity was also obtained from our study. In our study a significant association between indicators of over training syndrome (physical exhaustion, mental exhaustion, distraction and apathy) and injury occurrence was noticed among

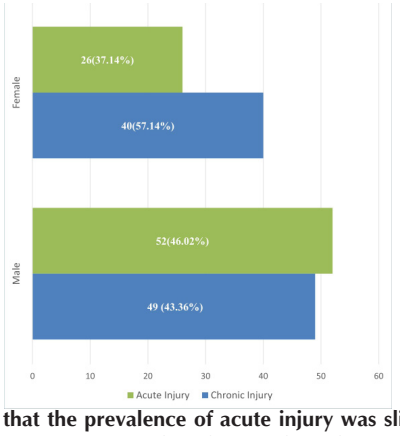

Fig 2: shows that the prevalence of acute injury was slightly higher in male participants compared to the female and vice versa for the chronic injury

the athletes. A similar observation was made in a study done by Lehmann et al., which heightens the risk of musculoskeletal injury, stress fracture and over-use injuries in the over trained athletes(14). Thus, in order to bring this under control and to avoid risk, monitoring of training loads and implementation of adequate recovery stratagem can be followed. A multifaceted complex phenomenon exists between training intensity and over training syndrome. Though the performance and athletic development requires high intensity training, inadequate recovery period with excessive volume of training leads to OTS(15,16).

In our study physical and mental exhaustion along with incidence of injury was most observed in training more than 5 days a week, especially in those who do similar training even during non-competition season. Halson et al., in his study had explained clearly that the presence of physical and mental exhaustion is a major warning sign stating the athlete is going in for OTS. Mental fatigue leads to lack of performance among athletes along with decision making. He also states that a close observation in terms of over training is to be practiced for those athletes' experiencing lethargy, persistent fatigue, irritability and mood disturbances(17–19). The psychological stressors are one among the many reasons for mental exhaustion; social expectation, pressure due to academics and performance anxiety are few commonly observed stressors. There stressors are said to exacerbate the risk of development of OTS(20). It is also evident from other studies that mental fatigue commonly characterized by tiredness and lack of energy, limits exercise tolerance by limiting short term endurance performance by affecting the sensory inputs generating perception of effort during exercise(21). Thus, it is essential to take utmost care to prevent the development of OTS in our participants. Implementation of adequate recovery period and restorative modalities along with sufficient sleep, nutrition and hydration which ae considered to be recovery strategies can have a significant effect in preventing the risk of over training syndrome among the athletes(22). Systematic monitoring and surveillance of athletes training is an ultimatum and can be achieved by interdisciplinary collaboration among sports scientist, trainer coach and medical team to monitor, identify and address the physical and mental stressors along with other risk factors associated with OTS is essential(16). Possible burnout should be considered in case of complaints on muscle or joint problems, fatigue, or poor academic activities. Following the scientific principles of training specially the appropriate periodization, with appropriate and adequate recovery in an individualized, non-monotonous training program, is absolute essential Increasing the awareness of the athletes through educational intervention on the risk factors and preventive strategies contributes in promoting the culture of health and wellbeing among the college athletes(23).

Limitation

The study has few limitations, the primary one being the generalization of training intensity and volume across all sports activities. The data on training intensity and exhaustion were self-reported, and since the nature of each is unique it was difficult to use a standardized scale to asses training intensity which is a confounding bias. Identifying sport-specific training components would provide more accurate guidance for planning effective training programs while minimizing potential adverse effects. The cross-sectional nature of the study does not allow for establishing causality between overtraining and its effects.

CONCLUSION

This study was preliminarily done to Our study contributes to understating the complexity of relationship between training intensity, injury and exhaustion which are considered as potential indicators of OTS. Recognizing injury patterns associated with OTS allows for targeted prevention strategies. Elucidation of these factors and actionable recommendations on preventive strategies and evidence-based intervention in promoting the health and performance of college athletes. Since OTS has a colossal negative effect on the health and performance of the athletes, an early detection and adequate intervention is vital to mitigate its adverse effects and prevent the progression. There should be efforts put into reduction of both physical and mental stressors for a holistic well-being. It emphasizes the necessity for training load monitoring and early recognition of OTS signs to promote optimal performance and well-being. With effective interdisciplinary collaboration and integration of comprehensive protocol for recovery into the training regimen of athletes will minimize the likelihood of over training and will optimize the performance. The impact of diet, sleep, stress, social support and coping mechanism on OTS development can be assessed. The relationship between biomechanics, training load, and injury rates can be explored along with development and testing of various interventional strategies to prevent and manage OTS. Longitudinal studies to observe the

progression and long-term effects of OTS are few areas where more research could be done to have a better understanding on OTS.

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