An Evaluation of Knee Overuse Injuries and Sleep Disturbance Among Men and Women Fencers

Tianyuan Ma

Shanghai University of Sport

He Zhang (✉ Hzha4325@uni.sydney.edu.au)

University of Sydney

Jamie Ghigiarelli

Hofstra University

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An evaluation of knee overuse injuries and sleep disturbance among men and women fencers

Author: Tianyuan Ma¹
Shanghai University of Sport
mty1993@163.com

He Zhang²
University of Sydney
Hzha4325@uni.sydney.edu.au

Corresponding author: He Zhang
University of Sydney
Hzha4325@uni.sydney.edu.au

Jamie Ghigiarelli
Hofstra University
Jamie.Ghigiarelli@Hofstra.edu

Mainly Correspondence to Hzha4325@uni.sydney.edu.au

Abstract

Background:

Fencing is an Olympic sport, it has many associations and competitions around the world. Modern fencing originated in ancient European fencing duels, which was popular among the nobility and became a way of resolving conflicts. Not only did fencing rise in Europe, but also it was popular in ancient Egypt, China, Arabia and other countries. China first combined the theory of fencing with the theory of politics. According to ancient Chinese records, in the 4th century BC, the Chinese philosopher Zhou Zhuang taught the King of Zhao the philosophy of fencing. Zhou Zhuang declared that if the King used the blade, he should observe the political environment of the whole county, following the wills of the people and the laws of nature. Then, he could make the whole county obey him.

France is the cradle of modern fencing. The fencing mask was invented in 1776, and the weight of the blade was lightened to match in the 19th century. At the first Olympic Games in Athens in 1896. In this time, male's fencing became an official sport, and female's fencing entered the Olympic Games in Paris in 1924 later.

At present, researches on fencing mainly focus on the training, strategic, tactics and physiological mechanism. In other words, they concern the performance of fencers in training, but ignore their recovery and life. They are in an asymmetrical position for a long time in training, which is easier to accumulate fatigue in the dominant side, especially the knee joint. Pain from the overuse injury or other factors are known to affect sleep quality, but very little researches have been done for fencers. When people do not acquire good sleep, they usually feel tired easily, and have hard time to concentrate on the study and work. Athletes need to undergo greater body load than common people. The sleep disturbance due to pain may slow the body recovery speed, and further aggravate the pain and accumulate the overuse injury. Therefore, it is necessary to assess the association between the sleep disturbance and the overuse injury. The knee joint bears the main body load in fencing, hence this research select knee joint for evaluation.

Hypothesis:

The purpose of this study was to evaluate the correlation between knee overuse injury and sleep disturbance in fencers. If there is a correlation between them, it will suggest that coaches and team doctors need to protect players outside of training. Such as improving sports nutrition intake, refining rehabilitation methods, and increasing psychological counseling. These methods may help fencers sleep better. Good sleeping quality may protect athletes from overuse injury. The study also examined the relationship between sleep quality and individual factors in fencers, especially female's menstrual pain factor. Because the study hopes to discuss the effects of various factors on knee pain and sleep quality.

Methods:

This research uses the questionnaire survey method, and provides a six-week

questionnaire survey for fencers. Participants were asked to fill out questionnaires once a week.

20 professional fencers took part in the survey. They filled out the knee portion of the OSTRC overuse injury questionnaire and the sleep disturbance questionnaire. Male fencers were asked to answer 8 questions, while female fencers need to answer 9 questions, additional questions about menstrual pain. Depending on the choice, the score for each question ranges from 0 to 25. 0 means there is no discomfort, and 25 means something is really bad, such as cannot training or sleeping.

Result:

Overall, knee pain had no significant effect on sleep in Male fencers, but it affects Female fencers. Female fencer's sleep is more fragile than Male. Menstrual pain, age and sports career(how long they training) make sleep turn worse. By contrast, male fencer's sleep quality is not easily disturbed.

Conclusion:

Knee overuse injuries and sleep disturbance are correlated in male fencers. Fencers think knee joint pain affects sports performance. Effective management of overuse injuries and sleep disturbance in fencers is essential. Female athletes need to be concerned about menstrual pain.

Keywords: Knee; Overuse injury; Fencing; Sleep disturbance

Introduction

Fencing actually an important sport worldwide, which is a part of international competition. Fencing was introduced to China from the Soviet Union in 1955, and became the official competition in the 1965 National Games. Although the Chinese fencing team has a good place in the Olympic Games; however, fencing is not a popular sport in China. The reason may be that fencing has some dangers. For instance, children feel pain when they are hit, and parents want their children to take part in much safer sports.

The most serious risk is from a penetrating wound; nevertheless, this type of injury is rare in matches with complete protective equipment. In a professional fencing team, compared to acute injuries in fencing, injuries caused by overuse of muscles and joints are more worthy to study. Acute injuries may be accidental, but overuse injuries are more difficult to find, which is caused by some bad factors, such as unreasonable posture, lack of sports nutrition, delayed treatment or cannot distinguish early symptoms. Overuse injuries are common in many sports settings. Fencing has not been studied frequently but players can get overuse injuries. The unique characteristics of fencing make specific study necessary.

Between 2002 and 2007, Harmer (2008) collected 184 cases of time-loss injuries in fencing competitions. The knee is the most vulnerable part, and the second and third are the thigh and the ankle. Overall, 60% of injuries come from the lower limb (Harmer, 2008). An epidemiological study of injuries among elite fencing athletes from South Korea also showed that lower limb injuries were the main injury site in fencing, with 47.2% of all injuries (Ki Jun Park & Song Brian Byung, 2017). Lower limb injury is a major problem that confounds fencers, which might be due to the special style of fencing.

The movement patterns of fencing sport are unique, and the fencing arena is narrow that it could only be moved backward and forwards. The posture of athletes is asymmetrical during the whole fencing movement. Owing to its unique asymmetry in movement, fencing imposes high physiological demands in terms of neuromuscular coordination, strength and power, and the impact on the musculoskeletal system (Murgu, & Buschbacher, 2006). Iruetia et al. (2008) showed that fencers had significantly higher handgrip strength and greater isokinetic leg strength on the dominant side than on the non-dominant side. Correspondingly, fencers need to forward their weapons to their opponents quickly to get score. This action requires the lower limbs to provide explosive power, quick and asymmetrical actions, leading different parts of the body to always suffer the repeated impact. The risk of overuse injury may be increased, especially in the knee joint; therefore, biomechanical analysis of the different actions of fencing can help prevent overuse injury (Tony Lin, Duo Wai, Yan, Sicong, Fei, & Ming, 2017).

These quick offense and defense movements further expose fencers to impacts, explosive forces, power absorption, and shear forces of varying magnitude, asymmetrically distributed across the body (Sinclair, Bottoms, Taylor, & Greenhalgh, 2010). Harmer (2008) did a survey in 5 years by United States Fencing Association

(USFA), the injury rates were 19.6%, 15.2%, and 13.0% respectively for the knee, thigh, and ankle. These quick movements also cause other problems, such as iliopsoas muscle and pelvis torsion led lumbar spine problems. Injury in the lower limb joint may distort the athlete's movements. Wrong movements may cause problems elsewhere in the body.

Zhao et al (2017) found that when the front leg landing, the ground reaction force, knee joint reaction force, and knee joint torque almost reach the maximum at the same time. The instantaneous value of ground reaction can reach 5.3 ± 1.3 times of body weight. For the knee joint, because the knee bear the direction of the shear force is different, the knee bears the average equivalent to 2.1 ± 0.9 times of the weight, which is easy to cause injury of the knee joint (Zhao, & Fei, 2017). In Zhao et al (2017) research, they measured a 60cm distance lunge; however, the lunge distance and speed are bigger and faster in training and competition. Another main reason which causes knee injury is that before the front leg landing, fencers make conscious active contraction of rear thigh muscles and active flexion and landing of the shin. It helps more stable landing with a shorter time, as well as the quick transition of soar to lunge movement, which is more favorable to their own (Zhao, & Fei, 2017). On the contrary, at the moment of landing, the direction of a huge reaction is in the anterior knee, indicating that the external torque direction generated by the ground reaction force is in the opposite direction with the knee moment (Roi, & Bianchedi, 2008). Due to the heavy load of the knee joint in fencing, it is necessary to effectively evaluate the accumulation of knee joint overuse injury. At the same time, whether the overuse injury influencing the fencer's daily life is also an issue that needs to be paid attention to.

The overuse injury is a slow accumulation process from the beginning to the appearance of symptoms. It is impossible for sports teams to detect fencers on various chemical indicators frequently. Chemical indicators are not able to replace the subjective feelings of athletes, and reasonable questionnaire design help athletes express their feelings more accurately. It also provides the reference for coaches and team doctors in training and rehabilitation. In 2013, The Oslo Sports Trauma Research Centre (OSTRC) published the overuse Injury questionnaire. The study selected three areas that were frequently injured due to overuse, the knee, lower back, and shoulder (Benjamin, Grethe, & Roald, 2013). There are four questions for each part, and the maximum score for each question is 25. The number 25 means cannot move, and 0 means no problem. After the scores, the athletes will be given a chart to check for motor impairments caused by overuse. Through a survey of 1,074 Norwegian athletes, 82 athletes recorded a total of 103 time-loss injuries, 42 acute injuries, and 61 overuse injuries. Excessive use causes more injuries than acute injuries. The new method's recognition rate for overuse is ten times of the old one. The OSTRC questionnaire provides a more accurate method for the recording of overuse injuries (Benjamin et al., 2013). Prevention is the main strategy in dealing with overuse injuries. The International Olympic Committee (IOC) and its Medical

Commission made preventing injuries in sports a top priority (Engebretsen et al., 2014). Ben Clarsen (2016) claims that the current response to overuse injuries is inadequate, which means no single method can estimate all overuse injuries; therefore, the combination of objective records and athletes' self-reports should be considered.

With the prevention of overuse injury requiring consideration beyond training and rehabilitation, life factors also need to be taken into account. Sleep is one of the body's most important recovery processes, and the time is about eight hours. It takes up one-third of a day. Therefore, sleep is an important factor in sports performance, improving athletes' sleep and having a huge impact on performance (Bird, 2013). Halson (2008) shows that sleep may be the most effective way to recover after training, but it is easy to be ignored by athletes. Cognitive and motor performance, reaction and emotional stability are reduced in athletes with insufficient sleep (Walter, 2002). In terms of physical health, athlete's immunity and metabolism are also affected by poor sleep quality (Samuels, 2008). Therefore, detecting and managing the athlete's sleep quality can not only help effectively improve athletic performance, but more importantly, preventing overuse injury.

This study used the knee joint part of the OSTRC questionnaire to investigate fencers. Moreover, the researcher imitated the scoring mode of OSTRC to increase the problems with sleep quality. In the preparation for the study, we found a phenomenon that, one of the female participants had menstrual cycle disrupted and pain after an ankle injury. However, her periods were improved and pain were reduced when her ankle got Traditional Chinese Medicine (TCM) treatment. This raises the question of whether knee problems, if it is able to affect a female fencer's menstrual cycle? Therefore, we added extra questions about menstruation.

Method

Ethics Committee Permission

Tianyuan Ma had applied for and got the permission of the research, *an evaluation of knee overuse injuries and sleep disturbance among men and women fencers*, in the cycling fencing management center committee of Shanxi Provincial Sports Bureau.

The ethical content involved in the project has been reviewed and approved by the cycling fencing management center committee in strict accordance with relevant Chinese laws, regulations and international practices.

At the same time, the research has obtained the informed consent of all subjects, or informed consent from parents (if subjects are under 18) and / or legal guardians was obtained, which include,

The age, height, and weight data of 20 participants

The condition of male and female fencers' knee, menstrual pain, and sleep.

Study population

The study involved 20 participants (11 male and 9 female) from the Fencing center of Shanxi Province, China. The whole fencing took part in the study; therefore, participants have wide range of age (male:14-20; female 13-23), height (male:178-192cm; female:160-190cm), weight (male:60-90kg; female:38-75kg) (Table 1). Career means the time they spent training in fencing.

Personal					
Information					
I D	Gender	Age	Height(cm)	Weight(kg)	Career(year)
1	Male	18	180	75	4
2	Male	14	192	60	1
3	Male	18	191	68	6
4	Male	15	180	60	3
5	Male	17	180	62	4
6	Male	17	178	68	5
7	Male	20	187	80	7
8	Male	17	188	90	7
9	Male	18	183	73	7
10	Male	19	183	75	6
11	Male	19	183	64	4
12	Female	18	177	66.5	4
13	Female	17	190	75	4
14	Female	17	173	62.5	4
15	Female	13	160	38	0.5
16	Female	16	173	62.5	3
17	Female	16	173	70	4
18	Female	18	183	70	5
19	Female	18	180	70	5
20	Female	23	183	75	11

Table 1. The age, height , and weight data of 20 participants

Informed consent

The fencing center is managed by the Shanxi Provincial Sports Bureau, and the study was first approved by the Sports bureau. The researcher explained to the participants the purpose of the study, the process, and the possible impact on them. Participants were paid weekly energy drinks for their participation. All participants agree to participate in the survey.

Privacy protection

The study promises to protect the personal information and questionnaire results

of all participants. The results were not available to anyone but the participants and the researchers.

Timing of surveys

The study was conducted from May 2 to June 30, 2019.

Procedures

When participants received the questionnaire, they filled in the first time, and we recorded the data as week 0 (initial data). For the next six weeks, participants filled out questionnaires at the end of each training week.

Questionnaire scoring criteria

Part 1 of the questionnaire comes from the OSTRC questionnaire. Part 2 and 3 are the questions designed for this study, and they use the same scoring criteria as the OSTRC questionnaire. The score for each question ranged from 0 to 25, with 0 indicating no problem and 25 indicating the most serious problem. When the answer had four choices, the score was 0-8-17-25; When there were five options, the score was 0-6-13-19-25.

Questionnaire

In this study, OSTRC knee problems were selected in the overuse injury questionnaire. In order to match the OSTRC questionnaire, we designed four questions about sleep quality and adopted the same scoring criteria as the OSTRC questionnaire. The design of the questions was similar to the OSTRC questionnaire. The sleep questions focused on the athlete's subjective feelings about their sleep quality. For female athletes, we added an additional question about menstrual pain. There are nine questions in this questionnaire (the last one is only for female athletes), and 7 times of data were collected during the six-week survey. Since the participant's native language is Chinese, participants used the Chinese version. The Chinese version was translated by the researcher

Questionnaire content

A knee problem is one or both knees that are painful, sore, stiff, swollen, unstable, difficult to control, difficult to move, and other things that make you feel uncomfortable. Sleep problems refer to the poor quality of sleep caused by difficulty in falling asleep, easy waking up, excessive dreams, nightmares, etc., and unrelieved fatigue after waking up, etc., which makes you feel uncomfortable.

Please answer all questions regardless of whether or not you have problems with your knees. Selecting the alternative option that is most appropriate for you, if you are unsure, try to give an answer according to your first sense. The term "knee problems" refers to pain, ache, stiffness, swelling, instability/giving way, locking or other complaints related to one or both knees.

Part 1: Knee Problems (OSTRC)

Question 1

Have you had any difficulties participating in normal training and competition due to knee problems during the past week?

- A. Full participation without knee problems
- B. Full participation, but with knee problems
- C. Reduced participation due to knee problems
- D. Cannot participate due to knee problems

Question 2

To what extent have you reduced your training volume due to knee problems during the past week?

- A. No reduction
- B. To a minor extent
- C. To a moderate extent
- D. To a major extent
- E. Cannot participate at all

Question 3

To what extent have knee problems affected your performance during the past week?

- A. No effect
- B. To a minor extent
- C. To a moderate extent
- D. To a major extent
- E. Cannot participate at all

Question 4

To what extent have you experienced knee pain related to your sport during the past week?

- A. No pain
- B. Mild pain
- C. Moderate pain
- D. Severe pain

Part 2: Sleep Problems**Question 5**

Did you feel difficult fall into sleep in the past week? (Including inability to fall asleep for more than 30 minutes or due to external factors, such as roommates, electronics, diet, etc.)

- A. No difficulty in falling asleep
- B. To a small extent
- C. To a moderate extent
- D. To a large extent
- E. Absolutely unable to fall asleep

Question 6

Do you wake up during sleep in the past week? (Including feeling sleepy and easy to wake up, wake up because of dreams or need to go to the toilet, etc.)

- A. Not waking up at all
- B. Occasionally wake up (less than 2 times a week)
- C. Sometimes wake up (2-3 times a week)
- D. Always wake up (more than three times a week)

Question 7

In the past week, do you feel energetic and in good spirits after waking up?

- A. Feels very good.
- B. Feel better. A little rest would be great.
- C. Feeling general
- D. Feeling poor, sleep does not effectively alleviate fatigue
- E. Feeling more tired after waking up

Question 8

In the past week, how much the sleep problems affected your performance?

- A. No impact
- B. To a small extent
- C. To a moderate extent
- D. To a large extent

Part 3 Menstrual pain (Female only)

Question 9

How much pain did you have in the last three menstrual cycles?

- A. No pain
- B. Mild pain, pain but tolerable, not affecting normal life and sleep
- C. Moderate pain, obvious pain, unbearable pain, want to take medication, sleep disturbance
- D. Severe pain, severe pain, unbearable pain, need to take medication, sleep disturbance, and passive posture (relief can only be found in a certain movement).

Statistical Analyses

In the study, SPSS is used to conduct Descriptive and Correlation statistics of all the data. The study described the Maximum, Minimum, Std. deviation and mean scores of all athletes. Correlations between all factors were also counted. Then, male fencers and female fencers were counted separately.

Result

Descriptive Statistics(all fencers)				
	Minimum	Maximum	Mean	Std. Deviation
Knee	0	76.00	18.5571	18.29466
Sleep	0	78.00	30.8071	17.74151
Descriptive Statistics(male fencers)				
Knee	0	76.00	20.6104	22.01743
Sleep	0	78.00	27.7273	18.22205
Descriptive Statistics(female fencers)				
Knee	0	51.00	16.0476	12.02072
Sleep	6.00	72.00	34.5714	16.50681

Table 2. The knee and sleep data of male and female fencers.

The 20 fencers completed the questionnaire in the training week, they attend 6 hours of professional fencing training from Monday to Friday.

For all the fencers, the Minimum, Maximum, and Std. Deviation are basically equal, but the Mean of sleep ($P=30.81$) was greater than the knee ($P=18.56$). Sleep problems may be more troubling for fencers. Female fencers have fewer knee joint scores ($P=51.00$; $P=16.05$) than male fencers ($P=76.00$; $P=20.61$) at Maximum and Mean, but they have higher sleep score ($P=34.57$) than male ($P=27.73$) (Table 2). Female's sleep score at Mean was twice as many as the knee. According to the scores, female fencer's sleep disturbance was more severe.

Correlations(all fencers)							
Sig. (2-tailed)	Gender	Age	Height	Weight	Career	Knee	Sleep
Gender			.028	.153	.702	.788	.554
Age			.097	.078		.884	.131
Height	.028	0.97		.009	.075	.143	.802
Weight	.153	.078	.009		.030	.972	.327

Career	.702		.075	.030		.489	.046
Knee	.788	.884	.143	.972	.489		.165
Sleep	.554	.131	.802	.327	.046	.156	
*. Correlation is significant at the 0.05 level (2-tailed).							

Table 3. The correlation of the fencers' career and sleep

There are some blanks in the Correlation (all fencers) table (table 3), blanks also appear in the table below. The blank indicates that the data is meaningless.

There are 4 data less than 0.05: Gender and Height (P=0.028); Weight and Height (P=0.009); Career and Weight(P=0.030); Career and Sleep(P=0.046). However, other than Career and Sleep, other data have no research value, their correlation is normal.

Correlations(Male fencers)						
Sig. (2-tailed)	Age	Height	Weight	Career	Knee	Sleep
Age		.739	.116	.011	.973	.879
Height			.605	.921	.336	.967
Weight	.739	.605		.005	.393	.006
Career	.011	.921	.005		.322	.339
Knee	.973	.336	.393	.322		.030
Sleep	.879	.967	.006	.339	.030	
*. Correlation is significant at the 0.05 level (2-tailed).						

Table 4. The correlation of male fencers' knee and sleep.

In the table of male fencers, 3 dates were statistically significant. But only Knee and Sleep (P=0.030) worth to concern, it showed the correlation between knee problem and sleep disturbance (Table 4). In addition, the correlation between weight and sleep disturbance was 0.06. Although there was no significant correlation, it was noteworthy.

Correlations(Female fencers)

Sig. (2-tailed)	Menstruation	Age	Height	Weight	Career	Knee	Sleep
Menstruation		.041	.814	.569	.104	.017	.013
Age	.041		.049	.283		.889	.008
Height	.814	.049		.099	.086	.167	.339
Weight	.569	.283	.099		.287	.711	.892
Career	.104		.086	.287		.926	.019
Knee	.017	.889	.167	.711	.926		.465
Sleep	.013	.008	.339	.892	.019	.465	
*. Correlation is significant at the 0.05 level (2-tailed).							

Table 5. The correlation of female fencers' knee, menstrual pain, and sleep.

The data of female fencers are more complicated than male fencers. Except for age, menstrual pain was significantly associated with knee problems ($P=0.017$) and sleep disturbance ($P=0.013$). Menstrual pain is known to affect sleep, but as female fencers age and career increase, with a decreasing of sleep quality (Table 5). According to the data, female fencer's sleep is more easily affected. In addition, female fencers did not feel that knee problems made their sleep worse.

Discussion

The study assessed the correlation between knee overuse injury and sleep disturbance. The researcher assumed they were correlated before the study. Because of the physical characteristics, knee problems might be worse in female fencers. However, in fact, female fencer's knee Mean less than male, and there was also no correlation between female fencer's knee problems and sleep disturbance. Female fencer's sleep is fragile, which means their sleep quality is affected by menstrual pain and age. Coaches and team doctors often overlook menstrual problems, even female athletes also do not care about it. The reason may be due to coaches and female athletes' lack of medical knowledge, and female athletes usually do not seek help from team doctors for menstrual problems. The team doctors are generally composed of physiotherapists, psychologists and orthopedist, meaning that sports teams might be supposed to add physicians. According to the characteristic of fencing, the researcher discussed the results and limitations of the study, and suggested next steps and future directions.

Fencing is a high-intensity sport of confrontation. Fencers need to move irregularly on a narrow, long field with very fast back, and forth movement, which is accompanied by rapid start and stop. These movements cause a great load on the knee joints (Zhao, & Fei, 2017). Therefore, fencers need effective recovery methods to

eliminate muscle and joint fatigue accumulated during the training. China's sports teams usually use TCM to help athletes, and fencing team is no exception. However, the fencers told the researcher that, they did not receive regular and effective treatment after training. In fact, not every team has high-level team doctors. It is necessary for every sports team to better sleep to help athletes recover. Good sleep quality is an effective way to help athletes recover outside of training. It can help athletes maintain stable athletic performance and are important for maintaining muscle mass, muscle strength (Fullagar et al., 2015). Sleep disturbance will negatively affect hormonal rhythms and metabolism (Kim et al., 2015). Long periods of poor sleep lead to muscle atrophy and loss of strength, which affects athletic performance (Mônico-Neto, 2013).

With sports medicine pay more attention to the athlete injury prevention (Engebretsen et al., 2014), while sleep management is becoming more important. When communicating with the participants, we learned that the diet of the athletes during the training was provided by the training center, the restaurant is a buffet, and protein food is adequate; however, the researcher did not get the data of the diet of the athletes. Participants did not receive regular rehabilitation, muscle recovery assistance, and physical examination from the rehabilitation center, and coaches asked them to perform static squats after training to improve knee discomfort. It is not enough for professional athletes. Administrators have not yet focused on the quality of their athlete's sleep. Through the self-report of athletes, the researcher found that some athletes have obvious sleep disturbance, and they believe that this problem has affected their sports performance in the next day; however, it has not been paid attention to by athletes and coaches. No studies have looked at the correlation between overuse of the knees and sleep disturbances in fencers. Knee problems and sleep disorders are mainly studied in clinical medicine, especially after knee surgery (Wylde et al., 2011). Reported the pain evaluation of total hip replacement (THR) and total knee replacement (TKR) among 105 patients, patients presented different pain characteristics before and after surgery, and knee pain was relieved after surgery. The relationship between knee strength or injury and sleep needs further study. For athletes, overuse injuries are more common than acute injuries (Benjamin et al., 2013). Athlete's sleep needs to be given greater attention.

OSTRC overuse injury questionnaire is an effective method to evaluate athletes' overuse injury, and one of the obvious advantages of this questionnaire is that, the severity of overuse injury can be directly assessed by the scores of self-reported questionnaires. To evaluate the correlation between knee overuse injuries and sleep disorders, we designed four sleep disorders and adopted the same scoring criteria as OSTRC overuse injuries. In terms of the design of the problem, we recorded the sleep disorders of the athletes from four perspectives, whether it was difficult to fall asleep, whether they would wake up during the sleep process, whether they were still tired after waking up, and whether sleep affected their sports performance. According to the comparison of the median knee problems and sleep disorders among all athletes, the median of sleep disorders was 30.8 greater than the median of knee problems (18.56). The result shows that sleep disturbances are more serious than knee problems

among fencers. The analysis of the correlation between knee problems and sleep disturbance scores in all the athletes found no significant correlation. It can be seen from the trend chart that there is a certain degree of correlation between them (Figure 1).

Figure. 1 Correlation between knee problems and sleep disturbance scores

It may be that the overuse injury has no obvious pain or discomfort, and not enough to have a significant effect on sleep before it accumulates into a serious injury. The factors that affect sleep are complex, such as diet, living habits, video games or cellphone, and emotions. Fencers may think about training mistakes and difficult to sleep. According to a study on adolescent sleep disturbance factors, potential factors that affect sleep include age, gender, obesity, asthma, and other bronchial problems, cough and, sputum (Sharon et al., 2000). Among the individual factors of athletes, sleep disturbance is significantly correlated with a sports career. The longer training time, the more overuse injury may be accumulated. From this perspective, it can be suggested that some overuse injuries caused by training may affect sleep quality.

For female athletes, the researcher added an additional question about menstrual pain. One of the participants had an ankle injury (the pain was between the medial condyle and the Achilles tendon), and her menstrual cycle became disrupted and more

pain. When her ankle pain eased with moxibustion (A TCM method), her period also improved, which means this case made researcher want to know the question of whether a knee problem could affect a woman's period. So the study added extra questions about menstruation. The study found that all female athletes have menstrual pain of varying levels.

Menstrual pain was significantly associated with knee problems ($p=0.17$), sleep disturbances ($p=0.13$), and age ($p=0.13$). The consist of menstrual pain are complex, Jerry et al., (1987) show that menstrual pain in teenagers is positively correlated with socioeconomic conditions. This suggests that lifestyle may be an important factor in dysmenorrhea. The mechanism of association between menstrual pain and knee problems is not clear and needs further study. Among the participants, a 13-year-old female athlete reported more serious knee problems and had not yet menstruated. There was a correlation between intense training and the menstrual cycle. Dušek, T. (2001) found that, secondary amenorrhea was found to be three times more common in 72 athletes and 96 women aged 15-21 years without training experience ($p=0.037$). The incidence of primary amenorrhea in athletes was significantly higher than that in the control group (6/72 vs. 0/96, $p=0.014$), and high-intensity training before menarche could delay the occurrence of menarche. In Kishali et al., (2006) record 241 athletes showed that the onset of menarche was delayed by intense training, and participants did not believe that menstrual disorders affected their athletic performance. Fu et al., (2008) for 11 project training according to the survey of 131 women athletes starting age and negatively correlated with menstruation time; however, in the menstrual cycle has serious discomfort of athletes, most of the athletes in within 1 to 3 days to reduce the volume, feeling athletic performance decline, and nobody thought during the menstrual cycle of athletic performance.

Menstrual problems are closely related to the female's overall physical health and mental state. It is that paying attention to the menstrual health of female athletes, that is significant to improve their sports performance and prevent sports injuries. Such as maintaining training volume and emotional stability. Sleep disturbance in female athletes was significantly correlated with both career ($P=0.019$) and age ($P=0.008$). It may show that knee overuse injury accumulation negatively affect sleep quality over a long period of time.

There was a significant correlation between knee problems and sleep disturbances in male fencers ($P=0.03$), possibly due to gender differences, with male fencers having greater strength and speed than female fencers. This may have resulted in more knee overuse injuries in male fencers, significantly affecting sleep quality. Male fencer's weight may be correlated with sleep disorders ($P=0.06$), which might because males have more muscle mass than females (Janssen et al., 2000), and accumulating more fatigue than female athletes. A cross-section study from Norway show reported 50 elite athletes' from nine teams knee prevalence, and they found that at least 22% of the athletes' knee problems, and the prevalence of male elite athletes are significantly higher than female, is twice as female athletes, this could indicate that male are more likely to accumulate knee overuse injuries than female (Lian et al.,

2005). Lian et al (2005) found volleyball and basketball had the highest prevalence among different exercise comparisons, and they claimed that the higher the tendon load, the higher the prevalence of exercise. We found knee problems may be one of the main reasons for the decline in exercise performance, but they did not survey fencers. Majewski et al (2006) recorded 17,397 patients with 19,530 sports injuries over a 10-year period. 6,434 patients (37%) suffered knee joint injury in 7,769 patients (39.8%). Among them, men accounted for 68.1% and women 31.6%, which were significantly higher than women. The ratio is similar to the Lian et al study.

Lessi et al (2017) compared the effects of lower extremity muscle fatigue on knee, hip, pelvic, and trunk kinematics and lower extremity muscle activity in men and women during single-leg vertical take-off and landing. They found that after fatigue, males showed greater trunk curvature than females, which reduced the force on the knee when landing and helped male athletes better adapt to fatigue. The results do not explain the fact that male athletes have more knee problems than female athletes. Researchers speculate that adapting to fatigue is not the same as accumulating fatigue. Perhaps males are better able to cope with fatigue, and male fencers may accumulate more fatigue when they do not feel it. The training differences between male and female fencers need to do further study.

Female fencer's score is higher on sleep disturbance than male. Some studies show that females are more prone to sleep disturbance than males. Fatima et al (2016) used the Pittsburgh sleep questionnaire (PSQI) to report sleep quality from 3,778 adults (20.6 ± 0.86 years old), females have more sleep disturbances than males (65.1% vs. 49.8%). They suggest that female's propensity for poor sleep quality may be due to gender differences in the biology of sleep, or other variables that researcher did not include in the analysis (for example, a family history of poor sleep quality), and might be further exacerbated by higher emotional distress in females.

There was a certain correlation between sleep disorders and weight in male athletes ($P=0.06$). Although the data is not statistically significant, it needs to be discussed. Patel et al (2008) made a review of 36 articles (31 cross-sectional, 5 prospective, and 0 experimental). They found that short sleep duration may be positively correlated with body weight, especially in younger age groups. But they focused on the incidence of obesity, which is not consistent with athletes. The correlation between the athlete's weight and sleep quality needs further study. Thermodynamics states that in order to lose weight, one must consume less energy than one consumes, and for athletes. The main goal of weight loss is to lose body fat. Phillips et al (2016) claim that the amount of protein needed to maintain lean body mass increasing during the negative energy balance. The protein, as a macronutrient, may have the advantage of satiety during the energy balance and may allow for greater fat loss during the negative energy balance. However, this result may as a recommendation that athletes who experience sleep disorder should use exercise nutrition methods to reasonably reduce their weight (body fat) to help them sleep better. Proper nutrition design may help athletes achieve better recovery in sleep. Peter et al (2012) found that dietary proteins taken before bedtime are effectively digested and absorbed, thereby increasing the availability of amino acids in plasma at

night and stimulating the rate of protein synthesis in muscles, which might improve the protein balance at night.

Suggestion

Based on the results of the study and other literature findings. The researcher suggests:

- Sports teams need to improve the skill of the team doctors. Overuse injury needs to be treated. Acupuncture may be a better choice than the drug, there are limited studies on the effects of drug therapy on knee pain. If further developed into osteoarthritis (OA), the effects of non-steroidal anti-inflammatory drugs are small and transient, and they have side effects on the digestive system (white et al., 2007). In addition, fencers are severely restricted in drug's using.
- The doctors' team should have a physician and gynecologist.
- The team doctor should make a daily recovery plan according to the characteristics of fencing, it helps reduce the accumulation of fatigue.
- Administrators should make some rules to ensure that fencers can acquire good rest during the training day. For example, they should seek advice from sports' nutritionists, to help fencers intake better nutrition.
- Fencers and coaches need not only focus on training, but also to receive education. They need to know some basic sports medicine and strength and conditioning knowledge. It is very essential to prolong the fencer's sports life.

Conclusion

20 professional fencer reported their questionnaire scores every week, and the reporting rate is 100%. The study found that males fencers showed a significant correlation between sleep disorders and knee problems ($P=0.03$). Results of female fencers showed a significant correlation between menstrual pain and knee problems ($P=0.017$); moreover, sleep disturbance and menstrual pain ($P=0.013$); sleep disturbance and age ($P=0.008$). Sleep disturbance and sports career ($p=0.019$).

The study created the same criteria for sleep disorders to match the OSTRC overuse injury questionnaire, which is a new attempt to evaluate both sleep quality and knee problems in fencers. It provides an idea for the correlation study between different questionnaires using the same scoring method.

In future studies, researchers suggest that the OSTRC questionnaire correlates with the sports nutrition intake questionnaire, and the rehabilitation after training questionnaire or the menstrual cycle questionnaire of female athletes by the same scoring criteria. Those results will help researchers to assess athlete's overuse injury.

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Figures

Figure 1

Correlation between knee problems and sleep disturbance scores