**Biophysical and behavioral factors that influence university of Toronto students’ risk of inversion ankle sprain injuries**

University of Toronto

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KPE 190 Assignment Two

**Introduction**

The sprain is an injury that ligament is stretched or torn. As we all know, many situations, like falling, twisting, or getting hit, can cause sprain injuries. Inversion Ankle Sprain is the most common injury during physical activities. According to Beynnon, Murphy and Alosa (2002), Garrick (1977) is the first one to find the fact that ankle is the most commonly injured structures in athletes. The study following it shows support towards the research result (Mallow & Gwin, 2018). The data shows that 27,000 ankle ligament injuries occur every day in the United States, which is about 25% of all the injuries occurring in running and jumping sports. 75% of all ankle injuries are caused by inversion trauma (Baumhauer, Alosa & Renstrom, 1995). Since ligament is avascular structure, sprain injuries always need a very long time to fully recover. Most patients who sustained an inversion ankle injury, according to Anandacoomarasamy and Barnsley (2005), have symptoms for at least two years after the injury. The symptoms may include chronic pain and ankle instability. Due to the inconvenience that IAS injury have and its common happening, knowing how we can reduce the risk of this injury is important and helpful. To achieve the goal, this research about the factors influencing the risk of IAS injury is conducted.

**Literature review**

Eight articles about different factors that influence the risk of inversion ankle sprain (IAS) injury are read. Two of them are literature reviews, the other six articles are peer-review research journal articles. The six articles test IAS injuries factors from different aspects in different places and with different groups of people. They also get similar and different results. The research about the IAS injury risk factors are conducted in America (Gribble et al., 2016), Canada (Owoeye & Palacios-Derflingher & Emery, 2017), Britain (Mckay, Goldie, Payne & Oakes, 2011) and Greek (Kofotolis, Kellis & Viachopoulos, 2007), testing student athletes, amateur athletes, professional athletes and soldiers. The factors included in the eight articles can mainly be divided into two field—biophysical field and behavioral field.

**Biophysical factors:**

Some similar biophysical factors are found in these articles. Almost all the articles state that previous ankle injuries will significantly cause a higher risk of ankle injuries and the risk can be as high as five times (Owoeye, Palacios-Derflingher & Emery, 2017). The higher risk may be caused by a looser ankle ligament and a less stable ankle. However, if we treat the injury properly by using a band, it will decrease the risk (Beynnon, Murphy & Alosa, 2002)

Some of the biophysical factors found in these articles are very disputed. Many types of research show that the risk of ankle inversion injury can be influenced by people’s weight, height, and gender. Beynnon et al. (2001), in their research “Ankle ligament injury risk factors: A prospective study of college athletes”, found that gender is a factor because of anatomical structure difference, which is “woman has increased tibial varum and calcaneal eversion range motion”. Gribble et al. (2016) stated that BMI will lead to a higher risk of ankle inversion injury. However, Owoeye, Palacios-Derflingher & Emery (2017), in their research study, found that gender and BMI cannot influence the risks of ankle sprain injury in youth soccer and basketball players. Matthew and Craig also found that body mass index is not associated with injury risk. Therefore, whether weight and height can influence IAS injuries risk remains controversial.

**Behavioral factors**:

Different sports activities type, intensity, and duration might be the factors of a higher risk of ankle inversion injuries. For example, Owoeye, Palacios-Derflingher & Emery (2017) argue that playing basketball has a higher risk of getting injured on ankles than football. Playing different ball games require different movement pattern, thus making sense that the IAS injuries ankle are different. Beynnon, Murphy and Alosa (2002), in their research “Predictive factors for lateral ankle sprains”, found that athletes get more inversion ankle injuries in games than practices. As we all know, games are always high in intensity and might continue a long time. Therefore, the intensity and duration might be the factors of a higher risk of ankle inversion injuries.

Some other behavioral factors are also related with the risk of ankle inversion injury. Mckay, Goldie, Payne and Oakes (2001) found that doing stretch exercises can reduce IAS risk while wearing shoes with air cells will increase IAS risk. Beynnon, Murphy and Alosa(2002) argues that different anatomic foot type varies with the IAS risk.

**How literature review shaped my research question:**

Reading the literature review helped shape the research question of this paper, which is “biophysical and behavioral factors that influence university of Toronto students’ risk of inversion ankle sprain injuries”. I found that the factors that might influence the IAS injury can be divided into two parts, including biophysical factors such as weight and height, and behavioral factors such as physical activity habits. Therefore, the factors I want to research is about these two fields. Besides, most researches are conducted by studying the factors causing inversion ankle risk among professional athletes, but even people who do not do any professional sports have a possibility of suffering from inversion ankle sprain injuries. How and why normal people get inversion ankle sprain injuries are neglected. I chose my population as all kinds of university students, including those who do sports and those who do not. I chose students because IAS may have more influence on students than people of other age. Students always have a very busy life during their university period with their studies, sports and social activities. IAS injury will bring a lot of inconveniences to them. They might miss class because it becomes more difficult for them to walk to classrooms and their mental health might be negatively affected due to difficulties to attend social activities, causing fewer opportunities to keep contact with people around.

**Methods**

**Choosing research methods**

Based on previous studies investigating factors that influence ankle inversion injury risk, conducting survey would be used for this research paper. First, there are many factors influencing the sprain risks. The high risk in IAS injuries of someone can be caused by different factors. For example, participant A might suffers ankle sprain because of his/her inappropriate treatment after the last injury, while participant B might have a high risk of IAS injury because he/she does more physical activities than A. Therefore, it is better to use a large number of research sample. Also, deep analysis on sprain injury research is currently impossible for a first-year student with limited resources, including testing machines and related kinesiology knowledge support. Since only basic factors can be studied, there is no need for an interview.

**Conducting research questions**

Since my research question is the factors influencing the IAS injuries risk, the first survey question asks the frequency of IAS injury. For measuring the inversion ankle sprain situation of my participators, the times the participants got inversion ankle sprain injury before are researched. I divided the question into four groups, including “I never sprain before”, “I only sprained my ankle once before”, “I sprained my ankle 2~3 times before”, “I sprained my ankle 3~6 times before” and “I have repetitive ankle sprains”. Repetitive ankle sprains are defined as more than 6 times in my survey.

For biophysical factors, gender, weight, and height are added as my survey questions because they are possible factors influencing the IAS injury according to the literature review. Behavioral is a more important part in this research. Factors including whether they receive medical support after injury, their physical activity behaviors, walking behaviors and shoe choosing behaviors are researched. In physical activities behaviors, the intensity and duration of the physical activities are researched because they might be the factors of a higher risk of ankle inversion injury as people might be in a higher risk of injuries when they are more tired. Different types of sports might also matter because they have different degrees of intensity and different types of body movement, which might affect the risk. For example, playing basketball will lead to a higher IAS injury risk than playing football according to the literature review. At last, I want to know how shoes and feet influence the risk of IAS injury, the literature review shows that the types of shoes, anatomical foot position, and fitness of shoes and feet are also possible factors that might influence the risk of inversion ankle injuries. So, questions “what is your feet size?” “Do you like to wear shoes larger than or fit with your feet?” “Do you like to wear shoes with cells or not?” “What is your anatomical foot position?” are asked.

**Collecting data**

41 students from the University of Toronto are surveyed, containing 25 first-year students, 12 second-year students, 4 third-year students, 1 fourth year student, and 3 post-fourth-year students. I conducted my survey using Google Forms and sent to my participators through social media such as Wechat and Facebook. The data is analyzed in the Google Sheet.

**Analyzing data**

To evaluate and compare the level of ankle injuries, Different frequencies of inversion ankle injuries are enumerated. I score “never sprain before” as 1 point, “I sprained my ankle 2~3 times before” as 2 points, “I sprained my ankle 3~6 times before” as 3 points and “I have repetitive ankle sprains (more than 6 times) as 4 points. The average points are calculated and compared when different factors are considered. The higher score means a higher risk of ankle inversion injury. Vice versa.

**Peer review**

Through peer review, the advice is given about how to organize so many factors. The factors are originally divided into basic factors, physical activities factors, shoe choosing factors, anatomical foot position factors etc., but they are not very organized. Therefore, the division of biophysical and behavioral factors are created for better organizations of all the factors. Also, the title is changed to “biophysical and behavioral factors that influence university of Toronto students’ risk of inversion ankle sprain injuries”.

**Data Analysis**

**1. General inversion ankle injuries data.**

Ankle injuries are common. The average score of all the participants is 1.63 points, which is around 1～3 times in their lifetime. To be more detailed, 65.9% participants (27) got inversion ankle injuries before and about one-fifth of the participants have repetitive ankle sprains, which I defined is more than 6 times before. Among the 27 participants, 37% state that they can fully recover within a week, while 40.7% state that they can recover from a week to three months. This data is not consistent with literature review, which argues that IAS injury needs about two years to fully recover. The reason here might be the fact that people believe their IAS injuries are fully recovered but they are not. It makes sense because the definition of full recovery is the ligament become the same as the situation before this injury. However, people do not feel the pain before IAS injuries are fully recovered.

**2. Biophysical factors**

**Gender**

There is no significant relationship between gender and the risk of inversion ankle sprain. Women have an average ankle injury point of 1.48 points, while men have an average ankle injury point of 1.68 points. The result is out of my expectation, which is that women have a lower risk of inversion ankle sprain compared with men. This might be due to a small sample. No evidence is found that gender is a factor. Although females will have a wider tibia bone, with larger valgus and internal rotation angles according to the literature review, it seems that the structure difference will not cause a higher risk of ankle inversion sprain injury.

**Weight**

A higher weight will lead to a higher risk of ankle inversion injury. People with the weight between 50kg and 60kg score only 0.13 point. About 50% of them never sprain before. People who weigh between 60kg and 70kg, 70kg and 80kg, 80kg and 90kg and more than 90kg got the average point 1.8, 1.9, 2.0 and 4.0. It is very evident that the trend is increasing. This result makes sense because a higher weight provides our joints of the lower extremities with larger pressure, including ankle joint. It becomes more difficult for ankle joint muscle to keep stable under large weight, thus causing a higher risk of ankle inversion injury.

**Height**

A greater height also leads to a higher risk of ankle inversion injury. People with height 150cm to 160cm, 160cm to 170cm, 170cm to 180cm, 180cm to 190cm got the score 1 point, 1.36 points, 1.625 points and 3 points, which show a proportional relationship. The reason for the result might be the fact that greater height leads to a higher center of gravity, which will cause it more difficult to keep balance during physical activities. Therefore, the risk becomes higher.

**Foot Size**

I did the research with the only foot size of integers. The foot size between the two numbers will be considered as the smaller number. For example, foot size 5.5 is considered 5. According to the research result, foot size 5 scores 2 points, foot size 6 scores 0.83 points, foot size 7 scores 1.18 points, foot size 8 scores 1.6 points, foot size 9 scores 1.6 points, foot size 10 scores 2.6 points, foot size more than 10 scores 1.75. The data for foot size 5 and more than 10 is insufficient, thus is not precise. If these data are removed, the main trend is proportional. Therefore, larger feet will lead to higher risk of sprain ankle injuries.

**Discussion towards biophysical factors:**

Although all three factors of weight, height and foot size can lead to a higher risk of IAS injury, the three factors are correlated. People with greater height are very likely to have higher weight and bigger foot size. Therefore, it is still not clear that which of these factors have the influence on IAS injury. Further researches are required to know which factor matters most.

**3. Behavioral Factors**

**Medical support**

People asking medical support score 2.5 points, while those do not ask for medical support score 2.4 points. It shows that asking medical supports only has slight influence on the overall risk of suffering from IAS injury. However, the research found that it can greatly reduce the risk of getting repetitive IAS injury. 20% participants asking for medical support had repetitive inversion ankle injuries, while 35.3% participants do not ask for medical support had repetitive inversion ankle injuries. The data shows that asking for medical support and reduce the risk of getting repetitive IAS injury by about 45% percent. When someone’s ankle gets injured, their anile joint becomes less stable, thus they will easily sprain their ankle again. The ligament around their ankle becomes looser and looser and may even be broken. Therefore, getting medical support after ankle sprain injury is very important.

**Physical activity intensity**

Participants who report that they always do physical activities of high-intensity score average 1.8 points for the risk of IAS injuries. Participants who always do physical activities of moderate intensity score average 1.86 points for the risk of IAS injuries, while participants who always do physical activities of low-intensity score average 0.5 points for the risk of IAS injuries. We can get to the conclusion that doing low-intensity exercises can have a significantly lower risk of IAS injuries, while the risk of IAS injuries does not have differences regard to moderate and high-intensity physical activities.

**Physical activity duration**

Participants who always do physical activities less than an hour score average 1 point, those who do physical activities among one to two hours score average 1.92 points, and those who do physical activities more than two hours score average 1.6 points. The data shows that there is no significant relationship between the duration of performing physical activities and the risk of IAS injuries.

**Warm up**

Participants who do warm up before physical activities score average 1.59 points, while those who do not do warm up before physical activities score average 1.66 points. It shows that doing warm-up only has slight benefits on the risk of IAS injuries. However, what is beyond my expectation is that those who sometimes do warm up and sometimes not score average 2.8 points, which is greatly larger than those who always do warm up and those who never do warm up before physical activities. The data shows that inconsistency in warm up exercises will lead to highest IAS injury risk. The reason of this result remains unknown and needs further research.

**Type of physical activity**

The average rate is only calculated if there are more than five participants doing one particular activity. For example, there are 19 participants doing gym, so the average point of people doing gym is calculated. While, only 4 participants playing volleyball, the average point is not calculated because of imprecise data. 7 physical activities are tested under this circumstance, including basketball, soccer, badminton, gym, walking or running, ping-pong and water sports. What is unexpected is that the physical activity which gets the highest score is water sports (2.23), following with basketball (1.83), walking or running (1.8125), badminton (1.77), gym (1.63) and soccer (1.4). The hypothesis of the reason that water sports get the highest score might be that the kicking motion of swimming, especially free style, will loosen the ankle joint ligament. This will induce a higher risk of IAS injury when doing other physical activities. Besides, McKay et al. (2001) argues that most ankle injuries happen when landing. Jumping and landing are integral components of basketball, running and walking, and badminton. It makes sense that these exercises will lead to higher risk of IAS injury. However, it is strange that playing soccer has the least possibility that cause IAS injury. Its reason requires further research.

**Shoe fit**

People prefer wearing shoes larger than their feet get 2.22 points, while people prefer wearing shoes that fit their feet get 1.55 points, which is significantly smaller than those love wearing large shoes. It shows that wearing shoes larger than our feet has a greater risk of suffering from IAS injuries. Wearing shoes larger than feet will make your feet slipping in the shoes, affecting the walking postures, which might be the reason to cause instability when walking and running.

**Air cells**

People prefer wearing shoes with air cells get a score of 2.2 points, while people do not wear shoes with air cells get a score of 1.45 points. It means that wearing shoes with air cells will increase their risk of getting IAS injuries. Mckay et al. (2001) make a hypothesis that “air cells located in the heels of basketball shoes decrease rear foot stability”, which increase the risk of IAS injury. Further research to prove this hypothesis is required.

**Anatomical foot position**

People with eversion foot position score 1.67 points; People with inversion foot position score of 1.71 points; People with a neutral foot position score of 1.78 points. There is not clear evidence that anatomical foot position will influence IAS injuries risk.

**Conclusions**

**Results**

From the research, we found that biophysical factors like height, weight and foot size will increase IAS injuries risk. Therefore, people with these characteristics should be more careful. Among behavioral factors, shoe selection, asking for medical support and performing different types of physical activity will influence IAS injury. To decrease the risk of IAS injuries, people should better wear shoes that fit their feet and without air cells. Besides, If IAS injuries have already happened, medical support is recommended for not injuring again. Swimmers and athletes performing sports with many jumping and landings should be more careful about the IAS injuries.

**Strength**

Factors that may cause a higher risk of inversion ankle injuries are researched among University of Toronto students. In one hand, this research will give us a better understanding of how sprain injury is caused even among ordinary students who don’t often do physical exercises; on the other hand, some advice is proposed to reduce IAS injuries risk. It is a relatively comprehensive research including factors from basic information like height and weight to exercise habits like the shoe type students wear.

**Further research directions**

First, this research mainly focuses on the correlation between different factors and IAS injury risk, the causation of the results remains unknown, which requires further research. Second, some correlated factors like height, weight and foot size need further research to determine which factor influences the IAS injury risk the most.

**Reference**

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**Appendix:**

Survey questions

1. How often do you suffer from inversion ankle injuries?

I never sprained my ankle before

I only sprained my ankle once before

I sprained my ankle 2~3 times before

I sprained my ankle 3~6 times before

I have repetitive ankle sprains (more than 6 times)

I am not sure

1. How long do you need to fully recover from sprain injuries?

within a week

a week to three months

3 months to a year

more than a year

I am not sure

1. Did you ask for medical support for rehabilitation when you sprain your ankle? (wearing a brace)

Yes

No

I forget

1. What's your grade?

1st year

2nd year

3rd year

4th year

after 4th year

1. What is your gender?

Female

Male

I don't want to share

1. What is your weight?

>90kg

89~90kg

70~80kg

60~70kg

50~60kg

<50kg

I don't want to share

1. What is your height?

more than 190cm

180cm~190cm

170cm~180cm

160cm~170cm

150cm~160cm

less than 150cm

I don't want to share

1. Do you currently or previously play sports?

Yes

No

1. What kinds of sports do you play?

Soccer

Basketball

Volleyball

Football

Badminton

Tennis

Ping-pong

Gym (work out, yoga etc.)

Water sports (swimming, water polo etc.)

Ice sports (skating, ice hockey etc.)

Walking or running

Others\_\_\_\_\_\_

1. Do you do warm up before sports activities?

Yes

No

Maybe

1. How long do you usually play sports at a time?

less than an hour

an hour to two hours

two hours to three hours

more than three hours

1. What is the normal intensity when you play sports?

High

Moderate

Low

1. What is your foot size?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. How does your shoe fit your foot?

I like to wear shoes larger than my feet

I like to wear shoes that fit with my feet

1. Do you always wear shoes with air cells?

Yes

No

Maybe

1. What is your anatomical foot position when you are walking?

图片包含 地图, 文字



自动生成的说明

Inversion

Eversion

Neutral

I am not sure