A RETROSPECTIVE STUDY OF INJURIES IN HONG KONG BADMINTON PLAYERS

BY

WONG WING SHEUNG

08001561

AN HONOURS PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF ARTS

IN

PHYSICAL EDUCATION AND RECREATION MANAGEMENT (HONOURS)

HONG KONG BAPTIST UNIVERSITY

April, 2010
HONG KONG BAPTIST UNIVERSITY

23th APRIL, 2010

We hereby recommend that the Honours Project by Miss WONG WING SHEUNG entitled "A RETROSPECTIVE STUDY OF INJURIES IN HONG KONG BADMINTON PLAYERS" be accepted in partial fulfillment of the requirements for the Bachelor of Arts Honours Degree in Physical Education and Recreation Management.

____________________                 ____________________
Dr. Lobo LOUIE                         Prof. Chow Bik Chu
Chief Adviser                          Second Reader
ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my chief advisor, Dr. Lobo Louie for his professional advices and valuable recommendations throughout the entire project period. I would also like to thank Prof. Chow Bik Chu for being my second reader.

Appreciation was given to the cooperation of the following tertiary institutes, secondary schools and badminton clubs, for participating in this study.

**Tertiary Institutes**

City University of Hong Kong  
Hong Kong Baptist University  
Hong Kong Institution of Vocational Education  
Hong Kong Shu Yan University  
Lingnan University  
The Chinese University of Hong Kong  
The Hong Kong Institute of Education  
The Hong Kong Polytechnic University  
The Hong Kong University of Science & Technology  
The University of Hong Kong
Secondary Schools

Cheung Sha Wan Catholic Secondary School
Creative Secondary School
Diocesan Boys’ School
Good Hope School
Heep Yunn School
Holy Family Canossian College
Holy Trinity College
Jockey Club Ti I College
Maryknoll Secondary School
Marymount Secondary School
PLK Laws Foundation College
Queen Elizabeth School Old Students’ Association Secondary School
SKH Bishop Mok Sau Tsang Secondary School
STFA Lee Shau Kee College
St. Paul's Secondary School
St. Paul's Convent School
St. Stephen's College
St. Joseph's Anglo-Chinese School
Wong Shiu Chi Secondary School
YCH Law Chan Chor Si College
Ying Wa College
YLPMSAA Tang Siu Tong Secondary School
Badminton Clubs

Avion Badminton Club
Bauhinia Culture Badminton Club
City U and Friends
Chun Fung Badminton Club
Gathering Badminton Club
Green Power Club
Hong Ching Badminton Club
Kwai Tsing Badminton Club
Lok Wah Badminton Club
Match Badminton Club
May Ching Sport Association
MOB
NK Sports
O Lam Badminton Club
Police Badminton Club
Professional Badminton Club
Sai Kung Sports Association
Silver Feather Badminton Club
Skylark Badminton Club
South China Athletic Association
Southern Union Badminton Club
Swift Badminton Club
Tai Po Sports Association
Target Badminton Club
Tuen Mun Sports Association
Yuen Long Sports Association

__________________________________________

Wong Wing Sheung

Department of Physical Education

Hong Kong Baptist University

Date: 23th April, 2010
ABSTRACT

Badminton is one of the most popular sports in Hong Kong. It is an activity that is suitable for all people. In order to have fun, it is necessary to prevent injury to occur. The purpose of this study was to understand the injury pattern among Hong Kong badminton players.

In this study, 1200 badminton players from Hong Kong team to recreational players, aged between 11 and 64 were invited to do the questionnaire (Appendix A).

The result showed that 46% of the players have suffered from at least one injury in the past one year. There were a total of 1499 injuries in the past one year among all the players, which gives an incidence rate of 4.22 per 1000 playing hours. Recreational players had the highest incidence rate of injury. The most common sites of injuries were ankle and foot (259), knee (246), and waist (226). Strain (512) overuse (496) and sprain (406) were dominant accounted for 94% of all the injuries. The single most frequent injury was ankle sprain (221). The major causes of injury were intrinsic factors
including insufficient warm up (18%), wrong movements (17%) and tiredness (16%).
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>14</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>15</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>15</td>
</tr>
<tr>
<td>Research Questions</td>
<td>15</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>17</td>
</tr>
<tr>
<td>Delimitations</td>
<td>19</td>
</tr>
<tr>
<td>Limitations</td>
<td>19</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>20</td>
</tr>
<tr>
<td>2. REVIEW OF LITERATURES</td>
<td>22</td>
</tr>
<tr>
<td>Previous Studies on Badminton Injuries</td>
<td>22</td>
</tr>
<tr>
<td>Common Injuries among Badminton Players</td>
<td>27</td>
</tr>
<tr>
<td>Physiological Needs and Characteristics of Badminton</td>
<td>37</td>
</tr>
<tr>
<td>Summary</td>
<td>39</td>
</tr>
<tr>
<td>3. METHOD</td>
<td>40</td>
</tr>
<tr>
<td>The Subjects</td>
<td>40</td>
</tr>
<tr>
<td>Instrument</td>
<td>40</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Demographic information of the players (N=1200)</td>
<td>48</td>
</tr>
<tr>
<td>2. Age distribution of players with percentage of injuries (N=1200)</td>
<td>49</td>
</tr>
<tr>
<td>3. Independent t-tests of hours of badminton or fitness training among Male and Female Players (N=1200)</td>
<td>50</td>
</tr>
<tr>
<td>4. Exposure Hours, total number of injuries and incidence rate of injuries (per 1000 hours) for each group of players (N=1200)</td>
<td>52</td>
</tr>
<tr>
<td>5. Time spent on warm up time for different genders (N=1200)</td>
<td>54</td>
</tr>
<tr>
<td>6. Warm up patterns for different genders (N=1200)</td>
<td>55</td>
</tr>
<tr>
<td>7. Chi square test for different categories with injury (N=1200)</td>
<td>57</td>
</tr>
</tbody>
</table>
8. Number and Incidence (per 1,000 player hours) of Injury with Different Injured Body Sites for different performance level players (N=547).

9. Number and Incidence (per 1,000 player hours) of Injury with Different Injury Types for different performance level players (N=547).

10. Frequency, percentage and incidence rate of injuries for different genders (N=547).

11. The ten most common Injuries in badminton for different genders (N=547).

12. Causes for injuries for different genders (N=547).

13. Treatments for injuries for different genders (N=547).

14. Medical help from casualty for different genders (N=547).

15. Recovery period for injuries for different genders (N=547).
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Histogram of the time spent on warm up of the players</td>
<td>54</td>
</tr>
<tr>
<td>2. Histogram of the warm up patterns of the players</td>
<td>55</td>
</tr>
<tr>
<td>3. Histogram of the frequency of the top 10 injuries in males and females</td>
<td>66</td>
</tr>
<tr>
<td>4. Histogram of the frequency of the perceived causes of injuries in males and females</td>
<td>69</td>
</tr>
<tr>
<td>5. Histogram of the frequency of treatments for injuries in males and females</td>
<td>71</td>
</tr>
<tr>
<td>6. Histogram of the frequency of recovery period for injuries in males and females</td>
<td>73</td>
</tr>
</tbody>
</table>
Chapter 1

Introduction

Badminton is one of the elite sports in Hong Kong, since our athlete gained remarkable results in world-class events, especially the Asian Games 2006 and the East-Asian game 2009, Hong Kong players appeared in the final of those big events, which drew public attention on it.

Playing badminton is suitable for all age, it can build a healthier body and stronger character; broaden the social circle (劉帆, 趙小平, 2010), and help to release stress from daily life. Besides, equipments are minimal and the court are flexibility and accessible (張長寛, 劉和昌, 2009), which can serve as a sport and entertainment (孫雪翰, 王慶菊, 2009).

Citizen participated in sports mainly for fun and health. Since badminton is one of the most popular sports in Hong Kong and it is suitable from children to the elderly, it is necessary to understand the injury patterns so as to set up preventive measures so as to prevent injury to occur.
Statement of the Problem

The aim of the study was to investigate the injury patterns of different levels of badminton players in Hong Kong. Included in the study was an attempt to identify the incidence, nature, cause and effect of badminton players in Hong Kong.

Purpose of the Study

The purpose of the study was to investigate the injury patterns among badminton players in Hong Kong providing information for coaches and players of common injuries in badminton. This would help the coaches to develop a better plan for training so as to reduce the risk of injury and improve their training quality. Also, it can raise the awareness of sports injuries among recreational players.

Research questions

To understand the injury patterns of the badminton players, the following research questions were asked:

1. What would the demography of the players be?

2. What would the injury patterns of badminton players in Hong Kong be?
3. What would the gender-related injury patterns of the badminton players be?

4. What would the age-related injury patterns of the badminton players be?

5. What would the performance level-related injury patterns of the badminton players be?

6. What would the ten most common injuries among badminton players in Hong Kong be?

7. What would the warm up patterns of the badminton players be?

8. What would the common causes of injuries be?

9. What would the common treatments of injuries be?

10. What would the recovery period of the injuries be?

11. Are there any association between different event types of players and their injury patterns?

12. Are there any associations between players having or not having additional fitness training and injury patterns?

13. Are there any association between players joining or
not joining competitions and injury patterns?

14. Are there any association between the cool down and injury patterns?

15. Are there any association between the knowledge of injuries and injury patterns?

Definition of Terms

The operational definitions of the terms in this study were defined as follows:

*Sports Injury*

It refers to any kinds of injuries that occurs during sports or exercise, which may result from accidents, poor training practices, and improper equipments, lack of conditioning, or insufficient warm up and stretching. (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2009)

*Performance Level*

It refers to the highest playing ability of the subjects, including Hong Kong team, junior squad, Club representative, School team players and recreational players.

*Injured Cases*
It refers to any reported case of injury caused by badminton within the past one year.

*Incidence Rate of Injury*

It refers to the number of injury cases divided by the amount of playing hours. In this report, the numbers are transformed into rate of 1000 playing hours.

*Additional Fitness Training*

It refers to any type of extra training apart from normal badminton training which aims to improve the performance in badminton, such as running or gym.

*Warm up*

It refers to light exercises and stretches prior the exercises that gradually increase the level of activity until the proper level is reach (Powers & Howley, 2009).

*Specific Warm Up*

It refers to exercise that increases body temperature using similar body parts that will be used in the subsequent, more strenuous activity (Shellock & Prentice, 1985). It is a rehearsal of the movement required in the game, such as swing
of the racket and footwork.

Cool down

It refers to slow walking and stretching exercise after the exercise that gradually return the heart rate and blood pressure to normal (Powers & Howley, 2009).

Delimitations

The delimitations of the present study were list as follows:

1. The subjects were delimited to males and females badminton players aged from 11 to 65.
2. The subjects were delimited to players who regularly take part in badminton activity at least once a week.
3. Incidence of injuries was delimited to the past year.

Limitations

The following limitations should be considered when interpreting the results of this research:

1. It was assumed that the injury items of the questionnaire are enough to measure the common types of injury.
2. It was assumed that all subjects would answer the
questionnaires honestly.

4. It was assumed that all subjects were able to identify their injuries.

Significance of the Study

The significance of the study was to identify injury patterns among different levels of badminton players in Hong Kong. It examined associations between genders, age and performance level of the players with injuries. It also provided information to compare between elite players and recreational players in Hong Kong. Besides, the warm up patterns, causes and treatment for injuries will be investigated.

Van Mechelen, Hlobil, and Kemper (1992) mentioned that there were four steps to prevent sports injuries. Finding out the injury patterns was the initial step, while understanding the risk factors and mechanism of injuries was the second step. This study focused on these two steps, and gave information for further study on measures for reducing risks of injuries.

Moreover, this study provided information for coaches to
develop a better coaching plan, which can help to improve the players’ performance more effectively.

Furthermore, this study also provided information for player to understand more about the injury patterns and the causes of them so as to prevent them occur. This may be useful for promoting badminton in the future.
Chapter 2

Review of Literatures

In this chapter, the researcher would focus on reviewing the past literatures that correlated with the topic of our study. The review of literatures was divided into following sections:

(a) Previous Studies on Badminton Injuries, (b) Common Injuries among Badminton Players, (c) Physiological needs and characteristics of badminton and (d) the Summary.

Previous Studies on Badminton Injuries

Numerous researches have been done on badminton injury patterns. Most of them focused on the injured sites, injured types and causes of injuries.

In reviewing several researches, the mean age of injured player was about 25 to 33 (Fashlstrom, Bjornstig, and Lorentzon, 1998b; Hensley & Paup, 1979; Hoy, Lindlad, Terkelsen, Helleland and Terkelsen, 1994; Kroner et al., 1990) and they also discovered that the mean age of men to get injury...
was higher than that of women. Besides, some other researches also reported that the incidence rate of men were higher than women (Fashlstrom et al., 1998b; Jorgensen & Winge, 1987; Kroner et al., 1990). Only Hensley and Paup (1979) had a contradictory finding that women (0.14) had a higher incidence rate than men (0.09).

Some researches focused on the patients who required hospital medication. The rate was not high compared to other sports. It accounted for less than 5% among all sports injuries in hospitals (Fashlstrom et al., 1998b; Hoy et al., 1994; Kroner et al., 1990). For the severity of the injuries, some of the researches categorized the injuries by the Abbreviated Injury Scale (AIS). Within the 100 cases of badminton injury in Denmark hospital, 17 of them were minor, 56 of them were moderate and 27 of them were severe. Moreover, it discovered that more than half of the players with severe level were older than 25 (Hoy et al., 1994). Another research also included the AIS scale in their study and reported that 51.3% of the injuries were minor and 48.7% were moderate but no one was
In severe level (Fashlstrom et al., 1998b).

Insufficient warm up prior the exercise would increase the risk of injuries. Kroner et al. (1990) found that 44.8% of the players in Denmark took less than 15 minutes to do warm up and they also found that players above 30 took significant less time to do warm up than the younger group. Another study by Fashlstrom et al. (1998b) also provided that most of the players did not have proper warm up before playing the game. Only 16.9% of the players had both warm up and stretch before exercise, and 28.6% of the players did not have any warm up or stretch at all.

Hensley and Paup (1979) investigated on the etiology and event types of the players. Players from club level to national team were involved. Within those 231 players, 82% of them have suffered from at least one injury caused by badminton. Single players (53%) were more prone to get hurt than doubles (34%) or mix (10%) players.

A recent research on Hong Kong elite athletes was conducted by Yung, Chan, Wong, Cheuk and Fong (2007). Their survey
divided the players into 3 groups by their performance level, including elite senior, elite junior and potential level. The incidence rate was about 5.04 per 1000 hours, while 2.49 was new injuries. Based on the information provided by the athletes, they tend to have higher risk of injury during training than competition for all the three groups (73.7%, 83.3% and 100%). Besides, it stated that senior athletes (7.38) were more prone to get injury than the junior athletes (5.03) and potential athletes (2.07). Furthermore, it was easier for elite senior athletes to get recurrent injury (4.58), while it was easier for elite junior athletes to get new injuries (3.10). The most common type of injuries were strain (64%), followed by sprain (14%).

李擎等人(2009) conducted a study on elite players in China, 73 types of injuries were reported and 93.4% of the players had injury before. Muscle injuries were the most frequent (21.5%) among all types of injuries, whereas waist injuries were most frequent (31.6%) among all injured sites, followed by ankle (17.1%), knee (15.6%) and thigh (7.4%). 劉開物(1999)
also investigated on elite junior players in China, it stated that 83.5% of the players had injury and reported a similar rate in boys and girls. Joint and ligament injuries ranked the highest (57.0%) followed by muscle injuries (42.2%) which confirmed with Kroner et al. (1990).

Jorgensen and Winge (1987) conducted a study including both elite and recreation players in Denmark. The incidence rate was 2.9 per 1000 playing hours; men were more frequent to get injury than women added that no significant difference was found between elite and recreation players. They extended their study and made consistent findings that males were more prone to get injury. However, they uncovered that recreational players had a higher risk than elite athletes in their second study (Jorgensen & Winge, 1990).

Furthermore, 余長青 and 石鴻冰 (2007) had study both elite and recreation players. There were no significant difference between elite (84.9%) and recreation players (83.4%). He separated the injuries into acute and chronic. 38.8% of the players got acute injuries, 29.4% got chronic injuries and
31.7% got both. He added that wrist and shoulder injuries were common among recreational players, which mainly caused by incorrect motions. On the other hand, lower limb injuries were dominant in elite players which was caused by overuse.

Murphy, Connolly and Beynnon (2003) had a review of the risk factors of lower extremity injury. Extrinsic factors include level of competition, shoe type, ankle bracing and playing surface; while intrinsic factors including age, genders, phase of menstrual cycle, previous injury experience, lack of recovery, fitness, flexibility, limb dominance and the anthropometry of the players.

Common Injuries among badminton players

Lower Extremity. With reference to the research in Denmark hospital (Kroner et al., 1990), lower extremity injuries were the most prominent and common among badminton injuries, which accounted for 82.9% of all the cases. Joint and ligament injuries were the most frequent (58.5%), while muscle injuries came second (66.9%). Another study in Sweden also had similar
findings, 92.3% of the badminton injuries occur in lower extremities (Fashlstrom et al., 1998b). Also, both studies mentioned that most of the players did not have proper warm up before exercise, which means including warm up and stretching exercise, and this would probably increase the risk of acute injuries, such as Achilles tendon rupture, ankle sprain and muscle or ligaments strain.

Hensley and Paup (1979) reported that most of the injuries in badminton were not prominent compared to other sports. 70% of the injuries were lower extremity injuries. More than half of the injuries were caused by intrinsic factors including retrieving (36%) and stroking (29%), while extrinsic factors only accounted for 35%. Chard and Lachmann (1987) had conducted an eight year retrospective studies on racket sports injuries. It stated that badminton shared similar injury patterns as squash and tennis. Lower limb injures were dominant in all three racket sports, and they stated that poor warm up was a common factor among the players.

In reviewing the work of Jorgensen and Winge (1987),
overuse injuries (74%) were the most common, followed by strain (12%) and sprain (11%). They extended their study on the injured sites and possible precautions of that. It stated that most injuries were located at foot and ankle, whereas overuse injuries were common in badminton players, especially tennis elbow. Achilles tendon rupture was rare and usually occurs in older recreational players (Jorgensen & Winge, 1990).

The incidence rate of lower extremity injuries (1.24) in Hong Kong elite athletes was double of the rate of upper extremity (0.62) and dorsal (0.64) (Yung et al., 2007). For Chinese elite players in China, they had some differences as in Hong Kong. Waist was the most frequent site of injury (31.64), and then several sites in lower limb followed, including ankle, knee, thigh, foot, calf, which totally accounted for more than half of the incidence (李擎等人, 2009).

_Achilles tendon_. Achilles tendon is a long board tendon at the back of the leg, which attaches the calf muscle with the calcaneous, human relies on it for the walking motion.
It is the strongest tendon in the body and which has the greatest tensile strength in human body (Miller, 2007).

Some common reasons of Achilles tendonitis include over training, anatomic variations, weakness and tightness of calf muscle (Miller, 2007). Achilles tendon rupture was the most severe acute injury in the lower leg which was quite common in badminton player above the age of 30 (Chan, Chung, & Ho, 2008; Fahlstrom et al., 1998a; Kaalund, Lass, Hogsaa & Nohr, 1989). With reference to Wang, Tu and Chiu (2007), maximum force acted on Achilles tendon occur when the ankle joint changes from dorsi-flexion to plantar flexion and study showed that Achilles tendon receives 46-75 times body weight. For sign, a “POP” sound will be heard at that moment, visible defect of the tendon, swelling and unable to stand or walk properly. People suffering from this need surgery in order to repair it (Anderson, Hall, & Martin, 2005).

An Orthopaedic and Traumatology Department of a public hospital in Hong Kong had received 15 patients with Achilles tendon rupture whereas one third of the cases were caused by
badminton (Chan et al., 2008). Similar research were done in Denmark, 39 out of 96 people require medical help from Aalborg Hospital were caused by badminton (Kaalund et al., 1989).

In Sweden, a hospital received 31 recreational badminton players who had Achilles tendon rupture (Fahlstrom et al., 1998a). The researchers concluded that age, high previous activity level and previous injury experience would increase the risk of Achilles tendon rupture. They extended their study on painful condition in Achilles tendon region among elite athletes. 32% of them reported disabling painful condition within the past five years and 17% had prolonged pain in that region (Fahlstrom, Lorentzon, and Alfredson, 2002).

Another research also done by Fahlstrom et al. (1998b) focused on all the acute badminton injuries in casualty. Achilles tendon rupture were the most popular account for 34.6%, second is ankle sprain 29.5%. In contrast, a report in Denmark casualty showed that only 13% of the cases are Achilles tendon rupture (Hoy et al., 1994).

Ankle. The early stage survey on badminton injuries was
done by Hensley and Paup (1979) on recreational players. 43% of the injuries were located at ankle which was the highest among all body sites and it was nearly three times more than the second frequent injured site. There were no significant difference between males and females in ankle injury, while there was big different in knee and leg, as either one of them was dominant. 劉開物 (1999) had a study on junior players and stated that joint and ligament injuries were the highest among all types of injuries. Moreover, ankle injury (22.8%) was the highest among all sites.

There were several researchers studied cases in hospital. Research in Denmark hospital found that 66.9% of the ligament injuries were in ankle, and it informed that it was more common in younger group. He suggested that intensive and coordinate exercise and taping may help to reduce the risk of occurrence (Kroner et al., 1990). Another study in Sweden hospital recorded that ankle sprain as the second highest injury among badminton injury accounted for 29.5% of the acute badminton injury. It also discovered that 52.2% of ankle sprain occur
in the middle of the playing time (Fashlstrom et al., 1998b).

Apart from survey that focused on badminton, another survey studied sport-related ankle injury in Hong Kong. There were 240 sport-related ankle injuries required medical help from Prince of Wales Hospital within one year. Most cases were sustained from contact sports including basketball (32.9%) and soccer (31.7%) and ligament sprain (81.3%) occurred in most cases and fractures (10.4%) was comparatively rare. Besides, ankle sprain due to badminton was not often, which only accounted for 4 cases in a year (Fong, Man, Yung, Cheung, & Chan, 2008).

On the contrary, there were some studies did not agree with the above findings. 余長青 and 石鴻冰 (2007) had a research on both elite and recreational players, ankle injury was not that common in their study, It only ranked fifth (18.5%), while upper limb injuries were more common including wrist (27.2%) and elbow (25.4%). Besides, Yung et al. (2007) found that the incidence rate of ankle injury was not that high as before. It only ranked fourth in elite athletes in Hong Kong, where
back, thigh and knee recorded a higher rate of incidence than ankle. 李擎等人 (2009) also found that there was a higher rate of injury in waist (31.6%) rather than ankle (17.2%) among Chinese elite athletes.

Shoulder. Shoulder injuries were most likely to occur when the shoulder transform from the cocking phase to acceleration phase. It gave great stress to the shoulder as it transformed from external rotation to internal rotation rapidly (Lintner, Noonan, & Kibler, 2008). The researchers also supported that the angular velocity of this throwing action was the fastest in human motion and the peak rotation was about 7000 degree per second.

Since badminton required over-shoulder motions very often, which abduct and external rotate the shoulder joint and generate forceful movement within a short period of time frequently. This explained why more than half of the elite players have shoulder pain within their career (Fahlstrom, Joo Seng, Alfredson, & Soderman, 2006). Some possible causes of shoulder injury including overtraining, inadequate skill
level, wrong movement, competition, lack of warm up, stiff muscle (李正洪, 吳靜, 2006), tired, lack of recovery (劉智英, 鄭學軍, 2009) and muscle imbalance (王金亮, 彭云志, 2006).

Elite athletes in Hong Kong demonstrated shoulder pain was the most serious problem in upper extremities. It accounted for nearly half of the upper extremity injuries and it was one of the most often injured sites among the whole body. It also recorded that it had the highest incidence rate in elite senior athlete, which shows that overuse was one of the major reason of them (Yung et al., 2007). In addition, 52% of the players in World Mixed Team Championships revealed previous or present painful condition in shoulder, while 37% were previous and 20% were on going. Moreover, shoulder pain not just affected their badminton habit and sleeping quality, but also their daily life. (Fahlstrom et al., 2006)

Not only the world class athletes, Fahlstrom and Soderman (2007) also found that recreational players have a similar figure on shoulder pain in their dominant side. 52% of the players reported painful condition in their shoulder and 16%
reported on going pain which affected their normal training.

Lower back. Badminton intensity was high with complicated trunk movement. A lot of trunk movements including flexion and extension; abduction and adduction; and rotation were necessary. Those movements were usually large degree forceful action with sudden change of direction and speed, which produced great stress to the spine; both acute trauma and chronic overload are common in badminton players (陳揚等人, 2006).

Research on senior players in Malaysia presented more than 30% of them suffered from low back pain, it also found out that players in elite level were even more liable to low back pain. (Chiao Yee, Yeap, & Singh, 2006) There was another study on elite athletes in China, where 53.6% of the elite athletes suffered from chronic low back pain. Tendonitis and dislocation of vertebrate were more common, which accounted for 38% and 35%. Reasons of those injuries included improper movement during the game, poor body condition and also some external factor like the court surface (陳揚等人, 2006).
Physiological needs and characteristics of badminton

Although Badminton is a non-contact sports, but it also required high intensity of work out, players requires change the speed and direction in seconds. Requirement on endurance, strength, power agility and coordination were relatively high. Being good in both aerobic and anaerobic systems were necessary for a good player. (李擎等人, 2009)

Hughes (1995) found that the maximum heart rate for adult was 186 beats/min, which is close to their theoretical maximum. Cabello Manrique and Badillo (2003) focused on physiological variables such as heart rate and lactate concentration on badminton players. Study on eleven players from four national team showed that the maximum heart rate was 190 beats/ min with an average heart rate during the game is 173.5 beats/min. For the performance and rest ratio (action interval), it was about 1:2, 6.4 seconds performance with 12.9 seconds rest which has consistence finding as his previous studies where the ratio was 8 seconds performance with 16 seconds rest. He also pointed out that the mean maximum concentration of
lactate was 4.6 mmol/ml which conformed to other researchers that the maximum lactate concentration was less than 5 mmol/l (Abe, Haga, & Nakatani, 1990; Ghosh, Goswami, & Ahuja, 1993; Ghost, Mazumdar, & Goswami, 1990).

According to 劉開物 (1999), former world champion from China, Suen Chun and Gong Chi Chiu have recorded maximum heart rate more than 200 beats per minute in the competition, while the mean heart rate was 186 and 185 beats respectively. This figure demonstrated that how high intensity badminton player have.

Majumdar et al. (1997) investigated the physiological response of badminton players during training; they discovered that court training has a higher intensity than playing a game. A high lactate values (8-10.5 mmol/l) have been recorded in his research. During the shadow play practice, which is much higher than the competition, the maximal lactate were around 3-6mmol/l. He has also stated that the possible problems included affecting the coordination, inhibiting fat oxidation, acidosis affecting the endurance.

Tsai, Pan, Huang and Chang (2007) studied the EMG signal
of lower extremity in badminton smash and reported that quadriceps played an important role especially the rectus femories and vastus medialis. Strengthening of those muscles could increase the power and ability when performing smash.

Summary

In summary, badminton is a sport which requires both good aerobic and anaerobic fitness. Besides, coordination and agility were necessary for a good player. Sudden change of directions and speed were very common in badminton, and these changes suddenly increase the load of muscles which may lead to injury.

Common types of injury in badminton including muscles strain, ligaments sprain, and overuse. Most of the injuries were localize at the lower extremity, where ankle sprain and leg muscle strain were common. Most of the injuries were not very serious in badminton, except Achilles tendon rupture, which requires surgery to repair and needs long time for returning back to the court.
Chapter 3

Method

The method of this study was presented in the following sections: 1) The subjects, 2) Instruments, 3) Procedures, 4) Data Collection and 5) Method of analysis.

The Subjects

The subjects were both male and female badminton players. They were from 26 badminton clubs, 10 tertiary institutes, 22 secondary schools and some recreational players who had regular badminton practice. The total number of subjects was 1200 with 691 males (57.6%) and 509 females (42.4%) respectively, aged 11 to 64.

The performance level included Hong Kong team players (1.8%), junior squads (12.8%), club representatives (24.1%), school team players (26.2%) and recreational players (35.2%).

Instruments

Since there was no previous studies data collection instrument available, a self-designed questionnaire was used as the method of collecting data (see Appendix A). The
procedures for developing the self-designed questionnaires are based on reviewing the journals which were related to the research topic. The development of the questionnaire and translation were supervised by the advisor. The questionnaire consisted of 18 questions, which were divided into two parts.

In the first part, the demographic information of the respondents such as gender, performance level, dominant events, training hours on badminton and fitness, warm up and cool down exercise habit and perceived knowledge on injury were investigated. They were not required to give their names.

In the second part, it focused on injuries caused by badminton within one year period. Common injuries in badminton were investigated, sorted by injury sites with types of injuries, other injuries out of the list would be asked to specify by the subject. The cause of injuries was divided into intrinsic and extrinsic factors, time for recovery and medical help from hospitals have also been asked.
Procedures

In order to assess the suitability of the questionnaire before the actual adoption for the main study, a pilot test was conducted with the players from Hong Kong Baptist University badminton team and Bauhinia Culture Badminton Club. The purposes of this pilot study were two-fold: (1) to see whether the Chinese translation matches the English items accurately, and (2) to test whether the wordings were comprehensible and acceptable. In this pilot study, 30 members were asked to complete the questionnaire and stated out the problem of understanding the questions after completing the questionnaires.

In the main study, questionnaires were administered to subjects by their coaches or team captains. The purpose of the study has been explained to the subject by the administrator. The respondents were asked to recall their past experience in badminton within the past one year. Each questionnaire took approximately 3 minutes to complete. Distribution of the questionnaires to different clubs and
schools has started from January 2010.

Data Collection

The questionnaires were distributed to coaches and captains from different schools and badminton clubs. A total of 1500 questionnaires were distributed while 1200 questionnaires were returned. After the completion of the project, all questionnaires were destroyed to ensure confidentiality.

Method of Analysis

All the responses of the questionnaires will be coded for further data analysis and inputed into Statistic Package of Social Science 16.0 for windows” (SPSS 16.0) and Microsoft Excel. All statistical procedures were tested at the 0.05 level of significance.

Descriptive statistics such as frequency, mean, standard deviation and percentage will be used to describe the social demographic information such as the personal data, exercise and warm up habit and injury patterns of the subjects.

In comparing the means difference between male players and
female players in hours of badminton and additional fitness training, the independent group t-test was used.

Chi square will be used to determine whether there are any significant differences between the frequency of injury in different group categories.
Chapter 4

Analysis of Data

The purpose of this study was to investigate the injury patterns of the badminton players who have regularly participated in badminton activity. It also measured whether the demography affects the injury patterns or causes of injuries.

The descriptive statistics, independent t-test, Chi square were used to analyze the data. The analyses of the data were presented in the following results:

1. Demographic information of respondents
2. Age group distribution with percentage of injuries
3. Hours of badminton and fitness training of the players
4. Exposure hours and the incidence rate of injuries for different performance groups
5. Warm up patterns of the players
6. Chi square test on the frequency of injury in different categories of background information
7. Details of injuries among injured body sites and injury types

8. Injury patterns of the players

9. The Ten Most Common Injuries in Badminton

10. Causes of Injuries

11. Treatments for Injuries

12. Acute injuries that required medical help for casualty

13. Recovery period for injuries
Results

Demographic information of respondents

In this study, there were 1200 badminton players involved, 691 were male (57.6%) and 509 were female (42.2%). The overall mean age was 26 (SD±13), ranged from 11 to 64. The gender distribution, mean age and percentage of injury in different groups were summarized in Table 1.

Of the players, 21 were Hong Kong Team Level (1.8%), 153 were Junior squad level (12.8%), 289 were club representative level (24.1%), 315 were school team level (26.2%) and 422 described themselves as recreational level (35.2%).

Overall in this study, 46% of the players have suffered from injury during the past one year. Within these five groups, Hong Kong Team players had the highest percentage of injury (71%) while school team players had the lowest percentage of injury (35%). For the other groups, there were 45%-57% of the players have suffered from injuries.

Chi square showed a significant difference (p<.05) among the total number of injured players in different performance
levels. (Hong Kong Team: 15 players, 71%; junior squad: 87 players, 57%; club representative: 141 players, 49%; school team: 111 players, 35%; recreational player: 193 players, 46%)

**Table 1**

*Demographic information of players (N=1200)*

<table>
<thead>
<tr>
<th>Performance Levels</th>
<th>Male</th>
<th>Female</th>
<th>Mean Age</th>
<th>Injury</th>
<th>No injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>HK Team Player (n=21)</td>
<td>13</td>
<td>8</td>
<td>30</td>
<td>15(71%)</td>
<td>6(29%)</td>
</tr>
<tr>
<td>Junior Squad (n=153)</td>
<td>80</td>
<td>73</td>
<td>20</td>
<td>87(57%)</td>
<td>66(43%)</td>
</tr>
<tr>
<td>Club representative (n=289)</td>
<td>174</td>
<td>115</td>
<td>25</td>
<td>141(49%)</td>
<td>148(51%)</td>
</tr>
<tr>
<td>School team player (n=315)</td>
<td>182</td>
<td>133</td>
<td>16</td>
<td>111(35%)</td>
<td>204(65%)</td>
</tr>
<tr>
<td>Recreational player (n=422)</td>
<td>242</td>
<td>180</td>
<td>34</td>
<td>193(46%)</td>
<td>229(54%)</td>
</tr>
<tr>
<td>Total (n=1200)</td>
<td>691</td>
<td>509</td>
<td>26</td>
<td>547(46%)</td>
<td>653(54%)</td>
</tr>
</tbody>
</table>
Age group distribution with percentage of injuries

Of whom, 440 players were under 18 (37%), 312 were between 18 and 25 (26%), 293 were between 26 and 45 (24%) and 155 were above 45 (13%). Table 2 illustrated the percentage of injuries among different age groups. Significant difference was found in Table 2. There was an increasing trend of injury with age; the elder group had a relatively higher percentage of injury than the younger groups.

Table 2
Age distribution of players with percentage of injuries (N=1200)

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>With Injury</th>
<th>Without injury</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 18</td>
<td>171</td>
<td>269</td>
<td>440</td>
</tr>
<tr>
<td>18 to 25</td>
<td>131</td>
<td>181</td>
<td>312</td>
</tr>
<tr>
<td>26 to 45</td>
<td>151</td>
<td>142</td>
<td>293</td>
</tr>
<tr>
<td>Older than 45</td>
<td>94</td>
<td>61</td>
<td>155</td>
</tr>
<tr>
<td>Total</td>
<td>547</td>
<td>653</td>
<td>1200</td>
</tr>
</tbody>
</table>
Hours of badminton and fitness training of the players

The mean hours spent on training were illustrated in Table 3. The mean hours for badminton for males and females were 5.91 (SD±4.20) and 5.40 (SD±3.54), while the mean hours for fitness training for males and females were 1.69 (SD±2.00) and 1.08 (SD±1.4). Both of them showed significant mean difference, (t=2.228; p=0.026) in number of hours of badminton between males and females; and (t=5.862; p=0.000) in number of hours of fitness training between males and females. Males spent more time in both badminton activity and fitness training than females.

Table 3
Independent t-tests of hours of badminton or fitness training among Males and Females Players (N=1200)

<table>
<thead>
<tr>
<th>Gender</th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>Mean Difference</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours of Badminton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5.91</td>
<td>4.20</td>
<td>691</td>
<td>0.51</td>
<td>2.23</td>
<td>*0.026</td>
</tr>
<tr>
<td>Female</td>
<td>5.40</td>
<td>3.54</td>
<td>509</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hours of fitness training</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.69</td>
<td>2.00</td>
<td>691</td>
<td>0.61</td>
<td>5.86</td>
<td>*0.000</td>
</tr>
<tr>
<td>Female</td>
<td>1.08</td>
<td>1.40</td>
<td>509</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<.05, two-tailed.
Exposure hours and the incidence rate of injuries for different performance groups

Exposure hours for different performance groups were shown in Table 4. The mean playing hours per week per player was 5.7 (SD±3.9). The total playing hours for all the respondents were 6825.5 hours per week, approximately 354926 playing hours per year. Among them, 1499 injuries were recorded in a total of 1200 players in the past one year. The overall incidence rate of injuries was found to be 4.22 injuries per 1000 hours.

Among these five groups, recreational players had the highest incidence rate of injuries (5.66), followed by club representatives (4.32). Hong Kong team players (3.64) and junior squads (3.26) ranked third and forth, while school team players had the lowest incidence rate of injuries (3.22).
Table 4
Exposure Hours, total number of injuries and incidence rate of injuries (per 1000 hours) for each group of players (N=1200)

<table>
<thead>
<tr>
<th>Performance Levels</th>
<th>Exposure hours</th>
<th>Total number of injuries</th>
<th>Incidence rate of injuries (per 1000 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong Team Player (n=21)</td>
<td>12,896</td>
<td>47</td>
<td>3.64</td>
</tr>
<tr>
<td>Junior Squad (n=153)</td>
<td>68,068</td>
<td>222</td>
<td>3.26</td>
</tr>
<tr>
<td>Club representative (n=289)</td>
<td>90,714</td>
<td>392</td>
<td>4.32</td>
</tr>
<tr>
<td>School team player (n=315)</td>
<td>81,458</td>
<td>262</td>
<td>3.22</td>
</tr>
<tr>
<td>Recreational player (n=422)</td>
<td>101,790</td>
<td>576</td>
<td>5.66</td>
</tr>
<tr>
<td>Total (n=1200)</td>
<td>354,962</td>
<td>1499</td>
<td>4.22</td>
</tr>
</tbody>
</table>
Warm up patterns of the players

The vast majority of the players (635) spent 5 to 10 minutes to warm up prior badminton, 382 players spent less than 5 minutes, and only 183 players spent more than 10 minutes to warm up. Chi square showed no significant difference in different warm up time in males and females. Details were shown in Table 5 and Figure 1.

In this questionnaire, warm up exercise had been classified into jogging, stretching and specific warm up. We would consider both jogging and specific warm up as warming up exercise for muscles. 92.7% of the players had stretching before exercise, and 44.6% of the players had both warming up and stretching before exercise. Whereas, only 6.9% of the players either jogged or had specific warm up and less than 1% of players did not have any warm up at all. Details were shown in Table 6 and Figure 2.
Table 5
Time spent on warm up time for different genders (N=1200)

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5min</td>
<td>217</td>
<td>165</td>
<td>382</td>
<td>0.139</td>
</tr>
<tr>
<td>5-10min</td>
<td>371</td>
<td>264</td>
<td>635</td>
<td>0.391</td>
</tr>
<tr>
<td>&gt;10min</td>
<td>103</td>
<td>80</td>
<td>183</td>
<td>0.149</td>
</tr>
<tr>
<td>Total</td>
<td>691</td>
<td>509</td>
<td>1200</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure 1. Histogram of the time spent on warm up of the players
Table 6
Warm up patterns for different genders (N=1200)

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 type</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1 type</td>
<td>355</td>
<td>301</td>
<td>656</td>
</tr>
<tr>
<td>2 types</td>
<td>239</td>
<td>160</td>
<td>399</td>
</tr>
<tr>
<td>3 types</td>
<td>93</td>
<td>47</td>
<td>140</td>
</tr>
<tr>
<td>Total</td>
<td>691</td>
<td>509</td>
<td>1200</td>
</tr>
</tbody>
</table>

Figure 2. Histogram of the warm up patterns of the players
Chi square test on the frequency of injuries in different categories of background information

Chi square test was performed to find out whether there are any significant differences between the frequency of injury in different categories of background information of the players. Data were displayed in Table 7.

Significant difference were found between the frequency of injury in different genders (p=0.019); age groups (p=0.000); levels (p=0.000); event types (p=0.008); competition habits (p=0.000) and cool down habits (p=0.000).

However, results showed that there was no significant between the frequency of injury in different warm up time, with or without fitness training and knowledge on sports injury.
Table 7
Chi square test for different categories with injury (N=1200)

<table>
<thead>
<tr>
<th>Categories</th>
<th>Chi square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>335</td>
<td>5.512</td>
</tr>
<tr>
<td>Female</td>
<td>212</td>
<td></td>
</tr>
<tr>
<td>Age Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;18</td>
<td>171</td>
<td>27.997</td>
</tr>
<tr>
<td>18-25</td>
<td>131</td>
<td></td>
</tr>
<tr>
<td>26-45</td>
<td>151</td>
<td></td>
</tr>
<tr>
<td>&gt;45</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HK Team</td>
<td>15</td>
<td>28.295</td>
</tr>
<tr>
<td>Junior Squad</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Club representative</td>
<td>141</td>
<td></td>
</tr>
<tr>
<td>School team player</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>Recreational player</td>
<td>193</td>
<td></td>
</tr>
<tr>
<td>Event type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>82</td>
<td>9.682</td>
</tr>
<tr>
<td>Doubles</td>
<td>241</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td>224</td>
<td></td>
</tr>
<tr>
<td>Fitness training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With</td>
<td>373</td>
<td>1.692</td>
</tr>
<tr>
<td>Without</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>Competition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Join</td>
<td>393</td>
<td>14.485</td>
</tr>
<tr>
<td>Not joining</td>
<td>154</td>
<td></td>
</tr>
<tr>
<td>Warm up Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 min</td>
<td>160</td>
<td>3.925</td>
</tr>
<tr>
<td>5-10 min</td>
<td>295</td>
<td></td>
</tr>
<tr>
<td>&gt;10 min</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>Cool down</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have</td>
<td>362</td>
<td>17.716</td>
</tr>
<tr>
<td>Not have</td>
<td>185</td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sufficient</td>
<td>199</td>
<td>1.908</td>
</tr>
<tr>
<td>Insufficient</td>
<td>348</td>
<td></td>
</tr>
</tbody>
</table>
Details of injuries among injured body sites and injury types

Injured body sites

Among all the injured body sites, lower extremity injuries were higher (incidence rate=1.967) than both upper extremity (incidence rate=1.508) and dorsal (incidence rate=0.730). Interestingly, recreational players had a higher incidence rate of injury in upper extremity (2.417) than lower extremity (2.230), which was different from other groups.

Overall, most frequently injured body sites included ankle and foot (incidence rate=0.73), knee (incidence rate=0.69), waist (incidence rate=0.64), shoulder (incidence rate=0.59) and elbow and arm (incidence rate=0.53).

For Hong Kong team and club representatives, knee injuries were prevailing, whereas ankle and foot injuries were leading in junior squad and school team players. Nevertheless, elbow and arm injuries were dominant in recreational players. The details of injured body sites with incidence rate were summarized in Table 8.
Table 8
Number and Incidence (per 1,000 player hours) of Injury with Different Injured Body Sites for different performance level players (N=547)

<table>
<thead>
<tr>
<th>Injured body sites</th>
<th>HK Team Player</th>
<th>Junior Squad</th>
<th>Club Representative</th>
<th>School Team Player</th>
<th>Recreational Player</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>0 0.000</td>
<td>1 0.015</td>
<td>1 0.011</td>
<td>2 0.025</td>
<td>5 0.049</td>
<td>9 0.03</td>
</tr>
<tr>
<td>Eye</td>
<td>1 0.078</td>
<td>1 0.015</td>
<td>5 0.055</td>
<td>0 0.000</td>
<td>4 0.039</td>
<td>11 0.03</td>
</tr>
<tr>
<td>Waist</td>
<td>7 0.543</td>
<td>43 0.632</td>
<td>51 0.562</td>
<td>35 0.430</td>
<td>90 0.884</td>
<td>226 0.64</td>
</tr>
<tr>
<td>Abdomen</td>
<td>0 0.000</td>
<td>2 0.029</td>
<td>4 0.044</td>
<td>3 0.037</td>
<td>4 0.039</td>
<td>13 0.04</td>
</tr>
<tr>
<td>Total dorsal</td>
<td>8 0.620</td>
<td>47 0.690</td>
<td>61 0.672</td>
<td>40 0.491</td>
<td>103 1.012</td>
<td>259 0.73</td>
</tr>
<tr>
<td>Shoulder</td>
<td>6 0.465</td>
<td>26 0.382</td>
<td>51 0.562</td>
<td>30 0.368</td>
<td>95 0.933</td>
<td>208 0.59</td>
</tr>
<tr>
<td>Elbow/Arm</td>
<td>5 0.388</td>
<td>17 0.250</td>
<td>40 0.441</td>
<td>29 0.356</td>
<td>98 0.963</td>
<td>189 0.53</td>
</tr>
<tr>
<td>Wrist</td>
<td>6 0.465</td>
<td>12 0.176</td>
<td>41 0.452</td>
<td>26 0.319</td>
<td>53 0.521</td>
<td>138 0.39</td>
</tr>
<tr>
<td>Total upper extremity</td>
<td>17 1.318</td>
<td>55 0.808</td>
<td>132 1.455</td>
<td>85 1.043</td>
<td>246 2.417</td>
<td>535 1.51</td>
</tr>
<tr>
<td>Knee</td>
<td>10 0.775</td>
<td>36 0.529</td>
<td>74 0.816</td>
<td>34 0.417</td>
<td>92 0.904</td>
<td>246 0.69</td>
</tr>
<tr>
<td>Ankle/Foot</td>
<td>7 0.543</td>
<td>47 0.690</td>
<td>71 0.783</td>
<td>54 0.663</td>
<td>80 0.786</td>
<td>259 0.73</td>
</tr>
<tr>
<td>Thigh</td>
<td>5 0.388</td>
<td>27 0.397</td>
<td>39 0.430</td>
<td>29 0.356</td>
<td>28 0.275</td>
<td>128 0.36</td>
</tr>
<tr>
<td>Calf</td>
<td>0 0.000</td>
<td>8 0.118</td>
<td>12 0.132</td>
<td>18 0.221</td>
<td>27 0.265</td>
<td>65 0.18</td>
</tr>
<tr>
<td>Total lower extremity</td>
<td>22 1.706</td>
<td>118 1.734</td>
<td>196 2.161</td>
<td>135 1.657</td>
<td>227 2.230</td>
<td>698 1.97</td>
</tr>
<tr>
<td>Other injuries</td>
<td>0 0.000</td>
<td>2 0.029</td>
<td>3 0.033</td>
<td>2 0.025</td>
<td>0 0.000</td>
<td>7 0.02</td>
</tr>
</tbody>
</table>
Injuries types

Most of the injuries were strain and overuse (512 cases, incidence rate=1.44; 496 cases, incidence rate=1.40), followed by sprain (406 cases, incidence rate=1.14). Reviewing contusion injuries, it was more common in non elite players than elite players (incidence rate=1:9). Fracture, dislocation, ligament and tendon injuries were rare with a low incidence rate range from 0.01-0.11 incidence per 1000 playing hours.

Hong Kong team, club representatives and recreational players shared similar injury patterns. Both of them were dominant in overuse injuries, followed by strain and sprain, while strain injuries were prevalent in junior squad and school team players. The details of injuries type with incidence rate were summarized in Table 9.
Table 9
Number and Incidence (per 1,000 player hours) of Injury with Different Injury Types for different performance level players (N=547)

<table>
<thead>
<tr>
<th>Injury types</th>
<th>HK Team Player</th>
<th>Junior Squad</th>
<th>Club Representative</th>
<th>School Team Player</th>
<th>Recreational Player</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprain</td>
<td>8 0.620</td>
<td>57 0.837</td>
<td>111 1.224</td>
<td>89 1.093</td>
<td>141 1.385</td>
<td>406 1.14</td>
</tr>
<tr>
<td>Strain</td>
<td>13 1.008</td>
<td>83 1.219</td>
<td>122 1.345</td>
<td>111 1.363</td>
<td>183 1.798</td>
<td>512 1.44</td>
</tr>
<tr>
<td>Overuse</td>
<td>24 1.861</td>
<td>69 1.014</td>
<td>136 1.499</td>
<td>47 0.577</td>
<td>220 2.161</td>
<td>496 1.40</td>
</tr>
<tr>
<td>Contusion</td>
<td>2 0.155</td>
<td>2 0.029</td>
<td>10 0.110</td>
<td>10 0.123</td>
<td>16 0.157</td>
<td>40 0.11</td>
</tr>
<tr>
<td>Facture</td>
<td>0 0.000</td>
<td>3 0.044</td>
<td>1 0.011</td>
<td>2 0.025</td>
<td>2 0.020</td>
<td>8 0.02</td>
</tr>
<tr>
<td>Dislocation</td>
<td>0 0.000</td>
<td>2 0.029</td>
<td>2 0.022</td>
<td>0 0.000</td>
<td>1 0.010</td>
<td>5 0.01</td>
</tr>
<tr>
<td>Ligament/Tendon rupture</td>
<td>0 0.000</td>
<td>1 0.015</td>
<td>5 0.055</td>
<td>0 0.000</td>
<td>4 0.039</td>
<td>10 0.03</td>
</tr>
<tr>
<td>Other types</td>
<td>0 0.000</td>
<td>5 0.073</td>
<td>5 0.055</td>
<td>3 0.037</td>
<td>9 0.088</td>
<td>22 0.06</td>
</tr>
</tbody>
</table>
Injury patterns of the players

For those who had injury, they were asked to identify the injuries that they have suffered from. There were 28 injuries concluded from this study. Both injured site and injury types were asked. The distributions of all the injuries were summarized in Table 10.

In considering shoulder sprain, shoulder inflammation, waist chronic pain, knee sprain and calf muscles strain. Chi square showed a significant difference (p<.05) among those injuries between males and females, where males had a higher frequency to suffer from those injuries.

Waist injuries accounted for 0.6 of the injuries. It is one of the most common sites of injuries and most of them are chronic. Anterior cruciate ligament rupture and Achilles tendon rupture were serious injuries and they rarely occur. It reported that males (8cases) showed a higher tendency in these two injuries than female (2cases). Other injuries reported included, skin problem, ligament injury, finger, abrasion, Achilles tendonitis, and adductor strain.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Incidence Rate</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head Contusion</td>
<td>5</td>
<td>0.5%</td>
<td>4</td>
<td>0.7%</td>
<td>9</td>
</tr>
<tr>
<td>Eye Contusion</td>
<td>5</td>
<td>0.5%</td>
<td>6</td>
<td>1.1%</td>
<td>11</td>
</tr>
<tr>
<td>Shoulder Sprain</td>
<td>34</td>
<td>3.6%</td>
<td>11</td>
<td>2.0%</td>
<td>45</td>
</tr>
<tr>
<td>Shoulder Dislocation</td>
<td>1</td>
<td>0.1%</td>
<td>2</td>
<td>0.4%</td>
<td>3</td>
</tr>
<tr>
<td>Shoulder Muscle strain</td>
<td>68</td>
<td>7.1%</td>
<td>45</td>
<td>8.2%</td>
<td>113</td>
</tr>
<tr>
<td>Shoulder Inflammation</td>
<td>37</td>
<td>3.9%</td>
<td>10</td>
<td>1.8%</td>
<td>47</td>
</tr>
<tr>
<td>Elbow Contusion</td>
<td>13</td>
<td>1.4%</td>
<td>7</td>
<td>1.3%</td>
<td>20</td>
</tr>
<tr>
<td>Tennis Elbow</td>
<td>61</td>
<td>6.4%</td>
<td>37</td>
<td>6.8%</td>
<td>98</td>
</tr>
<tr>
<td>Forearm Muscle Strain</td>
<td>40</td>
<td>4.2%</td>
<td>31</td>
<td>5.7%</td>
<td>71</td>
</tr>
<tr>
<td>Wrist Sprain</td>
<td>49</td>
<td>5.1%</td>
<td>26</td>
<td>4.8%</td>
<td>75</td>
</tr>
<tr>
<td>Wrist Dislocation</td>
<td>2</td>
<td>0.2%</td>
<td>0</td>
<td>0.0%</td>
<td>2</td>
</tr>
<tr>
<td>Wrist Chronic pain</td>
<td>42</td>
<td>4.4%</td>
<td>19</td>
<td>3.5%</td>
<td>61</td>
</tr>
<tr>
<td>Waist Strain</td>
<td>66</td>
<td>6.9%</td>
<td>56</td>
<td>10.2%</td>
<td>122</td>
</tr>
<tr>
<td>Waist Vertebral subluxation</td>
<td>10</td>
<td>1.1%</td>
<td>3</td>
<td>0.5%</td>
<td>13</td>
</tr>
<tr>
<td>Waist Chronic pain</td>
<td>64</td>
<td>6.7%</td>
<td>27</td>
<td>4.9%</td>
<td>91</td>
</tr>
<tr>
<td>Abdomen Muscle Strain</td>
<td>6</td>
<td>0.6%</td>
<td>7</td>
<td>1.3%</td>
<td>13</td>
</tr>
<tr>
<td>Knee Sprain</td>
<td>46</td>
<td>4.8%</td>
<td>19</td>
<td>3.5%</td>
<td>65</td>
</tr>
<tr>
<td>Knee Overuse</td>
<td>111</td>
<td>11.7%</td>
<td>62</td>
<td>11.3%</td>
<td>173</td>
</tr>
<tr>
<td>Knee ACL Rupture</td>
<td>4</td>
<td>0.4%</td>
<td>2</td>
<td>0.4%</td>
<td>6</td>
</tr>
<tr>
<td>Knee Meniscus Tear</td>
<td>1</td>
<td>0.1%</td>
<td>1</td>
<td>0.2%</td>
<td>2</td>
</tr>
<tr>
<td>Ankle Sprain</td>
<td>134</td>
<td>14.1%</td>
<td>87</td>
<td>15.9%</td>
<td>221</td>
</tr>
<tr>
<td>Ankle Facture</td>
<td>3</td>
<td>0.3%</td>
<td>5</td>
<td>0.9%</td>
<td>8</td>
</tr>
<tr>
<td>Achilles Tendon Rupture</td>
<td>4</td>
<td>0.4%</td>
<td>0</td>
<td>0.0%</td>
<td>4</td>
</tr>
<tr>
<td>Plantar Fasciitis</td>
<td>14</td>
<td>1.5%</td>
<td>12</td>
<td>2.2%</td>
<td>26</td>
</tr>
<tr>
<td>Quadriceps Muscles Strain</td>
<td>33</td>
<td>3.5%</td>
<td>16</td>
<td>2.9%</td>
<td>49</td>
</tr>
<tr>
<td>Hamstring Muscles Strain</td>
<td>45</td>
<td>4.7%</td>
<td>34</td>
<td>6.2%</td>
<td>79</td>
</tr>
<tr>
<td>Calf Muscles Strain</td>
<td>50</td>
<td>5.3%</td>
<td>15</td>
<td>2.7%</td>
<td>65</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
<td>0.4%</td>
<td>3</td>
<td>0.5%</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>952</td>
<td>100.0%</td>
<td>547</td>
<td>100.0%</td>
<td>1499</td>
</tr>
</tbody>
</table>

*p<.05
The Ten Most Common Injuries in Badminton

The details of the top 10 injuries were shown in Figure 3 and Table 11. Ankle sprain with 221 cases (0.62) were the most common among all injuries, followed by knee overuse with 173 cases (0.49), waist strain with 122 cases (0.34) and shoulder muscle strain with 113 cases (0.32).

Overuse injuries including knee overuse (incidence rate=0.49), tennis elbow (incidence rate=0.28) and waist chronic pain (incidence rate=0.26) were also common.

Apart from extremity injuries, waist injuries were also dominant, both waist strain (incidence rate=0.34) and waist chronic pain (incidence rate=0.26) were affected many badminton players.

For waist chronic pain, knee sprain and calf muscle strain, chi square showed a significant difference (p<.05) in those injuries with different genders.
Table 11  
The ten most common Injuries in badminton for different genders (N=547)

<table>
<thead>
<tr>
<th>Injury</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Incidence rate</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankle Sprain</td>
<td>134.00</td>
<td>61%</td>
<td>87.00</td>
<td>39%</td>
<td>221.00</td>
</tr>
<tr>
<td>Knee Overuse</td>
<td>111.00</td>
<td>64%</td>
<td>62.00</td>
<td>36%</td>
<td>173.00</td>
</tr>
<tr>
<td>Waist Strain</td>
<td>66.00</td>
<td>54%</td>
<td>56.00</td>
<td>46%</td>
<td>122.00</td>
</tr>
<tr>
<td>Shoulder Muscle Strain</td>
<td>68.00</td>
<td>60%</td>
<td>45.00</td>
<td>40%</td>
<td>113.00</td>
</tr>
<tr>
<td>Tennis Elbow</td>
<td>61.00</td>
<td>62%</td>
<td>37.00</td>
<td>38%</td>
<td>98.00</td>
</tr>
<tr>
<td>Waist Chronic Pain</td>
<td>64.00</td>
<td>70%</td>
<td>27.00</td>
<td>30%</td>
<td>91.00</td>
</tr>
<tr>
<td>Hamstring Muscles Strain</td>
<td>45.00</td>
<td>57%</td>
<td>34.00</td>
<td>43%</td>
<td>79.00</td>
</tr>
<tr>
<td>Wrist Sprain</td>
<td>49.00</td>
<td>65%</td>
<td>26.00</td>
<td>35%</td>
<td>75.00</td>
</tr>
<tr>
<td>Forearm Muscle Strain</td>
<td>40.00</td>
<td>56%</td>
<td>31.00</td>
<td>44%</td>
<td>71.00</td>
</tr>
<tr>
<td>Knee Sprain</td>
<td>46.00</td>
<td>71%</td>
<td>19.00</td>
<td>29%</td>
<td>65.00</td>
</tr>
<tr>
<td>Calf Muscles Strain</td>
<td>50.00</td>
<td>77%</td>
<td>15.00</td>
<td>23%</td>
<td>65.00</td>
</tr>
</tbody>
</table>
Figure 3. Histogram of the frequency of the top 10 injuries in males and females
Causes of Injuries

In this questionnaire, causes of injury were classified into intrinsic and extrinsic factors which were shown in Table 12 and Figure 4.

Insufficient warm up (17.5%), wrong movement (17.1%), tiredness (16.3%), recurrent injuries (13.1%), poor fitness (11.3%) and overtraining (10.8%) were classified as intrinsic factors. Court (6.9%), negligence (3.4%), improper equipment (3.2%) and other factors (0.4%) were classified as extrinsic factors. Most of the causes of injuries were intrinsic factors (86.7%) rather than extrinsic factors (13.3%). Chi square showed a significant difference (p<.05) in recurrent injuries with gender difference. More males (106) had recurrent injuries than females (57).
Table 12
Causes for injuries for different genders (N=547)

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Overall %</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient Warm up</td>
<td>128</td>
<td>91</td>
<td>219</td>
<td>17.5%</td>
<td>0.082</td>
</tr>
<tr>
<td>Overtraining</td>
<td>88</td>
<td>47</td>
<td>135</td>
<td>10.8%</td>
<td>3.599</td>
</tr>
<tr>
<td>Poor Fitness</td>
<td>80</td>
<td>61</td>
<td>141</td>
<td>11.3%</td>
<td>0.047</td>
</tr>
<tr>
<td>Wrong Movement</td>
<td>125</td>
<td>88</td>
<td>213</td>
<td>17.1%</td>
<td>0.129</td>
</tr>
<tr>
<td>Tiredness</td>
<td>121</td>
<td>82</td>
<td>203</td>
<td>16.3%</td>
<td>0.409</td>
</tr>
<tr>
<td>Recurrent Injuries</td>
<td>106</td>
<td>57</td>
<td>163</td>
<td>13.1%</td>
<td>*4.285</td>
</tr>
<tr>
<td>Court</td>
<td>54</td>
<td>32</td>
<td>86</td>
<td>6.9%</td>
<td>1.028</td>
</tr>
<tr>
<td>Negligence</td>
<td>27</td>
<td>16</td>
<td>43</td>
<td>3.4%</td>
<td>0.495</td>
</tr>
<tr>
<td>Improper Equipment</td>
<td>29</td>
<td>11</td>
<td>40</td>
<td>3.2%</td>
<td>3.77</td>
</tr>
<tr>
<td>Other Factors</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>0.4%</td>
<td>0.636</td>
</tr>
</tbody>
</table>
Figure 4. Histogram of the frequency of the perceived causes of injuries in males and females.
Treatments for Injuries

Since most of the injuries were minor, rest was a board choice of treatment, 436 players rest for recovery (46%). Physiotherapy (19%) and Chinese chiropractor (16%) came after. Medical help from acupuncture and orthopaedic doctor were not common, each of them only accounted for 7% of all types of treatments. Casualty (26) and family doctor (22) were unusual, other treatments included eye doctor, advice from expert or Tieh-ta wine. Chi square has shown significant difference in casualty and orthopaedic doctor in males and females. Details of treatment were displayed in Table 13 and Figure 5.
Table 13
Treatments for injuries for different genders (N=547)

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Overall %</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>264</td>
<td>44.59%</td>
<td>172</td>
<td>47.78%</td>
<td>436</td>
</tr>
<tr>
<td>Casualty</td>
<td>20</td>
<td>3.38%</td>
<td>6</td>
<td>1.67%</td>
<td>26</td>
</tr>
<tr>
<td>Orthopaedic Doctor</td>
<td>44</td>
<td>7.43%</td>
<td>19</td>
<td>5.28%</td>
<td>63</td>
</tr>
<tr>
<td>Family Doctor</td>
<td>10</td>
<td>1.69%</td>
<td>12</td>
<td>3.33%</td>
<td>22</td>
</tr>
<tr>
<td>Physiotherapy</td>
<td>116</td>
<td>19.59%</td>
<td>65</td>
<td>18.06%</td>
<td>181</td>
</tr>
<tr>
<td>Chinese Chiropractor</td>
<td>99</td>
<td>16.72%</td>
<td>55</td>
<td>15.28%</td>
<td>153</td>
</tr>
<tr>
<td>Acupuncture</td>
<td>36</td>
<td>6.08%</td>
<td>31</td>
<td>8.61%</td>
<td>67</td>
</tr>
<tr>
<td>Other Treatments</td>
<td>3</td>
<td>0.51%</td>
<td>0</td>
<td>0.00%</td>
<td>3</td>
</tr>
</tbody>
</table>

Figure 5. Histogram of the frequency of treatments for injuries in males and females
Acute injuries required hospitalization

In the past one year, 33 players with acute badminton injuries required hospitalization. Chi square showed a significant difference (p<.05) among male and female players who required or did not require hospitalization. The number of males were hospitalized was significantly higher than those for females. Number of players required hospitalization were shown in Table 14.

Table 14
Number of players required hospitalization (N=547)

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Overall %</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalization</td>
<td>27</td>
<td>6</td>
<td>8.06%</td>
<td>33</td>
</tr>
<tr>
<td>Without Hospital</td>
<td>308</td>
<td>206</td>
<td>91.94%</td>
<td>514</td>
</tr>
<tr>
<td>Total</td>
<td>335</td>
<td>212</td>
<td>100.00%</td>
<td>547</td>
</tr>
</tbody>
</table>
Recovery period for injuries

Table 15 and Figure 6 have shown the recovery period for the injuries. More than half of the players recovered within 2 weeks, 25% within one week and 37% within two weeks. 16% of them recovered in 3 to 4 weeks and 22% of them needed more than one month to recover. No significant gender difference was found in all groups regarding recovery period.

Table 15

<table>
<thead>
<tr>
<th>Recovery period for injuries for different genders (N=547)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>&lt;1 week</td>
</tr>
<tr>
<td>1 to 2 weeks</td>
</tr>
<tr>
<td>3 to 4 weeks</td>
</tr>
<tr>
<td>&gt;1 month</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Figure 6. Histogram of the frequency of recovery period for injuries in males and females
Discussions

A total of 1200 badminton players responded in this study. The result was used to give a better understanding of the common injury patterns, cause of injury as well as the effect of demographic backgrounds that may lead to a higher risk of injury. Since previous studies may not have the same target groups and design, it was difficult to make direct comparison with them, but some viewpoints of different studies are worth discussing.

Demographic of the players

Based on the data recalled from the respondents, the incidence rate of injury was 4.22 injuries per 1000 playing hours, which was analogous to the figure of previous studies (5.04-Yung et al., 2007; 2.9-Jorgensen and Winge, 1987).

There was an increasing trend of injury with age. The researcher thought that overuse problem should be more common in the older group since they had more exposure time to badminton and their physiological functioning were decreasing. On the other hand, Hong Kong Team players recorded the highest
percentage of injury which probably because of their tough training and not enough recovery from competitions and trainings. School team players have the lowest percentage of injury among all groups. This may be related to both training hours and intensity and the age of them, since the mean age of this group was only 16.

Among the five performance levels, recreational players got the highest incidence rate of injury (5.66). Although this group demonstrated a relatively low percentage of injury as mentioned before, but it had the highest incidence rate among all groups, which means most of the injured player got more than one injury. Within this group more than 70% of the players only treated badminton as a leisure activity. They did not join any competition at all. Possible reasons for their injuries included insufficient training, lack of knowledge on injury prevention and not knowing the treatment for injuries. This alert the researchers to focus on the incidence rate of injuries but not merely the percentage of injury, because it may hide some useful information.
Injured Body Sites and Injury Types

Lower extremity injuries were dominant and that corresponds to numerous studies (Li et al., 2009; Yung et al., 2007; Kroner et al., 1990; Hensley and Paup, 1979; Jorgensen and Winge, 1990). Knee, ankle and thigh injuries were common. It accounted for 42% of all the injuries. Since badminton require a lot of jumping, landing, and changing directions. All of these actions were done in a fast pace and this sudden increase of load may lead to injuries.

Although lower extremity injuries were dominant, we cannot leave upper extremity injuries aside. It was also critical in this study. Shoulder and elbow injuries in recreational players were obviously higher than that in other groups. The researcher believed that it was related to the incorrect movement of the players. Since most of them engaged in badminton for fun, they may not learn the correct movements before or have enough training for that, resulting in a higher risk of shoulder inflammation and tennis elbow.

Apart from extremity injuries, the results also showed that
waist injuries were common among players. Both waist muscle strain and chronic pain appeared in the top ten injuries, which gave us a warning that specific coordination exercise in waist may not be enough.

Different groups had different injury patterns, so different training programs should be specific to different groups. Generally, all groups should pay more attention to lower extremity coordination training, stretching and strengthening the back and abdominal muscles group. For specific group like recreational players, they should also pay attention to training in shoulders and elbow.

Consistent with previous study (Yung et al., 2007), strain was the most common type of injury. In our study, strain injuries were especially common in the recreational player group. We postulated that was because they may not have the proper movements. They may have griped the racket too tight or become very tense during exercise, these may excess their muscle abilities. Also, insufficient warm up may also lead to muscle strain because their muscles could not adapt to this
sudden change of demand.

Overuse injury was also popular which conforms to both studies by Jorgensen and Winge (1990, 1987). It usually occurs in Hong Kong team and recreational players, in which waist and knee overuse was serious. Overhead actions require extension of the waist muscle while underarm action requires flexion of the waist muscle. Repetition of those actions may result in waist muscle over fatigue and injury may occur. The researcher believed that overtraining and insufficient rest were the major causes of overuse injuries among elite players; while insufficient warm up and wrong movement were the major causes for recreational players. For any players who have regular badminton habit, specific training on both abdominal and back muscle should be invented to training so as to reduce the risk of injuries (Li et al., 2009).

Warm up patterns

The researcher considered both jogging and specific warm up as warming up exercise which aims to increase the body temperature and transits the body from rest to exercise state;
while stretching aims to increase the range of motion of joint and also the flexibility of the muscles. This study reported contrasting findings as Fahlstrom et al. (1998). Among all players in their report, 16.9% had both warm up and stretch, 50.6% had warm up but not stretch, 3.9% had stretch but no warm up, 28.6% neither had warm up or stretch, while in our study 44.6% had both warm up and stretch, 6.9% had warm up only, 48.1% had stretch only while only 0.4% neither have warm up or stretch at all. This contrast may be because of the different in culture and the setting of the venue. Our conjecture was that it is due to limited space in Hong Kong, open spaces around the courts were scare, so it is difficult for players to find space for jogging before playing badminton. Thus, they would rather do some stretching prior exercise.

Causes of Injuries

For the causes of injuries, intrinsic factors were prevalent (86.1%), 17.5% of them had insufficient warm up and 16.3% were tired. These injuries were possible to prevent. If someone knows that he or she not have enough warm up or
feel tired, they should stop before they get hurt. Although the pace in Hong Kong is fast and people may have limited time for activities but it is necessary to protect ourselves by preventing injuries to occur. Another popular reason was wrong movements. It occupied 17.1% among all the injuries. It is strange that so many players know that they are using wrong movement but they just ignore it and keep it as a habit.

The extrinsic factors (10.5%) were relatively low, which was similar to Kroner et al. (1990) research where it accounted for 8.1%. A dissimilar finding was reported by Hensley and Pulp (1979) where extrinsic factors were about 35% and negligence was predominant, which is quite different from this study.

Treatments and Recovery

Among all types of treatment, rest is a board choice of the players. Rest is a conservative treatment. It is safe, necessary and it does not cost. Physiotherapy and Chinese chiropractor were common choices for treatment. Both younger and older generation showed similar percentage in these two
choices. Medication from casualty was rare; only 26 cases were reported in 1200 players per year. Furthermore, more than half of the players recovered within 2 weeks. 38% of them recovered within a month. Only 22% of them needed more than one month to recover, which proved that most of the badminton injuries were not critical.

Prevention of injuries

In order to prevent injuries, here are some suggestions:

First of all, choose proper outfits and venues; secondly, do not start if you fell tired or not yet recover; then, do enough warm up prior exercise; managing correct skills and setting suitable training program; moreover, additional strengthening and stretching are necessary other than normal training; the last but not least, learn the prevention and management of injuries.
Chapter 5

Summary and Conclusions

This chapter consists of three main parts. They are (1) Summary of Results (2) Conclusion and (3) Recommendations for Future Study.

Summary of Results

The results of the study were summarized as follows:

1. Among 1200 badminton players, 46% indicated that they have suffered from at least one injury during the past one year. Hong Kong Team players had the highest percentage of injury (71%) while school team players had the lowest percentage of injury (35%). For the other groups, there were 45%-57% of the players suffered from injuries.

2. Players were aged from 11 to 64. 37% of the players were under 18, 26% were from 18 to 25, 24% were from 26 to 45 and 13% were above 45. There was an increasing trend of injury with age; the older group had a relatively higher percentage of injury than the younger groups.
3. The mean hours of badminton activity for males and females were 5.91 (SD±4.20) and 5.40 (SD±3.54). The mean hours of fitness training for males and females were 1.69 (SD±2.00) and 1.08 (SD±1.4). Significant mean differences were shown in both tests, while male spend more time on both badminton and fitness training.

4. The mean playing hours per week per player was 5.7 (SD±3.9). The total playing hours per year were about 354,926 hours. There were totally 1499 injuries in the past one year. The overall incidence of injury was found to be 4.22 injuries per 1000 hours.

5. For the warm up patterns, 32% of the players spent less than 5 minutes, 53% of them spent 5 to 10 minutes and 15% of them spent more than 10 minutes. 55% of the players neither have no warm up or one type of warm up only, 45% of them had both warm up and stretching exercise before playing badminton.

6. Chi square test has shown significant difference in the frequency of injuries with the following categories: gender; age group; level; event type; competition habit and cool
down habit. However, results showed that there were no significant between the frequency of injury in different warm up time, with or without fitness training and knowledge on sports injury.

7. Among these five groups, recreational players had the highest incidence rate of injuries (5.66), followed by club representatives (4.32). Hong Kong team players (3.65) and junior squads (3.26) ranked third and forth, while school team players had the lowest incidence rate of injuries (3.22).

8. In general, lower extremity injuries were higher (incidence rate=1.97) than upper extremity (incidence rate=1.51) and the dorsal (incidence rate=0.73). Overall, the most often injured sites were ankle and foot (0.73), knee (0.69) and waist (0.64). For the Hong Kong team players and club representatives, knee injuries were prevailing, whereas ankle and foot injuries were leading in junior squad and school team players. Nevertheless, elbow and arm injuries were dominant in recreational players.
9. The most often injury types were strain (n=512), overuse (n=496) and sprain (n=406) which accounted for more than 75% of the injuries. Contusion injuries were relatively common in non elite players than elite players. Facture, dislocation, ligament and tendon injuries were rare.

10. Chi square test has showed significant difference in the following injuries between males and females, including shoulder sprain, shoulder inflammation, waist chronic pain, knee sprain, and calf muscles strain, where males has a higher tendency to suffer from those injuries. Waist injuries were accounted for 0.64 of the injuries, it is one of the most common sites of injuries and most of them are chronic.

11. The ten most common injuries in badminton were ankle sprain (0.62), knee overuse(0.49), waist strain (0.34), shoulder muscle strain (0.32), tennis elbow(0.28), waist chronic pain(0.26), hamstring muscle strain(0.22), wrist sprain(0.21), forearm muscle strain(0.20), knee sprain(0.18) and calf muscle stain(0.18).
12. Most of the causes of injuries were intrinsic factors (87%) rather than extrinsic factors (13%). Common causes of injuries were intrinsic factors, including insufficient warm up (18%), wrong movement (17%) and tiredness (16%).

13. Common ways of treatments were rest for recovery (46%), physiotherapy (19%) and Chinese chiropractor (16%). Treatment by casualty was rare, only accounted for 3%. Chi square showed significant difference in the frequency of treatment from casualty and orthopaedic doctor in males and females.

14. In the past one year, 33 players with acute badminton injuries required hospitalization. Chi square showed a significant difference (p<.05) among male and female players who required or not required hospitalization.

15. For recovery period, more than 50% of the player recovered within 2 weeks, 16% of them recover in 3 to 4 weeks and 22% of them need more than one month to recover.
Conclusion

This study gave the injury patterns among Hong Kong badminton players, although majority of the injuries in badminton was not very serious, but it is necessary to reduce the rate, because it may affect players' performance and increase the chance of recurrent injuries.

Since lower extremity injury had a high incidence in numerous studies, additional strengthening and stretching exercise should be invented in order to prevent injuries occur.

Recommendation for Further Studies

Base on the study, the following recommendation are presented for further studies:

1. The items and choices injuries were limited. It may not be able to reflect all the problems.

2. Studies may focus on specific level group only, which may give a deeper understanding for each group, e.g. school team or recreational players only.
3. Study may focus on specific injury type or injured site only, which may give a more detailed result for setting up preventive measure or specific training program, e.g. the relationship among lower limb injuries, different kind of overuse injuries in badminton.

4. Qualitative studies can be conducted to acquire in-depth understanding of the mechanism of injury, which enable a more meaningful conclusion, e.g. which specific skill or action leading to a particular injury.

5. Research can include new and recurrent injuries, to find out any relationship between them.

6. Research can include the expense on medication for injury.

7. Research can include psychological impact after injury.

8. Research can include what the players will do to reduce the risk of injuries.


王金亮、彭云志(2006)。〈羽毛球運動中肩關節損傷的原因及預防〉。《體育世界(學術版)》，第7期，頁72

余長青、石鴻冰 (2007)。〈羽毛球運動所引起常見的運動損傷及預防方法〉。《北京體育大學學報》，第1期，頁227
李正洪、吴静（2009）。＜羽毛球运动中肩关节损伤的成因及其预防＞。
《科技信息》，第6期，页356

李擎、王建卫、李建平、李全意、刘翠萍、周长庚、王智琴（2009）。＜优秀羽毛球运动员运动创伤的流行病学调查与分析＞。
《上海体育学院学报》，第2期，页70

孙雪翰、王庆菊（2009）。＜羽毛球运动健康价值效应的探究分析＞。
《体育科技文献通报》，第7期，页95

陈扬、艾冬生、王向前、陆建峰、李永波、陈跃、罗维丝（2006）。＜参加2003年全国羽毛球锦标赛运动员308名腰伤情况的调查分析＞。
《中国临床康复》，第36期，页66

张长宽、刘和昌（2009）。＜上海市社区开展羽毛球运动的调查研究＞。
《体育科技文献通报》，第12期，页91

刘帆、赵小平（2010）。＜对当前羽毛球“热”现象的逆向思考＞。
《成功（教育）》，第2期，页214

刘开物（1999）。＜青少年羽毛球运动员运动损伤调查与分析＞。
《四川体育科学》，第1期，页23

刘智英、邺学军（2009）。＜羽毛球肩袖损伤的研究＞。
《福建体育科技》，第3期，页33
Appendix A

香港浸會大學體育學系

羽毛球球員運動創傷問卷調查

請在適當的□內加上“✓”

甲部（請勿填上姓名）
1. 性別: □男; □女
2. 年齡: ________
3. 身高: ________ 米; 體重: _______公斤
4. 您的羽毛球水平是?
   □香港隊代表 □青年軍 □球會代表 □學校校隊 □康樂
5. 您打羽毛球的主項是?
   □單打 □雙打 □兩者都是
6. 過去一年內，您平均每星期進行多少小時羽毛球訓練/活動?
   _______小時
7. 過去一年內，您平均每星期進行多少小時輔助體能訓練?
   _______小時
8. 過去一年內，您有沒有參加比賽?
   □有 □沒有
9. 運動前，您平均用多少時間作熱身運動?
   □少於五分鐘 □五至十分鐘 □多於十分鐘
10. 您做的熱身運動包括？（可選多項）
    □慢跑 □伸展(拉筋) □針對性的熱身運動
11. 運動後，您有沒有做緩和運動?
    □有 □沒有
12. 您認為您對預防羽毛球受傷的知識夠嗎?
    □足夠 □不足夠
13. 過去一年內，您有沒有在打羽毛球時曾經受傷?
    □有（到乙部） □沒有

請轉後頁
1. 過去一年內，您曾於羽毛球運動時出現以下那些受傷？（可選多項）

上肢:
- 頭部 - □ 撞傷
- 眼睛 - □ 撞傷
- 肩部 - □ 扭傷 □ 脫臼 □ 肌肉拉傷 □ 肩周炎
- 手肘 - □ 撞傷 □ 網球肘/發炎
- 前臂 - □ 肌肉拉傷
- 手腕 - □ 扭傷 □ 脫臼 □ 慢性痛楚

軀幹:
- 腰部 - □ 拉傷 □ 脊骨移位 □ 慢性痛楚
- 腹部 - □ 拉傷

下肢:
- 膝蓋 - □ 扭傷 □ 勞損 □ 十字韌帶撕裂 □ 半月板撕裂
- 腳踝 - □ 扭傷 □ 骨折 □ 腳跟撕裂 □ 足底筋膜炎
- 肌肉 - □ 大腿前肌拉傷 □ 大腿後肌拉傷 □ 小腿拉傷

其他（請註明）：

2. 您認爲下列那些是您受傷的原因？（可選多項）

個人因素:
- □ 缺乏熱身
- □ 運動過度
- □ 身體質素欠佳
- □ 動作不正確
- □ 疲倦
- □ 疲勞

外在因素:
- □ 場地
- □ 他人疏忽
- □ 沒有合適裝備
- □ 其他（請註明）：

3. 受傷後，您會如何處理？（可選多項）

- □ 休息
- □ 急症室
- □ 骨科醫生
- □ 家庭醫生
- □ 物理治療
- □ 中醫跌打
- □ 鈎灸
- □ 其他（請註明）：

4. 受傷後，您康復的時間需要多久？

- □ 少於一星期
- □ 一至兩星期
- □ 三至四星期
- □ 一個月以上

5. 您有否因打羽毛球而造成的急性受傷入院治療？

- □ 有
- □ 沒有

~完~