Research Report

INCIDENCE OF CHRONIC LOWER EXTREMITY MUSCULOSKELETAL INJURIES AMONG BADMINTON PLAYERS PARTICIPATING IN UAAP

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ABSTRACT

***Objectives*:** To determine the common types and sites of lower extremity injury in badminton varsity players in the UAAP and to determine the effects of playing surface and shoe type in relation to injuries of the lower extremity in this population. ***Methodology*:** A survey of college varsity players participating in the UAAP Badminton League using questionnaires was performed to determine the types and sites of lower extremity injury incurred during games as well as the frequency of lower extremity injury per playing surface and shoe type. All participants underwent assessment of range of motion, muscle strength, leg length discrepancies, and posture after completing the questionnaire to rule out injuries brought about by the pre-existing postural deviations, decreased muscle strength and joint motions, and unequal leg lengths of the players. ***Results*:** Seventy-five UAAP badminton players (mean playing years=12.5) answered the questionnaires. Seventy-two percent experienced overuse lower limb injuries when playing badminton, with a higher incidence in females. A greater proportion of participants who play on wooden surfaces "always" and "most of the time" present with injuries compared to those who played on other surface types. Ninety-nine percent of participants used badminton shoes during play. ***Conclusion*:** Ligamentous injuries involving the ankle and foot are the most common types of injuries incurred by UAAP badminton athletes. A greater proportion of athletes who play in wooden courts incurred injuries. There were inconclusive findings on the effects of footwear on injury occurrence since 99% of participants used badminton shoes during play.

Keywords: *Badminton; shoe; overuse injury; playing surface (not MeSH)*

INTRODUCTION

Badminton, a racquet sport which involves the use of a lightweight racquet and a shuttlecock, provides a total aerobic body workout. It is known as a cutting sport in which quick movements and sudden changes of directions are required. A badminton match consists of constant highly concentrated actions of running, jumping, twisting, stretching, running backwards, and striking. In the advanced level, the sport demands high amounts of speed, coordination, quick reactions and a relatively good physical condition.

Its rising popularity in the country greatly contributes to the phenomenal rise of public interest in badminton due to its accessibility, low cost and availability of equipment. It is an easy sport to learn and keeps the body physically fit with the appropriate parameters such as frequency and hours of play. However, data on the approximate number of people regularly engaged in this sport in the local setting are presently unavailable.

According to a study conducted by Jorgensen, et al[1], badminton is generally considered a relatively low-risk sport and injuries related to it are less severe compared with other contact sports. But since it

has made a major comeback, it would be beneficial to know possible factors that may predispose one to injury in order to put the necessary preventive measures in place.

In a study conducted by Fahlstrom, et al[2], 1.2% of all sports injuries that required emergency care at the University Hospital of Umea, Sweden were caused by badminton. The lower extremities were affected in 92.3% of the cases. Among these, Achilles tendon ruptures (34.6%) and ankle sprains and fractures (29.5%) were the most frequent. Achilles tendon injuries in badminton could be due to a combined effect of the special foot works: a fast forward movement stop with forceful heel strike requiring eccentric work by the triceps surae, alternating with backwards toe running involving concentric work of the triceps surae, and backward or combined back or sideward jumps with forceful eccentric work by the triceps surae. Most acute injuries in badminton involve the lower extremities with more than 1/3 being Achilles tendon rupture.[2,3] On the other hand, injuries such as patellofemoral pain syndrome can be secondary to sudden changes in eccentric-concentric activity during play.[4]

Strains and sprains are also common due to the sport's high speed, and the need for quick directional changes and quick reaction demands. Lack of specific training of muscular strength, coordination, endurance and insufficient warm-up in the lower extremity are some of the factors that were found to predispose one to injury.[1,5,6]

There are also other factors that contribute to injuries related to badminton. The type of equipment such as inappropriate shoes, court surface, environmental factors and racquet type can also contribute to the occurrence of injury. Since Fahlstrom et al[2] found that 92.3% of the injuries were localized in lower extremities with almost two-thirds (64.1%) of these occurring in the feet, court surfaces and inappropriate shoe wear are important factors that need to be considered.

A study by Heidt, et al[7] regarding biomechanical aspects in playing surfaces reported that data from epidemiological studies suggest strongly that the surface is an important factor in the etiology of injuries. Injury frequencies were reported to be significantly different for varying surfaces in several sports.

Maintenance-intensive grass courts have given way to harder, more durable courts. Clay courts, and new crushed stone "fast-dry" courts duplicate the softness of clay but require less upkeep and are undoubtedly safest to the foot and ankle. Outdoor courts are often surfaced with asphalt or concrete, and indoor courts with carpet; none of which allow for sliding.

According to Scranton, et al[8], badminton puts more stress on the knees than in any other part of the lower limb probably because of the sudden movement changes involved in the game. Therefore the type of flooring or playing surface gives a significant role in the risk of injuries in badminton. Heidt, et al[7] also found out that the best type of playing surface is sports matting on a wooden floor. The rubberized mat absorbs a player's weight while moving and wood is less hard than cement, thus decreasing the impact on the knees. Most badminton centers have courts usually made of plain wood or hard concrete/cement which is the worst type of playing surface.

According to Reinschmidt, et al[9], the development of technical athletic footwear is based on two interrelated principles: injury prevention and enhanced performance. In many situations, competitive or elite athletes are willing to accept the increased injury risk if the shoe can enhance performance. For these performance athletes, injury prevention may be a less important consideration. Emphasis can be placed on ultra-lightweight shoes which maximize energy return and do not restrict the desirable motions of the individual sport.

Shoes should be specifically designed for badminton. Heels should be snug-fitting to prevent slipping from side to side, and both heel and toe areas should have adequate cushioning; characteristics which are often absent in running shoes. The arch should provide both soft support, and the toe box should have adequate depth to prevent toenail injuries.

In an analysis by Nigg[10], it appears that the amount of lateral stability, torsional flexibility, cushion, and traction control in court shoes are the most important factors for prevention of injuries. Also, the fit and climate concepts are factors to consider for shoe comfort. Nigg[10] also reported that the shoe-playing surface combination, which determines the frictional forces, is connected to the injury frequency. The injury frequency on 'clay' and 'synthetic sand' is significantly lower than on other selected artificial surfaces. Surfaces with low frictional resistance are assumed to cause fewer injuries than surfaces with high frictional resistance. It can be concluded that the frictional property of a surface is one of the main factors to be considered when studying the etiology of acute and/or chronic pain and injury in sports.

The growing number of people playing badminton

magnifies the need for a much clearer understanding of musculoskeletal injuries in

badminton especially in relation with the types of environment they play in and the gear they use. It is important to establish baseline information on the common injuries and risk factors involved to provide relevant knowledge which can help in devising strategies for injury prevention.

The study aims to determine the common types and sites of lower extremity injury in badminton players in UAAP and to determine the effects of playing surface and shoe type in relation to injuries of the lower extremity in badminton varsity players.

METHODOLOGY

Participants

Varsity players participating in the University Athletic Association of the Philippines (UAAP) Badminton League were recruited for the study. A list of different universities in Metro Manila participating in this league-type competition was obtained to determine the total number of possible subjects for the study. To be eligible, a player should have played competitive badminton for at least 1 year, trains for at least once a week and consents to participate in the study.

Study Design

This is a descriptive study.

Outcome Measures

Questionnaires were distributed to different badminton teams included in the UAAP. The questions emphasized on the participants' experience as athletes. From the response, the types and sites of lower extremity injury were determined. The frequency of injury per playing surface and shoe type were also considered. In order to rule out any postural deviations, leg length discrepancy, and impaired muscle strength and joint motion, which can cause injuries, several objective evaluation procedures were done to all the subjects. These included Range of Motion Goniometric Measurements[11], Manual Muscle Testing[12], Leg Length Measurement[13] and Postural Assessment[14,15].

Development of the Questionnaire

The survey questionnaire was adapted from the studies of Fahlstrom et al.[2,3] The questions were patterned from the results of the said study, and were appropriated for Filipinos. The revised questionnaire addressed three main areas: (1) profile of the participants, (2) play information, and (3) injury inventory.

To describe the participants more completely as suggested by Youdas et al in 2000, a combination of open-ended and closed response formats was used.[16] Questions included intrinsic and extrinsic factors surrounding a musculoskeletal injury or discomfort. Intrinsic factors included questions pertaining to presence or absence of warm-up or stretching exercises, and age. Questions related to external factors pertained to the equipment, environment, biomechanical factors and training errors.

The first part of the questionnaire was about Play Information. This was to determine whether the player would be eligible for inclusion into the study, and to establish a baseline data regarding the frequency of play and warm-up exercises among players, the type of playing shoes used and type of surfaces where they play. Similarity of participants regarding training and warm-ups must be established to be certain that they regularly played badminton and to further eliminate faulty biomechanics and absent warm-ups as the causes for their injuries.

The second part of the questionnaire was the Injury Inventory which covered questions on injury characteristics such as the type, onset, and location. This focused on the effects of playing surface and type of shoes in relation to injury occurrence. It also focused on chronic/ repetitive type of injuries on the lower extremities. The inventory also determined the severity and impact of such injuries on the players' performance.

General demographic questions including age and sex were also asked as done in the study by Kiyono et al (2001).[17] Demographic questions regarding badminton included status and level as competitive players and the length of time play. The coaches of every team included in the survey were also asked regarding the leveling of the players' skills.

Validation of the Questionnaire

The revised questionnaire was distributed to physical therapists who play badminton for leisure purposes for content validation and pilot testing. Necessary revisions based on the results of the validity and pilot tests, such as the addition of a lower limb diagram to easily localize the site of the injured part/s, were done before the final survey was administered.

Administration of the Questionnaire

Validated survey questionnaires were distributed to all participants who met the inclusion criteria. The 3-page questionnaire was made up of 17 questions

and included a cover letter stating the study's purpose. Participants were given instructions to complete the questionnaire before undergoing physical examination and to refrain from comparing answers with their peers. The survey was administered before the training session and questions were not consequently entertained in order not to introduce bias into participants' answers.

Physical Examination of Participants

To ensure intertester reliability, as suggested by Williams, et al[18], the five researchers took blinded measurements of five randomly selected individuals. Each researcher measured for range of motion (ROM), manual muscle testing (MMT), leg length discrepancies (LLD), and posture (PA) of each participant. Measurements for each participant were compared among the researchers and the 2 researchers with almost the same findings were identified to be Researchers D and E while the other three were randomly assigned as Researchers A, B or C.

All participants underwent examination of ROM, MMT, LLD, and PA after completing the survey questionnaire. These objective examination procedures were used to rule out injuries brought about by pre-existing postural deviations, decreased muscle strength and joint motions, and unequal leg lengths of the players. Researchers A, B, and C measured ROM, MMT and leg lengths while Researchers D and E did the PA. Each researcher performed the measurements three times and the average findings were computed and recorded. This sequence of testing was standardized for all research sessions.

Statistical Treatment

Descriptive statistics were employed to present specific characteristics of participants, cross-tabulated among players with injuries and those without. Factors that differentiated players with injuries from those who have not suffered from any injuries were identified.

The mean was used to describe continuous data including total years spent in playing badminton, days played per week, minutes allotted for warm-ups, frequency of training in a week, and minutes in a day spent in training.

Proportions or percentages were used for categorical data including performance of warm up exercises, types of warm up exercises, type of playing surfaces, type of shoes, and severity, onset and location of badminton-related lower extremity musculoskeletal injuries or discomfort.

RESULTS

General Playing Information

Seventy-five out of a possible 114 UAAP players participated in the study. Administration of the survey questionnaire and objective examination of the participants, were done on the same day, thus, having no dropouts in the study.

Among the participants, 43% were females (25 out of 54) and 57% males (29 out of 54). Majority has been playing badminton for 6-7 years [Table 1].

Majority (52 out of the total 75 players; 69%) claimed that they do warm up exercises before playing badminton, 40% of them do it for an average of 5-10 minutes. Common warm up exercises included stretching of upper limb muscles (97%) and jogging (87%).

Most participants trained for an average of 120 – 180 minutes per week (Table 2) while frequency of training varied (Table 3).

Incidence of Overuse Lower Limb Injuries

Seventy-two percent (54 out of 75 total players) experienced overuse lower limb injuries when playing badminton. Furthermore, results showed that there was a higher incidence of injury among female players (Figure 1). It is interesting to note that a greater number of participants who regularly performed warm-up exercises experienced injuries (Table 4).

Common injuries incurred by the participants are shown in Figures 2. The ankle and foot were the most commonly affected body parts (Figure 3).

Injuries incurred by the participants affected their performance during both training and competition. Many (65%) claimed that injuries required further treatment by a physician though hospital confinement was not very common.

Forty-two (56%) of the participants utilized rubberized surfaces when playing badminton while wood was the next most popular (32%), and cement the least popular (12%). Considering the frequency of using different types of playing surfaces, a greater proportion of participants who play on wooden surfaces "always" and "most of the time" present with injuries compared to those who played on other surface types (Figure 4).

Participants used either running shoes or badminton shoes when playing. As expected, badminton shoes were the most popular with 99% of the participants utilizing these.

Table 1. Years of Playing Badminton
Base: Total participants

	Total		with injury		without injury	
Years of Play	#	%	#	%	#	%
0-1 year	3	4	1	2	2	10
2-3 years	9	12	4	7	5	24
4-5 years	16	21	13	24	3	14
6-7 years	17	23	12	22	5	24
8-9 years	15	20	11	20	4	19
10-11years	14	19	12	22	2	10
11-13 years	1	1	1	2	0	0
Grand Total	**75**		**54**		**21**	
Mean years		**12.5**		**9**		**3.5**

Table 2. Amount of Time Spent in Training (In a Day)
Base: Total participants

	Total		with injury		without injury	
Minutes	#	%	#	%	#	%
Less than 60 minutes	1	1	1	2	0	0
60-120 minutes	13	17	9	17	4	19
121-180 minutes	38	51	25	46	13	62
181-240 minutes	12	16	10	19	2	10
> 240 minutes	4	5	4	7	0	0
Others (varies)	7	9	5	9	2	10
Grand Total	**75**		**54**		**21**	

Table 3. Frequency of Training in a Week
Base: Total participants

	Total		with injury		without injury	
	#	%	#	%	#	%
Once a week	1	1	0	0	1	5
2x a week	24	32	20	37	4	19
3x a week	15	20	9	17	6	29
Once a day	8	11	4	7	4	19
Others	27	36	21	39	6	29
Grand Total	**75**		**54**		**21**	
Mean frequency		**3**		**3**		**4**

Table 4. Proportion of Participants Who Perform Warm-ups
Base: Total participants

	Total		with injury		without injury	
	#	%	#	%	#	%
always	52	69	34	63	18	86
most of the time	15	20	14	26	1	5
sometimes	8	11	6	11	2	10
Grand Total	**75**		**54**		**21**	

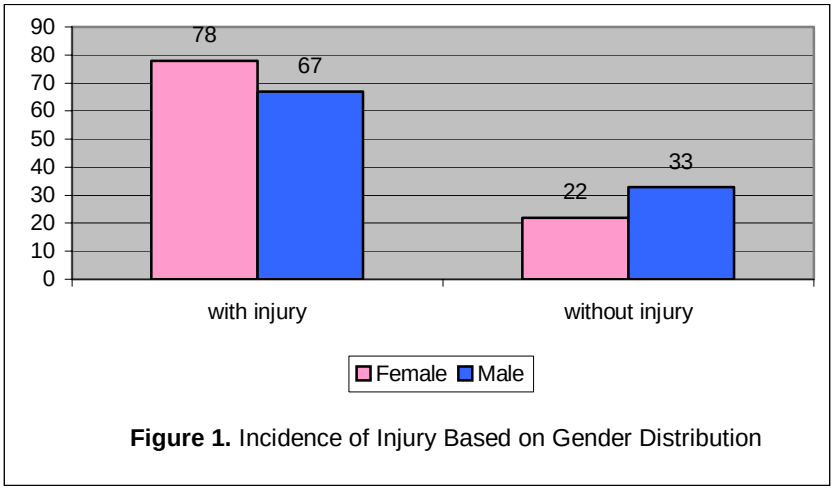

Figure 1. Incidence of Injury Based on Gender Distribution

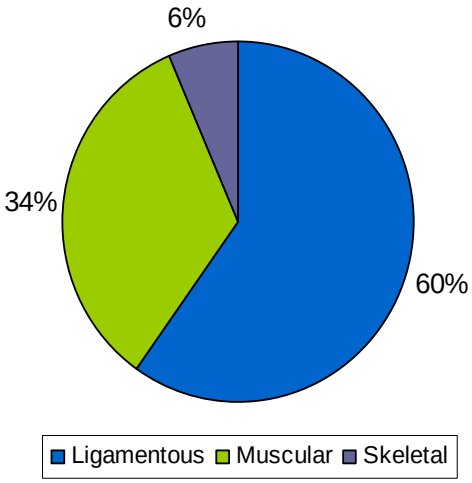

Figure 2. Types of Lower Extremity Injuries among UAAP badminton varsity players

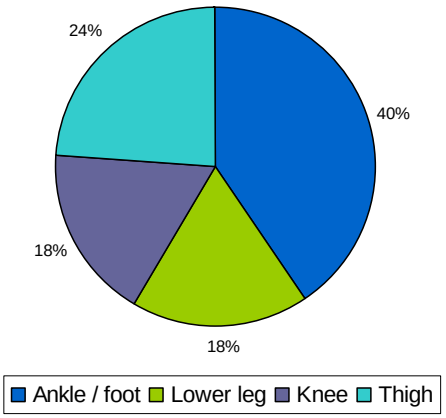

Figure 3. Specific lower extremity areas injured among UAAP Badminton players

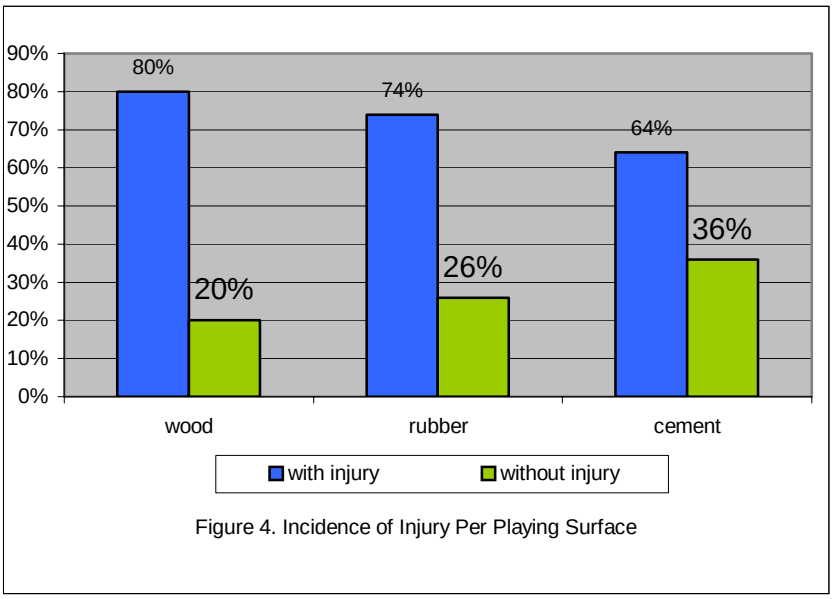

Figure 4. Incidence of Injury Per Playing Surface

DISCUSSION

Badminton is currently picking up pace as one of the most popular leisure sports in the country. However, those who enjoy playing the sport should bear in mind that they may incur injuries while playing the sport. This is evident in the relatively high incidence (72%) of injuries in the group of participants for this study even if most of them have been involved in the sport for 4-11 years and claimed to do regular warm-ups prior to play. It is even interesting to note that there was still a big proportion of participants who had injuries even if regular warm-ups were incorporated into their training. It may be that the time devoted to warm-up, mostly 5-10 minutes which falls slightly below the recommended duration of 10 minutes by Kisner and Colby[28], was insufficient to produce its intended effects of making the muscles more extensible prior to activity. It may also be that the warm up activities performed by the participants did not include the body areas commonly affected.

Playing surface may have also contributed to the incidence of injuries in this population. Rubber (Tara flex) and wood court surfaces were the most common types used. Comparing these two surface types, there was a greater proportion of participants who incurred an injury on wooden courts compared to rubberized courts. This may be due to the added friction provided by rubberized matting that prevents a player from slipping. Though cemented court surfaces seem to show the least proportion of participants who obtained injuries, it cannot be said that it is the best playing surface because of the limited number of participants who claimed to use this surface type. Furthermore, the study by Heidt, et al found that cemented courts are the worst type of playing surface.[7]

There seems to be a preference for using shoes specifically made for playing badminton since 99% of participants claimed to utilize this kind of footwear. Though it seems that a greater proportion of those who did not use badminton shoes obtained injuries, this may not be conclusive because there were only 4 participants who used running shoes as their regular footwear. However, Nigg found that players are more prone to injuries when they use running shoes compared to when using badminton shoes since badminton shoes offer more lateral stability, torsional flexibility, cushioning and traction control.[9]

LIMITATIONS AND RECOMMENDATIONS

The findings of this study have limited external generalizability given the size of the sample and the

purposive method of recruiting participants. This may be improved by recruiting more participants, not just competitive athletes but even those who only play badminton for leisure purposes. This may have identified differences in the incidence of injuries between competitive and non-competitive players.

It would also help to revise the questionnaire for future purposes. Indicating the time reference for stating occurrence of injuries, frequency of training, and even frequency of competition, e.g. for the past 3 months, would have retrieved more homogenous data among the participants. Furthermore, injuries to other areas of the body such as the upper limb and the back, may also be investigated so as not to limit findings to the lower extremities.

CONCLUSION

Ligamentous injuries involving the ankle and foot are the most common types of injuries incurred by UAAP badminton athletes. Rubberized court surfaces are more popularly used compared to wooden and cemented courts but a greater proportion of athletes who play in wooden courts incurred injuries. There were inconclusive findings on the effects of footwear on injury occurrence since 99% of the participants use badminton shoes during play.

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