The Epidemiology of Sports Injury during the 37th Thailand National Games 2008 in Phitsanulok

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Background: *Prevention of injury among athletes is of paramount importance for sport events. The incidence of injury differs depending on many factors, such as level of competition, type of sport, and standard of surveillance systems. It is our purpose to provide a descriptive epidemiology of a national level competition multi-sports event.*
Methods: *During the 2008 Thailand National "Phitsanulok" Games, official medical teams of the various sports completed a report form after each match or competition. The demographic data, type of sport, details of injury or illness, diagnosis, and treatment were collected from the PLKGames 2008 program and analyzed by the Medical Surveillance Committee.*
Results: *There were 14,429 athletes and staff participating in the "Phitsanulok" games. A total of 496 injuries were reported during the competition, of which 300 male and 196 female athletes sustained injuries, resulting in an incidence rate of 4.1 injuries per 100 registered athletes. For all sports, 71, 50 and 38 injuries occurred during Rugby, Handball and Basketball, respectively, which accounted for 32% of all injuries. No injury was reported from many sports, such as table tennis, shooting, dancing, and golf. The most common diagnoses were sprains and strains. About half of injuries were caused by contact with another athlete, followed by non-contact (28.6%) and limited-contact incidences (27.6%). According to the number of athletes, the risk of incurring an injury was highest in Pencak Silat, handball, basketball, and rugby football. About half of injuries affected lower extremities, while 135, 53, and 49 injuries involved upper extremity, head & neck, and axial body parts, respectively. The knee and ankle were the most common sites of injury.*
Conclusion: *The data demonstrates a potential risk of injury occurring predominately in full-contact sports and limited-contact sports. The data is potentially useful in developing injury surveillance systems for future sporting events.*

Keywords: *Epidemiology, The 2008 Thailand National "Phitsanulok" Games, Athletes, Injuries, Full-contact, Limited-contact and non-contact sport, Injury surveillance system*

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It has been well accepted that a sport injury is an important medical aspect, especially during major sporting events. The incidence of sport injury usually varies widely depending on many factors, such as level of competition, types of sport, and standard of surveillance systems. Any injuries may have an impact on the athlete, team, as well as the results depending on frequency, location, and severity of injury. Thus, injury prevention during the events should be one of the fundamental concerns which may decrease the incidence of injuries among the athletes.

The "Thailnad National Games" is a national level sporting event which is held in an every year

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interval. Athletes, representing 76 provinces from 5 regions of Thailand, compete in the event which is held in different parts of Thailand on a provincial rotation basis. Phitsanulok province, located in the northern Thailand, hosted the 37th Thailand National Games during 14-24th of December 2008.

The purpose of the present study was to provide the frequency, characteristics, and causes of injuries incurred in the competitions during the 37th Thailand National Games 2008 in Phitsanulok province, Thailand, in order to prevent future injuries and develop an effective surveillance system.

Material and Method

Design overview

The 2008 Thailand National "Phitsanulok" Games consisted of 37 types of sports which were distributed into 22 fields and stadiums, and 7 buildings. Twelve hospitals and 3 health stations contributed to a medical care and surveillance system while the Phitsanulok provincial health office served as the co-ordinator. All health care providers or official medical teams, including physicians and nurses, were assigned to monitor at all sporting locations and organize the hospital work flow.

An observational, epidemiological survey was used to analyzed injuries in all sport tournaments over the period of the Games. To achieve this we prospectively analyzed the injury report forms and "PLK games" software that were developed by the Medical Surveillance Committee for collecting the injury information. For all types of injuries, the following information was documented: demographic data, type of sport, type of injury or illness, diagnosis, treatment and consequence. The medical officers of the 37th Thailand National Games 2008 were asked to report daily all newly incurred injuries on a standardized injury report form, in which the data were obtained and linked to the Phitsanulok provincial health office by the PLKGames 2008 program. These data were then analyzed by the Medical Surveillance Committee and posted every day. Data collection started when the 37th Thailand National Games was opened and lasted until the end of the 37th Thailand National Games.

Definition of sport and injury

The authors divided 37 types of sports into 3 categories, namely "Full-contact sport", "Limited-contact sport", and "Non-contact sport". The full-contact sport referred to sport which the physical impact force on players is allowed by the rules. This refers to 10 sports including rugby, Thai boxing, boxing, judo, wushu, karate-do, pencak silat, taekwondo, kabaddi, and wrestling. Limited-contact sport referred to sports which their rules are designed to prevent contact between players. This includes football, basketball, handball, futsal, and softball. Non-contact sport are sports which the players are physically separated to make contact nearly impossible during the game. This includes all forms of track and field athletics, swimming, rowing, gymnastics, cycling, weightlifting, volleyball, beach volleyball, sepak takraw, hoop takraw, tennis, badminton, table tennis, golf, shooting, snooker, billiards, petanque, bridge, GO, dance, and bodybulding.

Statistical analysis

Incidence rates were estimated as the number of injuries divided by the sum of registered athletes. Statistical methods applied were descriptive statistics, frequencies, and cross-tabulations.

Results

A total of 2,230 staffs and 12,199 athletes (7,036 males and 5,163 females), representing 76 provinces, participated in the "Phitsanulok" Games. Bangkok, the capital of Thailand, had the largest group of athletes to compete in the Games with a total of 986, followed by Chiang Mai, Phitsanulok (host), Nakhon Ratchasima, and Chonburi with 672, 653, 508, and 484 athletes, respectively. There were a small group of athletes representing Mukdahan, Samutsongkhram, Amnatcharoen, Nongbualamphu, and Trat, with 4, 5, 8, 8 and 12, respectively. According to the types of sports, 1,395 athletes competed in swimming, 1118 in athletics, 884 in rowing, 771 in shooting, and 453 in rugby football, comparing to 110,105,96,77 and 36 who competed in bodybuilding, golf, beach volleyball, snooker and billiards, respectively, as shown in Table 1.

For the study period, a total of 496 injuries occurred during the competition were reported, equivalent to an incidence rate of 4.1 injuries per 100 registered athletes. Among injured athletes, 300 (4.3%) were males and 196 (3.8%) were females, with the age ranged from 10 to 50. The male athletes who sustained injuries ranged from 13 to 46 years while the range was from 10 to 50 in female athletes. The vast majority of injuries incurred during rugby (n = 71), handball (n = 50), and basketball (n = 38), which accounted for 32.0% of all injuries. No injury was reported from many types of sports, such as a table tennis, shooting, dancing, and golf. Among male athletes, the total

Table 1. Injuries classified by the types of sport

Type of sports	M	F	Total athletes	Injured male	Injured female	Injuries	Injury incidence (per 100 athletes)
Rugby Football	310	143	453	62	9	71	15.7
Handball	176	176	352	19	31	50	14.2
Basketball	130	128	258	15	23	38	14.7
Pencak Silat	86	37	123	18	12	30	24.4
Tennis	142	139	281	15	13	28	10.0
Athletics	596	522	1,118	17	10	27	2.4
Karate-do	185	92	277	19	5	24	8.7
Wrestling	189	105	294	16	5	21	7.1
Weightlifting	127	104	231	11	10	21	9.1
Football	216	216	432	7	13	20	4.6
Softball	198	156	354	10	10	20	5.6
Wushu	210	150	360	11	8	19	5.3
Judo	134	126	260	7	10	17	6.5
Boxing	163	163	267	15	1	16	6.0
Badminton	152	152	296	5	8	13	4.4
Sepaktakraw	151	162	313	6	5	11	3.5
Rowing	595	289	884	8	2	10	1.1
Futsal	131	131	262	3	6	9	3.4
Vollleyball	130	129	259	4	5	9	3.5
Beach Volleyball	48	48	96	8	1	9	9.4
Taekwondo	164	143	307	7	1	8	2.6
Gymnastics	55	109	164	3	5	8	4.9
Thai Boxing	165	0	165	7	0	7	4.2
Kabaddi	94	90	184	2	2	4	2.2
Cycling	271	36	307	2	0	2	0.7
Petanque	97	103	200	1	1	2	1.0
Swimming	713	682	1,395	1	0	1	0.1
Snooker	77	0	77	1	0	1	1.3
Shooting	469	302	771	0	0	0	0
Go	196	134	330	0	0	0	0
Table Tennis	124	152	276	0	0	0	0
Dance Sport	134	134	268	0	0	0	0
Bridge	126	60	186	0	0	0	0
Hoop Takraw	88	60	148	0	0	0	0
Bodybuilding	98	12	110	0	0	0	0
Golf	60	45	105	0	0	0	0
Billiards	36	0	36	0	0	0	0
Total	7,036	5,163	12,199	300	196	496	4.07

M = male, F = female

injury was outnumber by rugby football (n = 62), followed by karate-do (n = 19) and handball (n = 15), while handball and basketball female athletes suffered 31 and 23 injuries, respectively.

Pencak silat had the highest injury incidence with 24.4 injuries per 100 athletes, followed by rugby football, basketball and handball (Table 1). Besides, the highest rate was found in both male and female Pencak silat athletes. Basketball and handball also had a high incidence in females but it was replaced by rugby football in male athletes. All the details are shown in Table 1.

According to our categories, almost half of injuries (n = 217; 43.6%) were caused by full-contact sport. Limited-contact sport (n = 137; 27.6%) and non-contact sport (n = 142; 28.6%) were also frequent

Table 2. The injuries classified into 3 categories

Type of sports	M	F	Total athletes	Injured male	Injured female	Total injuries	Injury incidence (per 100 athletes)
Full-contact sport	1,700	990	2,690	164	53	217	8.1
Limited-contact sport	851	807	1,658	54	83	137	8.3
Non-contact sport	4,485	3,366	78,151	82	60	142	1.8
Total	7,036	5,163	12,199	300	196	496	4.1

causes of injuries (Table 2). However, limited-contact sports had the highest incidence with 8.3 injuries per 100 athletes, particular among female subgroup as shown in Table 2. The most common diagnoses were sprains and strains, with a total number of 359 reports (Table 3).

For all sports, most injuries (n = 234) affected lower extremity (Table 4). The knee and ankle were the most common sites of injury with 104 and 62 injuries reported, respectively (Table 5). The incidence of the site of injury was different depending on the type of sport, as shown in Table 6. The incidence of knee injuries among the limited-contact sports was 38.9% compared to 24.7% and 21.1% accounted for the full-contact and non-contact sports, respectively. In contrary, the prevalence of head and neck injuries associated with the full-contact sports was 18.8%, in which was higher than the other categories.

For 496 injuries incurred in this study, there were 59 hospitalization for injuries documented during the competition, of which the full-contact sports required the highest rate of referral at 21.1%, while the referral rate for the limited-contact and non-contact sports was 11.1 and 8.6%, respectively.

Table 3. The diagnosis reported for the injuries

Diagnosis	Number of injuries
Sprain and strain	359
Superficial injury	45
Open wound	36
Crushing injury	21
Fracture and dislocation	15
Other	20
Total	496

Table 4. The location of injuries

Location	Number of injuries
Lower extremity	234
Upper extremity	135
Head and neck	53
Body axis	49

Table 5. The 5 most common sites of injuries

Site of injury	Number of injuries
Knee	104
Ankle	62
Wrist, hand and fingers	56
Shoulder	42
Leg	26

Discussion

The present study demonstrated that full-contact sports had the highest number of injury during the competition in the 37th Thailand National Games 2008, which amounted to 45% of all injuries, and more than half of male athletes sustained injuries in the same category. The rugby football may well be a representative of the full-contact group because there were a total of 72 injuries reported during the rugby games. In addition, it had the largest athletes group diagnosed as fracture and dislocation with 6 out of a total of 15 athletes. Some studies on rugby competition have also shown that high overall risk of injury was due to the tackle, but a risk of sustaining a catastrophic injury could be regarded as acceptable[1,2]. Pencak Silat may be another good representative of the full-contact group because it incurred 30 injuries and had the highest injury incidence either male or female competition (24.4 per 100 fight participations), which is comparable to other combat sports such as Martial arts (23.6 per 100 fight participations)[3]. Many studies have reported that

Table 6. The site of injury stratified according to the type of sports

Type of sport	Head & neck (%)	Shoulder (%)	Elbow (%)	Wrist, hand, fingers (%)	Knee (%)	Ankle & foot (%)	Back (%)	Total injuries
Full-contact sports	32 (18.8)	21 (12.4)	8 (4.7)	25 (14.7)	42 (24.7)	38 (22.4)	4 (2.35)	170
Rugby	10 (17.2)	9 (15.5)	2 (3.45)	4 (6.9)	22 (37.9)	11 (19.0)	0	58
Combat sports	22 (19.6)	12 (10.7)	6 (5.4)	21 (18.8)	20 (17.9)	27 (24.1)	4 (3.6)	112
Limited-contact sports	14 (13.0)	6 (5.5)	5 (4.6)	13 (12.0)	42 (38.9)	23 (21.3)	5 (4.6)	108
Handball	3	1	2	9	18	8	0	41
Basketball	7	4	0	3	8	8	0	30
Football	2	1	0	0	8	3	4	18
Softball	2	0	2	1	7	2	1	15
Futsal	0	0	1	0	1	2	0	4
Non-contact sports	3 (3.3)	14 (15.6)	5 (5.6)	17 (18.9)	19 (21.1)	24 (26.7)	8 (8.9)	90
Overall	49 (13.3)	41 (11.1)	18 (4.9)	55 (15.0)	103 (28.0)	85 (23.1)	17 (4.6)	368

most injuries in combat sports such as Taekwondo, Martial arts, and Boxing are head and neck and are occasionally very serious, for example, cerebral concussion[3-6].

The incidence of injury during the limited-contact sport seems to be higher than the full-contact sport (8.3 vs. 8.1). This may be explained that most of the female athletes had been injured in the limited-contact sport such as handball and basketball. Interestingly, the incidence of knee injuries among the limited-contact sport was 38.9% which is higher than the incidence presented among the full-contact sport (with exception for the rugby) and the non-contact sport. This result is corresponding to the review by the International Olympic Committee (IOC) medical commission who has stated that the female basketball and handball athletes have a much higher incidence of the anterior cruciate ligament ruptures than male athletes[7]. The result may also be correlated to the previous studies showing the biomechanical differences between male and female soccer players during unanticipated cutting or jumping maneuver[8-11]. Another reason may be that the amount of female athletes participated in the full-contact category was less than the male group and none for some type of sport. However, the severity of injury should be another concern as for prevention and surveillance system of injury. If the severity of injury assume from the rate of referral to the hospital, the full-contact should have the top rate with 21.1% of all injuries in the same category compared to 11.1 and 8.6% in the limited or non-contact sport, respectively. Thus, the results of the present study establish that a medical supervision by well-trained teams is a fundamental requirement for the full and limited-contact sports.

The non-contact category had caused a low potential of injury as the injury incidence of 1.8 per 100 athletes, and no injury reported from many sports of this category. Nevertheless, in the present study, injuries were reported from some types of non-contact sport with the injury risk such as in tennis and beach volleyball. It may be due to the requirement of some kinds of sport in a cutting, jumping, and pivoting movement during the competition which has been previously evidenced as a risk of knee ligament injuries[12]. Many authors have also demonstrated that significantly more anterior cruciate ligament injuries were sustained in a non-contact situation[13-15]. Thus, these sports may need a well medical supervision as well.

About half of the injuries affected the lower extremity, with sprain and strain being the most common type. This is agreement with previous publications on the sport injury. Unfortunately, the limitation in the present study is to be unable to demonstrate neither definite diagnosis nor results of investigation and treatment. We suggest that education or training prepared for the health care providers should be included basic and even advance knowledge of caring the sprain and strain. Thorough, it may be necessary to spot at the lower extremity, since it was accounted as a most common site of injury in "the 37th Thailand National Games" particularly the knee and ankle. The equipment and supply preparation should be suitable to this probability as well. However, it also depends on the type of sports taken care such as head

and neck which has been reported as a most common injuries in Taekwondo[4] and spine in rowers[16]. Although, the present study demonstrated that the incidence of head and neck injuries was high in the full-contact sport especially in the combat sports when compared to the other categories. The knee and ankle injuries were still the most common site of injury for all the categories classified by the author.

The data collection system are important for analysis the event which is useful to prevent the injury and plan for the future event, if so it should be as complete as possible but still friendly to use with the least controversy such as a coding issue. It is our limitation to report injuries per 1000 exposures and an ability of the injured athletes to resume the competition, despite it may be valuable. An understanding of the reported form and software of the teams including a network link to the health care persons, provider and mass communication play an important role to obtain a complete data. It is our experience that transportation system is another thing to organize since there was 1 athlete deceased in a car accident and many sustained injuries. All the parts are able to improve the surveillance system.

Conclusion

The data demonstrates a potential risk of injury occurring predominately in full-contact sports and limited-contact sports. An overall risk of injury among female athletes is high during the limited-contact sport while the full-contact sport may be more risky among male athletes. The data is potentially useful in developing injury surveillance systems for future sporting events.

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ระบาดวิทยาของการบาดเจ็บจากการแข่งขันกีฬาระดับชาติครั้งที่ 37 "พิษณุโลกเกมส์"

อาทิตย์ เหล่าเรืองธนา, ไพศาล ภู่สามสาย, ธาริณี ฟังเสนาะ, ภัทรวรรณ สุพรรณไพบูลย์, เกษม ตั้งเกษมสำราญ

ภูมิหลัง: *การป้องกันการบาดเจ็บของนักกีฬาขณะแข่งขันมีความสำคัญเป็นอย่างยิ่ง เนื่องจากการบาดเจ็บต่าง ๆ ที่เกิดขึ้นอาจส่งผลถึงตัวนักกีฬาและทีมรวมถึงผลการแข่งขัน ทั้งนี้อุบัติการณ์ของการบาดเจ็บมักจะแตกต่างกันไป โดยขึ้นอยู่กับปัจจัยหลายอย่าง เช่น ชนิดของกีฬา ระดับของการแข่งขัน และมาตรฐานของระบบเฝ้าระวังอุบัติเหตุ และมาตรฐานของระบบเฝ้าระวังอุบัติเหตุและการเจ็บป่วย*

วัตถุประสงค์: *เพื่อศึกษาถึงระบาดวิทยาของการบาดเจ็บจากการแข่งขันกีฬาระดับชาติครั้งที่ 37 ที่จังหวัดพิษณุโลกเป็นเจ้าภาพ*

วัสดุและวิธีการ: *การบาดเจ็บของนักกีฬาทั้งหมด ทุกประเภทกีฬาที่เกิดขึ้นระหว่างการแข่งขัน ในการแข่งขันกีฬาระดับชาติครั้งที่ 37 "พิษณุโลกเกมส์" จะถูกบันทึกโดยแบบและโปรแกรมในการเก็บข้อมูล ซึ่งถูกพัฒนาขึ้นเพื่อใช้ในการส่งต่อข้อมูลสู่หน่วยงานกลางได้อย่างมีประสิทธิภาพ โดยมีคณะกรรมการการเฝ้าระวังทางการแพทย์เป็นผู้ประเมินข้อมูลที่ได้*

ผลการศึกษา: *พบว่ามีนักกีฬาและผู้ฝึกสอนเข้าร่วมงานกีฬาแห่งชาติครั้งที่ 37 เป็นจำนวน 14,429 คน มีการบาดเจ็บในขณะแข่งขันเกิดขึ้นทั้งหมด 496 ครั้ง เป็นนักกีฬาชาย 300 ครั้ง นักกีฬาหญิง 196 ครั้ง ในจำนวน 37 ชนิดกีฬา พบว่ารักบี้ฟุตบอล, แฮนบอล และบาสเกตบอลมีจำนวนครั้งของการบาดเจ็บมากที่สุด 71, 50 และ 38 ครั้งตามลำดับ มีหลายชนิดกีฬาในกลุ่มที่ไม่มีการปะทะกันในขณะแข่งขันที่ไม่พบการบาดเจ็บใด ๆ เลย การบาดเจ็บที่เกิดขึ้นได้รับการวินิจฉัยเป็น sprain and strain มากที่สุด ซึ่งหนึ่งของการบาดเจ็บเกิดขึ้นที่ Lower extremities โดยเฉพาะอย่างยิ่งข้อเข่าและข้อเท้า*

สรุป: *กีฬาชนิดที่มีการปะทะหรือกึ่งปะทะมีแนวโน้มจะเกิดการบาดเจ็บขณะแข่งขันได้สูงกว่ากีฬาที่ไม่มีการปะทะ และการบาดเจ็บส่วนใหญ่จะเกิดที่บริเวณ Lower extremities*