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Original Article

Survey of judo injuries in physical education classes: a retrospective analysis

CATHERINE JOY D. LARIOSA,[1] DARIUSZ GOZDOWSKI,[2] STEFAN PIETKIEWICZ,[3] REYLIN MACIEJEWSKI [4]
[1]Department of Sports Science, University of the Philippines Diliman, Quezon City, PHILIPPINES;
[2]Department of Experimental Design and Bioinformatics, Warsaw University of Life Sciences-SGGW, Warsaw, POLAND;
[3]Department of Plant Physiology, Warsaw University of Life Sciences-SGGW, Warsaw, POLAND;
[4]Department of Sports Marketing, Keimyung University, SOUTH KOREA

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Abstract:
Problem Statement: To date, most epidemiological studies on martial arts or combat sports have involved injuries incurred at the advanced or elite level. Thus far, there have been no studies on judo injuries sustained by students while participating in physical education classes. **Purpose:** The aim of this study was to assess the profile of injuries among physical education judo students and identify whether age and sex correlate with injuries. **Approach:** Male (n = 273) and female (n = 327) college students, with a mean age of 18.49 years (±1.82) and who took judo as a PE class, were surveyed retrospectively. The injury rates are expressed per 1000 athlete-exposures. **Results:** There were a total of 180 injuries, at a rate of 9.4 per 1000 athlete-exposures (95% CI: 8.00 – 10.70), which were reported by PE judo students from 2011 to 2016. There was no significant difference between males and females in terms of the injury rates (OR = 1.12, 95% CI: 0.78 – 1.60; $p = 0.545$). Age was found to have a significant effect on all injuries (OR = 0.91; 0.82 – 1.00; $p = 0.045$), to the ankles (OR = 0.79; 0.65 – 0.96; $p = 0.017$) and fingers (OR = 0.77; 0.61 – 0.97; $p = 0.027$). A similar pattern was found for strains ($p = 0.008$) and stress fractures ($p = 0.021$). Being thrown (31.1%) and impacts on the surface (26.1%) were the most common injury mechanisms. **Conclusion:** Compared with the injuries incurred at the advanced or elite level, the injuries sustained in PE classes were more varied in terms of the involved body parts and injury types.
Key Words: wounds and injuries, martial arts, epidemiology, combat sports

Introduction

A century and a half after its origination, judo is widely practiced even outside its birthplace in Japan. Almost all member nations of the International Olympic Committee are also members of the International Judo Federation (Maciejewski & Callanta, 2016). Jigoro Kano, the founder of Kodokan Judo, travelled worldwide to promote the sport. His efforts to bring judo to world championships and for its inclusion in the Olympic program in 1964 led to its popularity and, consequently, ushered in the evolution of the sport, its training methods, and its competitors in their present state (Sikorski, 2005). Kano propagated the sport in harmony with the goals of physical education, i.e., development of body and character of its practitioner (Kano, 1986). Exercises and regimens were designed to promote usefulness and balance without subjecting the body to excessive stress or overemphasis of any one part or fitness parameter that may result in pain and injuries. In terms of personal development, Kano's principle of using the right amount of force or strength on different types of opponents has application to real life decision-making, leading to self-knowledge and self-control. These principles are part of the judo-learning program.

Practicing judo has been found to have many beneficial effects for young people. Jacini and colleagues reported an increase in brain tissue density related to complex motor planning and execution (Jacini et al., 2009). Compared with recreational sports, judo has been discovered to produce greater effects in developing fitness parameters such as agility, muscle endurance, and flexibility in young boys and girls (Seculic, Krstulovic, Katic, & Ostojic, 2006; Krstulović, Kvesić, & Nurkić, 2010). Furthermore, it has been discovered that judo practitioners have better balance regulation and control than dancers (Perrin, Deviterne, Hugel, & Perrot, 2002). The worldwide popularity of the sport is related to its physical and mental benefits (Fukuda, Stout, Burris, & Fukuda, 2011) as well as its psychological benefits. For instance, it was found that young judo participants were generally happier and exhibited better indices of life satisfaction and well-being than non-participant norm groups (Matsumoto & Konno, 2005). Judo is practiced not only as a competitive sport but is also offered as physical education classes in schools and as a regular physical activity even in fitness gyms.

Corresponding Author: REYLIN MACIEJEWSKI, E-mail: reylinksj@yahoo.com

Unsurprisingly, judo has become relatively popular in the Philippines. Judo is included in sports leagues and sports festivals in the country. Indeed, it is being offered as a regular physical education class in many major universities in the country. However, anecdotal evidence shows a widely-held perception of the sport's danger, or any combat sport, among the locals. Coincidentally, recent news about severe injuries suffered by Japanese youth while practicing judo have surfaced (Uchida, 2011). However, the concern for safety cuts across various sports, leisure activities and even dance, because it is widely recognized that there is an inherent risk in any physical activity (Bloemers et al., 2012; Malkogeorgos, Mavrovouniotis, Zaggelidis, & Ciucurel, 2011). Therefore, injuries are not unique to judo. In addition, the risk of injury increases as involvement deepens (Howe, 2004) or with prolonged participation (Zetaruk, Violan, Zurakowski, & Micheli, 2005). However, no such conclusion was apparent in other related studies (Maciejewski & Callanta, 2016; Bačanac, Radović, & Vesković, 2007)

To date, most epidemiological studies on martial arts and combat sports have involved injuries that were incurred during competition or training, most of which were conducted at the elite level. We believe that injury is an equally important concern at both elite and amateur or grassroots levels. To our knowledge, no published study in English has been performed yet on judo injuries sustained by students while participating in PE classes. Therefore, the aim of this study was to assess the profile of injuries in this population. Specifically, we tested for differences between sex and age in terms of the injury rate, affected body regions, common injury types, situations leading to injury, mechanisms of injury, post-injury decisions and need for surgical procedures.

Materials and methods

Participants

A total of 600 participants of 1,195 college students, who took judo as a PE class under the supervision of the first author from June 2011 to May 2016, answered the injury questionnaire for this study. Among the 600 respondents (Male, n=273; Female, n=327), with a mean age of 18.49 years (±1.82), 174 reported that they acquired an injury during active participation, and these responses were included in further analysis. We define PE students in our study as those taking PE classes but who are not PE majors.

Measures

A 10-item injury questionnaire that was made available online was sent to the participants. The injury form questionnaire was a simple list for obtaining data on the injured body part, injury type, injury situation, injury mechanism, and injury severity. The obtained demographic variables included age and gender. The questionnaire was validated in terms of the item content validity (I-CVI= 1.0) and scale content validity indices (S-CVI= 0.97).

Procedures

The study was approved by the physical education department of the first author's institution acting as the ethics committee for this study. The first author's institution also provided technical assistance for the study. The link to the online questionnaire was sent to the participants via email and social media group accounts. The response rate was 48.2% after three weeks. Informed consent was built in the questionnaire and was required for all responders before proceeding with the online survey. Participants were asked to recall if they had any injuries during their PE judo classes. An injury was defined as any situation that required assistance, medical or otherwise, from the instructor or that affected the quality of participation or performance. Injury rates were calculated using the formula: (# events during specified time period × k) ÷ # of the population at risk. Injury rates were expressed per 1000 athlete-exposures (A-E). An A-E is defined as "one athlete [student] participating in one practice or game [class session] in which there is a possibility of sustaining an injury" (Zemper & Dick, 2007, p. 4). The NCAA Injury Surveillance System and the Athletic Injury Monitoring System both use this reporting method. The rationale for the use of such method and additional information regarding epidemiological rates can be found in the same paper published by the abovementioned authors.

Statistical Analysis

Logistic regression was employed to test whether age and sex predicted injury occurrence; the odds ratios and 95% confidence intervals for the odds ratios (OR) were calculated. Moreover, the rates (binomial proportions) and 95% confidence intervals for the rates were also computed using the Wilson method. The level of significance for all statistical analyses was set at .05. IBM SPSS statistical software, release 23.0, was used for all analyses.

Results

The exposure rate per 1000 A-E was calculated from the actual number of class days that students were required to attend and the number of students who responded, with or without injury. Most of those who were injured had one injury, and only a few had more than one injury. For males, the exposure rate was 8,736 A-E, and 10,464 A-E for females. A total of 180 injuries at a rate of 9.4 per 1000 A-E (95% CI: 8.00 – 10.70) was reported by PE judo students from 2011 to 2016. There was no significant difference between males (9.96/1000 A-E) and females (8.89/1000 A-E) in terms of the injury rate (OR = 1.12, 95% CI: 0.78 – 1.60; p = 0.545). However, age was found to have a significant effect on the total injury rate (OR = 0.91, 95% CI: 0.82 – 1.00; p =

0.045) and on injuries to the ankles (OR = 0.79; 95% CI: 0.65 – 0.96; p = 0.017) and fingers (OR = 0.77; 95% CI: 0.61 – 0.97; p = 0.027). Figure 1 shows a steady increase in the injury probability with the increase of participant's age, based on logistic regression.

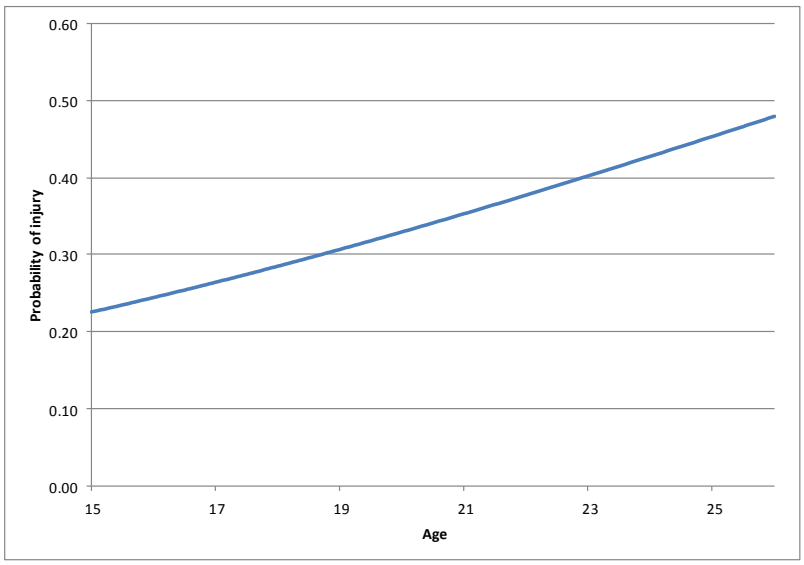

Fig. 1. Probability of injury depending on the age, based on logistic regression

Ankles were found to be susceptible to injury at a rate of 1.61/1000 A-E; 95% CI: 1.14 – 2.29, which was followed by fingers (1.04/1000 A-E; 95% CI: 0.67 – 1.61). The probability for feet and shoulders to be injured was higher than that of the remaining body parts (Supplementary Table 1). By body region, lower extremities and upper extremities had almost twice the odds of being injured, 4.2 and 4.4 times, respectively, compared with the head/neck and trunk regions (Figure 2).

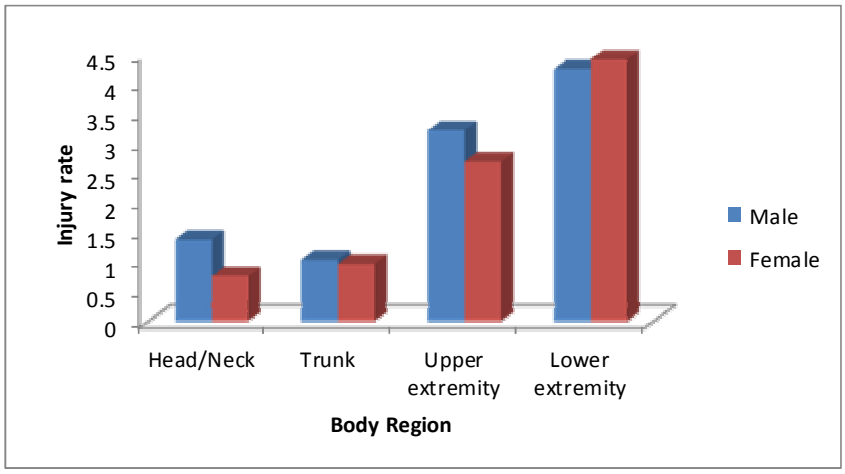

Fig. 2. Distribution of the injury rate by body region in male and female PE judo students. Rates are expressed per 1000 athlete-exposure.

In addition, age was found to significantly predict the injury type, such as strains (OR = 0.73; 95% CI: 0.59 – 0.92; p = 0.008) and stress fractures (OR = 0.34; 95% CI: 0.14 – 0.85; p = 0.021). Younger people showed a lower probability of incurring these types of injuries. In contrast, men had a significantly higher abrasion rates than women (OR = 2.40; 95% CI: 1.04 – 5.55; p = 0.040). Sprains (30.6%) were reported to be the most common injury type for both males and females, followed by abrasions (14.4%), contusions (13.3%), and strains (11.7%). Other injury types showed very low rates (Supplementary Table 2).

Male students had a significantly higher risk of being injured during randori (sparring) than female students (OR = 2.16, 95% CI: 1.27 – 3.67; p = 0.005). Although not significant, nage-komi (throwing practice) revealed a comparable injury rate (3.70/1000 A-E) with randori (3.54/1000 A-E). Table 1 shows the distribution of rates according to the situation leading to injury.

Table 1. Distribution of injury rates per 1000 A-E by injury situation in male and female PE students with 95% confidence intervals

	Male			Female		
Injury Situation	Rate	Lower	Upper	Rate	Lower	Upper
Warm-up	0.46	0.18	1.18	0.57	0.26	1.25
Conditioning	0.00	0.00	0.44	0.10	0.00	0.54
Uchikomi	0.69	0.31	1.50	1.05	0.59	1.88
Nagekomi	3.09	2.13	4.49	4.20	3.13	5.64
Randori	4.92	3.66	6.62	2.39	1.62	3.52
Cool-down	0.11	0.01	0.65	0.00	0.00	0.37
Others	0.57	0.24	1.34	0.38	0.15	0.98

Note: A-E = athlete-exposure, PE = physical education

There was no difference between age and sex in terms of the injury mechanism. However, being thrown (31.1%) and falling on or impacting the surface (26.1%) showed the highest rate compared with all other mechanisms. Table 2 shows the distribution of rates for the mechanisms of injury.

Table 2. Distribution of injury rates per 1000 A-E by injury mechanism in male and female PE judo students with 95% confidence intervals

	Male			Female		
Injury Mechanism	Rate	Lower	Upper	Rate	Lower	Upper
Arm lock	0.23	0.06	0.83	0.00	0.00	0.37
Counter throw	0.11	0.01	0.65	0.29	0.10	0.84
Fall/Impact with surface	2.63	1.76	3.95	2.29	1.54	3.41
Grappling/Pinning/Hold-downs	1.03	0.54	1.96	0.48	0.20	1.12
No evidence of contact	0.69	0.31	1.50	0.57	0.26	1.25
Performing/Delivering throw	1.83	1.13	2.97	1.15	0.66	2.00
Prohibited action	0.11	0.01	0.65	0.19	0.05	0.70
Receiving throw/Being thrown	2.63	1.76	3.95	3.15	2.25	4.43
Simultaneous throws	0.34	0.12	1.01	0.38	0.15	0.98
Sprints/Running	0.23	0.06	0.83	0.29	0.10	0.84
Others	0.11	0.01	0.65	0.10	0.00	0.54

Note: A-E = athlete-exposure, PE = physical education

In terms of returning to play, only age was found to have a significant effect on discontinuing practice for a day (OR = 0.75; 95% CI: 0.62 – 0.91; p = 0.004). Almost half of the injured students (46.1%) could continue to participate in class without any exercise modifications, but 11.1% had to discontinue participation for at least a week, and 9.4% had to stop participation for more than a week. Most injuries were acute injuries (86.1%), and no student reported the need for any surgical procedure.

Discussion

To our knowledge, this is the only study in English that investigated the injuries incurred by physical education students participating in judo. Comparison with other studies in physical education is also limited by the method of reporting injuries. We reported the injury rates per 1000 A-E based on the work of Zemper and Dick (2007). Although it was applied in the competitive context, several studies have also used the same principle for identifying exposure rates. For example, one study used the injury rate per year to report the average PE-related injuries recorded in emergency departments within 10 years (Nelson et al., 2009). Another study used the injury rate per 10,000 hours of school PE exposure to report the rates in relation to the level of leisure activity in a single year (de Loës et al., 1990). These differences reflect the various challenges in identifying and quantifying exposure data.

It is worth noting that these other investigations involved several PE activities compared with only one activity in this study. A study by Araki et al. was the only other identified study to focus on a single activity (Araki et al., 2015). Focusing on a specific activity alone allowed a more detailed description of the mechanism of injuries and the situations leading to the occurrence of those injuries, which can provide a more specific set of suggestions for injury prevention.

In comparison with studies involving injuries sustained during competition, our study supports the general findings that more injuries are sustained during competition than during training or non-competitive environment in judo and other martial arts (Ransom & Ransom, 1989; Rukasz, Sterkowicz & Kłys, 2011; Witkowski, Maśliński, Stefaniak, & Wieczorek, 2012; Cynarski & Kudłacz, 2008). Table 3 shows the gap between the injury rates obtained from PE participation and those derived from competition.

Table 3. Comparison of injury rates in male and female participants per 1000 A-E with previous studies

Different Studies	Male	Female
*This Study	9.96	8.89
**Green, Petrou, Fogarty-Hover, & Rolf (2007)	41.3	40.9
**James & Pieter (2003)	48.54	34.25
**Pieter, Talbot, Pinlac, & Bercades (2001)	25.18	41.28

Note: A-E= athlete-exposure; *= physical education class; **=competition

The lack of difference in the risk between male and female students in this study is reflected in some studies (de Loës et al., 1990; Carmeli, Azencor, Wertheim, & Coleman, 2003) but disagrees with other works (Nelson et al., 2009). In prior studies, when male students incurred higher injury rates, age was a factor. As age increased, males tended to have more injuries than females. In our study, this observation appeared in both sexes. As age cannot be associated with experience in this study because the population was homogenous, we can only suppose that students who were older may have been more willing to try novel movements or may have felt more obliged to perform new movements more than their younger classmates.

Both the upper and lower extremities were found to have high injury rates in this study; high injury rates were the highest among all body regions. This is similar to other studies that found that lower body incurred more injuries than other regions during PE, leisure time, dancing and organized sports (Collard, Verhagen, van Mechelen, Heymans, & Chinapaw, 2011; Malkogeorgos et al., 2011). However, injuries sustained in judo competitions mostly involved the upper body (James & Pieter, 2003; Maciejewski & Pietkiewicz, 2016). In general, judo was found to cause more injuries of the upper extremities (Harmer, 2009). The difference between our results and those reported for competitions may be due to the difference in the skill level of the participants. Judo techniques are characterized by rotational movements that are used to get into positions. This is accomplished during the tsukuri (positioning) and kake (actual throwing) phases of throwing, during which a tori (thrower) has to maintain balance against a partner's resistance (Imamura, Iteya, Hreljac, & Escamilla, 2007). Experienced practitioners can repeatedly perform these movements without a problem. However, these movements may tax the body of less experienced students.

The high risk of ankle and finger injuries in this study indicates the vulnerability of both the upper and lower extremities to injury in judo. During both the practice and competition, kumikata (methods of holding) is very important for gaining control of the other judoka (Maciejewski & Pietkiewicz, 2016). Only the standard way of holding (tsurite) is usually taught in PE classes. This may have limited the students from successfully performing throws or getting out of an injurious situation. In contrast, sustaining an injury to the foot and ankle suggests a lack of readiness of the joints to withstand more than the average shear forces. The inability to perform proper tsugi-ashi on the mats may also contribute to lower body injuries. The condition of the mats may have made the students prone to injury, especially when the mats were either too soft or too hard.

Unlike other PE studies (Austin, Rogers, & Reese, 1980), which found that sprain was the most common injury type, this study found higher rates for abrasion, strain and stress fracture. However, abrasion is considered unique to martial arts and combat sports with striking aspects (Nishime, 2007). In judo, participants hit the mats with various body parts, especially the head, hand or foot. Most students were not physically conditioned to fulfill the requirements of the sport. Most movements in judo training, including the seemingly simple gymnastic roll, seemed to be new for the beginners. Hence, in most cases, there is a need to allot more time for general body conditioning to physically and psychologically prepare the students for learning extraordinary movements. Isometric exercises strengthen joint ligaments and help prevent injuries (Bolotin & Bakayev, 2016). Thus, these exercises should be included in the general body conditioning of PE judo students.

The male students in this study sustained more injuries during randori, while the female students were hurt more during nage-komi. Our experience with students reveals that boys are more competitive during free-play compared with girls, who tend to cooperate and practice a give-and-take type of approach during randori. It seems that boys consider getting hurt to be part of the game, while girls tend to avoid getting hurt. The observation that girls are hurt more during nage-komi suggests a lack of falling skill and lack of control on the part of the uke and tori, respectively. The lack of space in which to move around and maneuver may also contribute to a higher rate of injury in class. Additionally, these two parts of judo practice may be exhausting for students because they require full effort and concentration. Fatigue may be an associated risk for injury (Detanico, Dal Pupo, Franchini, & Dos Santos, 2015). Because of nage-komi and randori, being thrown and falling or impacting the surface were found to result in more injuries than other mechanisms. The impact of a fall may be aggravated by the condition of the mats, e.g., old and worn-out or without extra cushioning underneath.

One of the limitations of this investigation is its retrospective design. Prospective designs are better in terms of information recall. However, our study can provide a preliminary set of data that can help refine the way injuries are reported. In addition, this design allows for a quick collection of an adequate amount of cases that is necessary to make a meaningful analysis. Second, the use of the amount of time to express exposure rate may be considered the most accurate method (Zemper & Dick, 2007). However, because of the nature of the study, it would be even more inaccurate for us to ask our respondents to estimate the number of minutes or hours

they acquired for the entire semester. Furthermore, asking whether the student consulted a physician or therapist was not included in our survey. Hence, we do not have a way of confirming whether those who were injured knew what exactly their injury was.

Methods of reporting an injury incurred in physical education classes varied in different studies. In a prospective study done by Verhagen, Collard, Paw and van Mechelen (2009), injury rates were expressed per 1000 hours of exposure. The injuries recorded from participation in physical education (PE), sports and leisure time physical activity of 10–12-year-olds revealed a higher injury rate for girls compared with boys. Another study, this time using injury rate per 10,000 hours of school PE, reported that students who were classified as mostly sedentary were, on average, seven times more likely to be injured than their more active counterparts (de Loës M, Jacobsson, & Goldie 1990). However, a 10-year retrospective analysis of epidemiological data, based on the National Electronic Injury Surveillance Study of the US Consumer Product Safety Commission, reported injury rate per 10,000 population per year (Nelson, Alhaj, Yard, Comstock, & McKenzie, 2009). Although the authors found a 150% increase in injury occurrence over the study period (4.39 to 10.9 injuries per 10,000 population from 1997 to 2007), almost none of these cases require hospitalization. Lower and upper extremity sprains and strains were the usual injury type. Among basketball, football, volleyball, soccer and gymnastics, running was found to incur the most number of injuries, especially in the lower extremities. However, some of the earlier reports on PE injuries were in terms of percentage proportions (Hammer, Schwartzbach & Paulev, 1981). Zemper & Dick (2007) pointed out the difficulty of comparing or combining results and findings from different studies because of these varying methods of reporting injuries. They also emphasized the importance of deriving the injury rates from the population at risk for the studies to have an epidemiological value.

In general, we can say that the lack of severity of injuries and the low injury rate reported in judo classes make it a relatively safe activity to promote health and fitness among young college students. We want to give special attention to the way in which the classes were handled in the present survey, which may have prevented injuries that could have otherwise occurred with less supervised activities. The first author has instituted a signal-command for students to follow during judo class. To our knowledge, this signal-command method is also used in other physical education classes. However, we found only one published study that used a similar method (Murphy & Beh, 2006). Students were never left alone, but they had to adhere to the rules about when to roll, throw, or grapple. However, our data also show an increasing number of head injuries. Although these injuries did not lead to any severe or fatal conditions, as reported by Uchida (2011), there should be an active monitoring by judo instructors for students who suffer from these injuries. Head injuries are known to be the most severe and catastrophic in judo and in other sports and physical activities (Boden, Tacchetti, Cantu, Knowles, & Mueller, 2007; Kemp, Hudson, Brooks, & Fuller, 2008).

Conclusions

Because the risk of injury was approximately equal between male and female participants, judo instructors and coaches should pay an equal amount of attention to ensure safety for all students regardless of gender. Older students may be forewarned of the consequences of engaging in risky behavior especially during the major part of the class session. Compared with injuries incurred in judo competitions, those sustained in PE classes were more varied in terms of the involved body parts and injury types. This retrospective study provides a good initial assessment of injuries sustained in PE classes. However, prospective designs should be conducted to obtain a more accurate data for this population. Establishing a simple surveillance system at school will have a long-term benefit for the students, instructors and administrators for injury management and prevention.

Conflicts of interest

The authors declare no competing financial interests.

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Appendices:

Supplementary Table 1. Injury rates per 1000 A-E by body part in male and female PE judo students with 95% confidence intervals

	Male			Female		
Body Part	Rate	Lower	Upper	Rate	Lower	Upper
Ankle	1.95	1.22	3.11	1.34	0.80	2.24
Breasts	0.00	0.00	0.44	0.10	0.00	0.54
Buttocks	0.00	0.00	0.44	0.29	0.10	0.84
Clavicle	0.00	0.00	0.44	0.10	0.00	0.54
Ear	0.11	0.01	0.65	0.00	0.00	0.37
Elbow	0.00	0.00	0.44	0.29	0.10	0.84
Finger	1.26	0.70	2.25	0.86	0.45	1.63
Groin	0.00	0.00	0.44	0.10	0.00	0.54
Forearm	0.34	0.12	1.01	0.19	0.05	0.70
Foot	1.14	0.62	2.11	0.48	0.20	1.12
Hamstrings	0.11	0.01	0.65	0.00	0.00	0.37
Hand	0.34	0.12	1.01	0.48	0.20	1.12
Head	0.46	0.18	1.18	0.67	0.32	1.38
Heel	0.11	0.01	0.65	0.10	0.00	0.54
Knee	0.23	0.06	0.83	0.57	0.26	1.25
Lower back	0.23	0.06	0.83	0.38	0.15	0.98
Lower leg	0.23	0.06	0.83	0.48	0.20	1.12
Mouth	0.34	0.12	1.01	0.00	0.00	0.37
Neck	0.46	0.18	1.18	0.10	0.00	0.54
Pelvis	0.00	0.00	0.44	0.10	0.00	0.54
Ribs	0.34	0.12	1.01	0.10	0.00	0.54
Shoulder	0.92	0.46	1.81	0.57	0.26	1.25
Sternum	0.23	0.06	0.83	0.10	0.00	0.54
Toe	0.34	0.12	1.01	0.86	0.45	1.63
Upper arm	0.00	0.00	0.44	0.10	0.00	0.54
Upper back	0.23	0.06	0.83	0.19	0.05	0.70
Upper leg	0.11	0.01	0.65	0.10	0.00	0.54
Wrist	0.34	0.12	1.01	0.19	0.05	0.70
Others	0.00	0.00	0.44	0.10	0.00	0.54

Note: A-E = athlete-exposure, PE = physical education

Supplementary Table 2. Injury rates per 1000 A-E by injury type in male and female PE judo students with 95% confidence intervals

	Male			Female		
Injury Type	Rate	Lower	Upper	Rate	Lower	Upper
Abrasion	1.95	1.22	3.11	0.86	0.45	1.63
Blister	0.23	0.06	0.83	0.29	0.10	0.84
Bursitis	0.11	0.01	0.65	0.00	0.00	0.37
Cartilage-torn	0.11	0.01	0.65	0.10	0.00	0.54
Concussion	0.57	0.24	1.34	0.48	0.20	1.12
Contusion	0.80	0.39	1.65	1.62	1.01	2.60
Dislocation	0.34	0.12	1.01	0.38	0.15	0.98
Fracture	0.00	0.00	0.44	0.19	0.05	0.70
Heat exhaustion	0.00	0.00	0.44	0.10	0.00	0.54
Hyperextension	0.11	0.01	0.65	0.29	0.10	0.84
Impingement syndrome	0.00	0.00	0.44	0.10	0.00	0.54
Inflammation	0.69	0.31	1.50	0.29	0.10	0.84
Internal injury	0.11	0.01	0.65	0.00	0.00	0.37
Laceration	0.00	0.00	0.44	0.10	0.00	0.54
Ligament(s)-complete tear	0.11	0.01	0.65	0.10	0.00	0.54
Nerve injury	0.11	0.01	0.65	0.10	0.00	0.54
Separation	0.00	0.00	0.44	0.10	0.00	0.54
Sprain	2.98	2.03	4.36	2.77	1.93	3.98
Strain	1.49	0.87	2.54	0.76	0.39	1.51
Stress fracture	0.00	0.00	0.44	0.19	0.05	0.70
Subluxation	0.00	0.00	0.44	0.10	0.00	0.54
Sub-periostal hematoma	0.11	0.01	0.65	0.00	0.00	0.37
Others	0.11	0.01	0.65	0.00	0.00	0.37

Note: A-E = athlete-exposure, PE = physical education