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## **Knowledge and attitude among Malaysian secondary school athletes on sports-related concussion**

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### **ABSTRACT**

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Adolescents' knowledge and attitude toward concussions are important in reducing the effects of post-concussion syndrome. To date, no standard education has been applied to Malaysian school-aged athletes. This study aims at identifying the level of knowledge and attitudes towards concussions among secondary school athletes. A cross-sectional survey with a purposive sampling method was employed. This study included 190 athletes at State Sports School. The RoCKAS-ST questionnaire was used to assess the knowledge and attitude of respondents on concussions. Independent t-tests were used to analyze differences in knowledge and attitudes score toward concussion between gender (male, female), sports type (contact, non-contact), and competition rank (U15, U18) with  $p < 0.05$ . There was no significant difference,  $p > 0.05$  for both Concussion Knowledge Index (CKI) and Concussion Attitude Index (CAI) score between male and female athletes in contact and non-contact sports athletes. Age differences did not influence CKI scores. However, there was a significant difference,  $p < 0.05$  for the CAI score between the age categories of under-15 athletes (U15) and under-18 athletes (U18). In conclusion, age level influenced athletes' attitudes toward concussions. The younger athlete was more vulnerable to concussion injury. Therefore, developing a standard SRC education program for young Malaysian athletes is strongly recommended for concussion management.

**Keywords:** concussion, contact sports, non-contact sports, knowledge, attitude

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### **INTRODUCTION**

Sports-related concussion (SRC) is a major health concern and one of the serious injuries in sporting activities, especially in contact sports (Abrahams, Fie, Patricios, Posthumus, & September 2014; McCrory et al., 2009, 2013, 2017). Concussion known as traumatic brain injury (TBI) is a complex pathophysiological condition that affects the function of the brain. It usually occurs due to biomechanical force imparted to the neck and head region (Sullivan, Pursell, & Molcho, 2018). The complication of concussion is varied and more serious compared to other sports injuries. This includes deficits in physical, emotional, memory function, sleep difficulty, and personality changes (Semrud-Clikeman & Klipfel, 2016). Concussion incidence is estimated at 3.8 million in the United States and the proportion of high school athletes is estimated at 8.9%. However, this number is higher because the existing data do not involve concussion injury in high schools (Halstead & Walter, 2010). To date, the researchers can only identify a few published reports of sports concussion incidence involving contact sports and non-contact sports in Malaysian secondary school athletes. Therefore, the exact number of SRC incidence among secondary school adolescent athletes (13-18 years old) in Malaysian is not well-reported.

Concussion injuries among adolescent athletes are worrying as adolescents are at greater risk compared to adults due to the developing physiological condition and rapid growth of the brain. Thus, it makes them vulnerable to injuries compared to normal adult counterparts (Halstead

& Walter, 2010; King, et al., 2014). Athletes that keep playing with concussion symptom before having full recovery poses a higher risk of further injuries such as getting the Second Impact Syndrome (SIS) and potential catastrophic brain damage (Sullivan, et al., 2018, American Academy of Pediatrics, 2010). Yet, underreporting of SRC incidence has been established in previous literature (Craig, Lininger, Vomacka, & Tiscareno, 2020). One possible approach to overcome this problem is implementing a structured education program to improve the knowledge and safer attitude of this athlete toward SRC. But there seems to be no standardized concussion education program implemented at Malaysian secondary schools.

Adolescent athletes need to understand the causes and mechanisms of concussions, symptoms being experienced and further actions to take following concussion events. Adequate knowledge may affect an athlete's attitude toward concussion in reporting and receiving early appropriate treatment. However, literature shows that knowledge and safe attitude toward sports concussion is still limited among athletes and sports personnel (Lempke, Rawlins, Lynall, & Schmidt, 2019; Register-Mihalik, et al., 2013; Weber & Edwards, 2012). Adolescents athletes who do not have a basic knowledge of concussions will influence the athlete's decision to report or not about the symptoms of the concussion to their coaches or parents. Failure to identify signs and symptoms of concussion and continued involvement in post-concussion sports activities will increase the risk of further injury and may result in death (Cournoyer & Tripp, 2014; Jinguji, Krabak, & Satchell, 2011; Register-Mihalik, et al., 2013). Besides, the level of knowledge and safe attitude including reporting behavior of the athlete towards concussion are two related elements that need to be further explored. Moreover, these two elements are closely linked (Taylor & Sanner, 2017) in determining the behavior of adolescent athletes toward a safer attitude on concussion management and to report incidents and symptoms experienced right after concussions to their coach, teachers, or parents for effective concussion management.

Therefore, to prevent and reduce the effects of concussion injuries, this study is performed to determine the level of knowledge and attitudes of adolescent athletes regarding concussion management. The findings from this study are expected to improve the knowledge of school sports coaches and management bodies on the concussion management required. This study aims at identifying the level of knowledge and attitudes of school-aged athletes (contact and non-contact sports) on sports-related concussions (SRC).

## **METHOD**

### **Design**

A cross-sectional survey design involving school athletes of contact and non-contact sports was used to determine the level of knowledge and attitude among selected participants toward sports-related concussions. This study has been approved and received ethical clearance from the University Research Committee (Code Project: 20170241-107-01) and Educational Planning and Research Division Ministry of Education, Malaysia (KPM.600-3/2/3-eras-130).

### **Participants**

The study population included all students involved in contact and non-contact sports from randomly selected state sports schools in Malaysia. The sampling technique used purposive sampling that refers to any school athletes representing at least at State School Level Council (MSSN). The study samples were calculated based upon 500 adolescent athletes involved in the 2017/2018 MSSN event. A sample size of 217 sports athletes was required in this study with a 95% confidence interval ( $p = 0.05$ ) (Krejcie & Morgan, 1970). Considering 10% dropout, 23 respondents were added to make the total number of respondents required for this study, 240 student-athletes. Thus, a total of 240 school athletes participated in survey completion. However, 190 respondents (80% -) completed the survey satisfactorily. Then, it was analyzed further in this study. Each participant was involved voluntarily, and the consent forms were signed by each respondent prior to data collection.

### **Data collection**

This research instrument used the Rosenbaum Concussion Knowledge and Attitudes Survey - Student Version (RoCKAS-ST) questionnaire designed by Rosenbaum and Arnett (2010). The questionnaire was adapted and translated from English to Malay using cross-cultural translation techniques, using back-back translation and test-retest reliability. 32 adolescent athletes were required to answer the RoCKAS-ST questionnaire (Malay version) twice at 14 days intervals, after first attempt. The RoCKAS-ST-M showed a moderate internal consistency with CKI and CAI score range 0.40 to 0.66 of Cronbach's alpha. The RoCKAS-ST-M scale was valid and reliable instrument to be used among high school athletes that involved in contact and non-contact sports (Fairus et al., 2020).

Surveys are considered satisfactory if the athlete completes at least 90% of the items that test their knowledge level and attitude. This RoCKAS-ST-M questionnaire has 55 items and is divided into five main sections. Section 1 and 2 examine the knowledge of the causes and effects of concussion involving 18 items (right / wrong). This 18-item scoring method will be referred to as the correct answer option provided. Section 5 contains a checklist of 8 items representing the symptoms of post-concussion syndrome that athletes often report. The correct answers will be scored 1 and the wrong answers will be 0. The overall score obtained from Section 1,2, and these 5 will be referred to the Concussion Knowledge Index (CKI), with a score between 0-25. Higher scores indicate higher levels of concurrent knowledge. The rating of poor knowledge (<60%), moderate knowledge (60%-80%) and high level of knowledge (above 80%) were used in this study (Rajali et al., 2020, Rosenbaum & Arnett, 2010).

Sections 3 and 4 further tested respondents' attitudes toward concussion containing 15 items using a 5-point Likert scale score (strongly agree - strongly disagree). Scores obtained from Sections 3 and 4 will be subdivided and referenced in the Concussion Attitude Index (CAI). The CAI score is between 15 - 75 points with the highest score indicating a safe attitude toward concussion. Each questionnaire completed by respondent were checked for Validity Scale (VS) to assess the poor, inconsistent effort or lack of thoughtfulness while completing the survey. The VS items were in true/false format. Correct and incorrect responses were given 1 and zero points, respectively. Possible scores on the VS ranged from 0-3; invalid survey with cumulative score of 0 or 1 considered as invalid and discarded from further analysis (Rosenbaum & Arnett, 2010).

The study was conducted at the randomly selected state sports schools consisting of five schools around Peninsular Malaysia. Upon meeting, the respective appointed coaches/teachers set up the meeting between school athletes and appointed researchers. The meeting was to inform the purposes of the study. Also, each athlete was provided with a set of survey that contained a review letter, study information, and authorization forms, survey form and stationery. The athletes were asked to complete the survey during the meeting. Of the 240 high school athletes involved in this survey, 190 surveys were considered as a valid completed form. The remaining 50 invalid survey were discarded and removed from the analysis because it increased the possibility of fabricated responses from the students (Rosenbaum & Arnett, 2010).

### **Data analysis**

The survey was analyzed, and the data were recorded in the research data form. The descriptive statistic (mean, SD) and independent t-tests were used to analyze differences in knowledge scores and attitudes toward concussion between gender (male, female), sports type (contact, non-contact) and competition rank that refer to athlete underage of 15 years old (U15) and athletes under 18 years old (U15, U18) with statistical significance at  $p < 0.05$  (two-tailed).

## **FINDING AND DISCUSSION**

### **Finding**

#### ***Participants' characteristic***

In this study, N = 190 school athletes were included (contact sports n = 150, non-contact sports n = 40) for further analysis for the completed survey (Table 1).

**Table 1. Demographic criteria of participants N=190**

Criteria		Contact Sports N (%)	Non-contact Sports N (%)
Gender	Male	94 (63%)	23 (57.5%)
	Female	56 (37%)	17 (42.5%)
Competition rank	U15	67 (45%)	3 (8%)
	U18	83 (55%)	37 (92%)

**Level of Knowledge (CKI) and Safe Attitude (CAI) based on gender distribution**

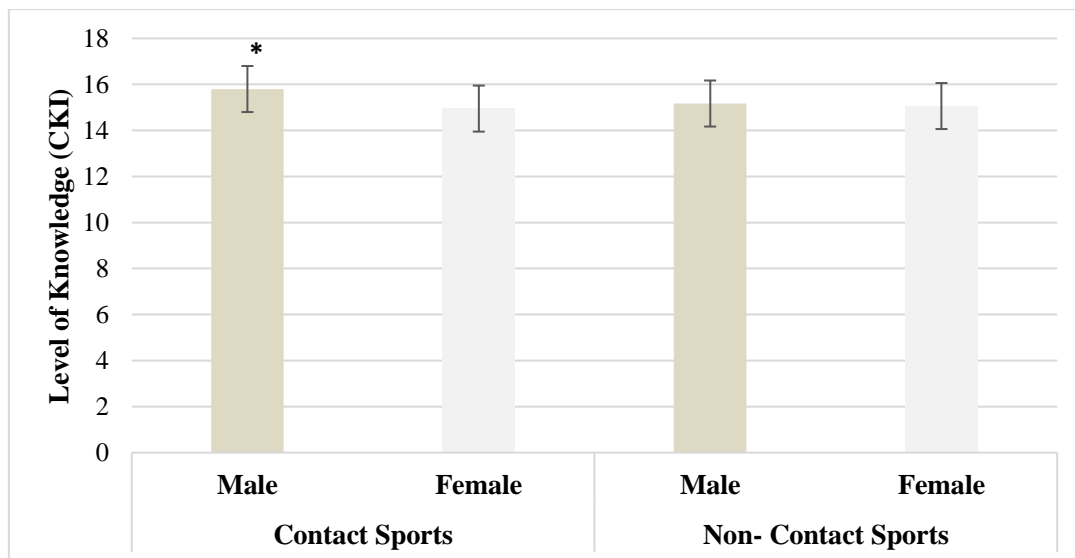
Significance difference was noted on Concussion Knowledge Index (CKI) between male and female athletes in Contact Sports,  $p = 0.05$  (Figure 1). However, the Concussion Attitude Index (CAI) score reveals no significant difference being found between male and female athletes for both groups of contact and non-contact sports athletes can be seen in Table 2.

**Table 2. Level of Knowledge (CKI) and Safe Attitude (CAI) of sports related concussion between gender (male, female) in contact and non-contact sports**

CKI	Male	Female	<i>t value</i>	P value (2-tailed)	95% of CI (Lower, Upper)
	Mean (S.D)	Mean (S.D)			
Contact Sports	15.80 (2.49)	14.95 (2.74)	$t (148) = 1.94$	0.05	(-.01, 1.72)
Non-contact Sports	15.17 (3.16)	15.06 (2.49)	$t (38) = 0.12$	0.90	(-1.76, 1.99)

CAI	Male	Female	<i>t value</i>	P value (2-tailed)	95% of CI (Lower, Upper)
	Mean (S.D)	Mean (S.D)			
Contact Sports	55.17 (7.16)	55.21 (7.06)	$t (148) = 1.94$	0.97	(-2.42, 2.33)
Non-contact Sports	59.39 (6.23)	57.59 (5.95)	$t (38) = 0.92$	0.36	(-2.16, 5.77)



**Figure 1. Level of Knowledge (CKI) between male and female based on sport types**

**Level of Knowledge (CKI) and Safe Attitude (CAI) based on competitions rank**

The independent t-test analysis found that there was no significant difference,  $p > 0.05$  for the Concussion Knowledge Index (CKI) score between the age categories of under-15 (U15) and under-18 (U18) for both groups of athletes in contact and non-contact sports. The results of this

study found that age differences did not influence CKI scores. Interestingly, there was a significant difference,  $p < 0.05$  for the Concussion Attitude Index (CAI) score between the age categories of under-15 (U15) and under-18 (U18) for both groups of sports athletes; contacts and non-contacts (Figure 2). The results of this study found that age level influenced athletes' safety attitude toward concussion where older athletes showed better CAI scores than athletes at younger ages can be seen in Table 3.

**Table 3. Level of Knowledge (CKI) and Safe Attitude (CAI) of sports related concussion between competitions rank (U15, U18) in contact and non-contact sport**

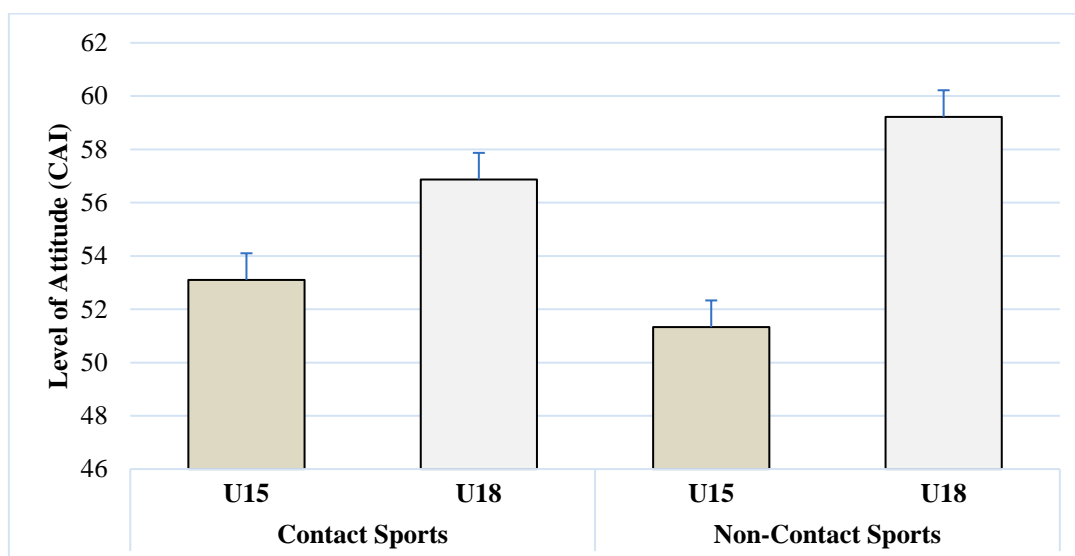
CKI	Competition Rank		<i>t value</i>	p value (2-tailed)	95% of CI (Lower, Upper)
	U15 Mean (S.D)	U18 Mean (S.D)			
Contact Sports	15.34(2.85)	15.59 (2.42)	$t (148) = -0.57$	0.57	(-1.09, 0.60)
Non-contact Sports	12.67 (2.89)	15.32 (2.79)	$t (38) = -1.58$	0.12	(-6.06, 0.75)

CAI	Under 15	Under 18	<i>t value</i>	p value (2-tailed)	95% of CI (Lower, Upper)
	Mean (S.D)	Mean (S.D)			
Contact Sports	53.10 (7.83)	56.87 (5.99)	$t (148) = -0.57$	0.001**	(-5.99, -1.53)
Non-contact Sports	51.33 (3.51)	59.22 (5.92)	$t (38) = -2.26$	0.03 *	(-14.95, - 0.82)

\*  $P < 0.05$

\*\*  $p \leq 0.001$



**Figure 2. Level of Attitude (CAI) between Athletes Under 15 and Under 18 Years old Based on the Sport Types**

**Discussion**

Little is known about the incidence and statistic of sports related concussion in Malaysia. More young athletes are involved in contact sports annually so that it makes them vulnerable and at higher risk of getting injured. Unfortunately, standardized sports related concussion education program for young athletes particularly in Malaysian context are rarely found. Therefore, this study aims at providing a basis on understanding the need to provide a structural, comprehensive and standardized sports related concussion education program for this population by determining the knowledge level and attitude (safe attitude toward concussion management) among high school athletes that participate in contact and non-contact sports. The discussions of the study are divided into two sections (1) Gender Differences and (2) Age Differences.

### ***Gender Differences***

Regardless is considered as below moderate level of knowledge (Rajali et al., 2020; Rosenbaum & Arnett, 2010) both among male and female athletes regardless of the sports' type (contact vs. non-contact sports). The almost identical level of knowledge among contact and non-contact sports athletes is most likely the result of academic training and exposure to similar concussion education and exposure implemented by sports school coaches for all of their athletes (Rosenbaum & Arnett, 2007). In previous literature, the concussion knowledge has been evaluated for its influences toward athlete's safety attitude and reporting behavior intention (Weber, et al., 2019; Register-Mihalik, Linnan, Marshall, McLeod, Mueller, & Guskiewicz, 2013; Kroshus, Baugh, Daneshvar, & Viswanath, 2014; Kroshus, Baugh, Stein, Austin, Calzo, 2017).

In addition, a moderate CKI score contributes to a moderate level of unsafe attitude and a less safe option to return to sports (Rosenbaum & Arnett, 2007). A study by Klipfel et al. (2016) reports that there may be differences in gender specifically on neuropsychological effects, emotional adjustment and healing (Embrace & Klipfel, 2016). In addition, a study by Baker et al. (2015) reveals that there is a gender difference in recovery time among adolescent athletes between the ages of 13 and 19 years. Female athletes took longer to recover than men. In addition, female reported more signs and symptoms of concussion than male athletes. These studies suggest differences in reporting of symptoms and concussion symptoms male and female athletes. This situation affects the length of time from injury to injury. Therefore, further observation of female athletes especially for athletes involved in contact sports and the coach's emphasis on the importance of reporting any signs and symptoms of concussion is important in determining the overall health of an athlete before participating in a sport or competition after an injury.

Moreover, researchers also found that there was no gender difference in terms of attitude toward concussion either for contact sports or non-contact athletes who had an average CAI score of 55-57 points (60% - 80%, moderate level). 75 was the highest score indicating a safer attitude toward concussion (Rosenbaum & Arnett, 2010). This study shows that all athletes whether contact or non-contact sports are at a moderate level (<80%) of having safe attitude toward concussion (CAI score below 60 points). In previous study (Register-Mihalik et al., 2013), the samples of study have moderate level of attitude in reporting the concussion incidence. The risk of removal from the competition, losing playing time and allowing the teammate feeling down are factors contributing to the findings. In addition, the coach's attitude, the lack of medical professional and the mentality of competition versus practice influence the athlete's safe attitude toward concussion management or reporting behavior (Semrud-Clikeman & Klipfel, 2016). The same reason may possibly apply over the sample of the current study. Also, the results of this study suggest that there is a need to implement an ongoing education program to raise awareness and knowledge levels regarding sports concussion among adolescent athletes regardless of gender differences in sports schools in Malaysia. Moreover, the sports concussion education program should include the coaches and the parents. This will increase the likelihood of program intervention accomplishment in delivering the correct sports concussion management. Increasing knowledge of sports concussions can reduce the risk of sports concussion injuries by increasing the ability of athletes to identify signs and symptoms of sports concussions while improving reporting of concussion symptoms to coaches or parents.

### ***Age Differences***

In addition, Previous literature showed that young age athletes pose risk of sports concussion injury (American Academy of Pediatrics, 2010; Giza et al., 2013). With only a minimal impact to the head area, the younger athletes and adolescences are at greater risk of developing concussion injuries due to the changing physiological conditions and their rapid growth of brain compared to adult athletes (American Academy of Pediatrics, 2010; Halstead & Walter, 2010; King et al., 2014). Moreover, the rate of healing is also slower than that of adult athletes (Giza et al., 2013; Taylor & Sanner, 2017). Previous studies using a sample of school-athletes also found that athletes were at higher risk for exposure to Second Impact Syndrome (Fields, & Comstock, 2012; Harmon et al., 2013; Marar, Mcilvain) compared to athletes of other ages. This SIS is most likely to cause cerebral vascular congestion as well as cerebral swelling

(Halstead & Walter, 2010). The consequence of concussion injuries to young and adolescent athletes is more serious which cause prolonged impairment on physical, physiological and emotional disturbance compared to adult. Based on this information, it is critical to develop a better structured sports concussion education program that can increase the awareness and educate these young athletes about the importance of concussion management to increase the athletes' knowledge and adopting a good safe attitude.

Furthermore, based on the authors knowledge, the comparison of current finding with previous literature in Malaysian context is limited particularly on the topic of adolescent athlete at secondary schools (13 - 18 years old) based on the Malaysian education standard. Also, the published research evidence on adolescent athletes in Malaysia and the effects of sports concussion are very limited. This encourages to conduct further study on this area. It is deemed as necessary action to identify the rate of concussion injury among adolescent athletes that participate in high-risk sports, and to explore the level of knowledge and attitude of sports concussion in larger sample in the future involving the athletes in secondary schools in Malaysia. The continuous monitoring of injury occurrence and structured comprehensive sports concussion education-based intervention is important step-in long-term management of sports concussion injuries.

Education on sports concussions is very essential to raise awareness, improve the ability of adolescent athletes to identify the sign and symptom of concussion and to determine the effectiveness of concussion injury management (Halstead & Walter, 2010). In this study, CKI scores do not show significant differences between the studied ages (U15 and U18) for contact and non-contact sports athletes. Athletes of both ages show moderate levels of concussion knowledge (scores below 15 versus 25 points). Lempke, Rawlins, Lynall, & Schmidt (2019) found a similar result whereas the concussion knowledge did not differ between student-athletes in different years of sport eligibility completed. In practical aspect, the intervention program of concussion education can be tailored to all athletes involved in contact and non-contact sports in secondary schools without separation. Weber et al. (2019) anticipated an increase in concussion reporting behavior and safer attitude with more education intervention as more years of involvement in sports. This is what we observed in our study, where the CAI scores between the two age groups (U15, U18) showed significant differences, with the U18 athlete group showing better CAI scores than the U15 athlete group regardless of sport types (contact or non-contact sports). Although, in this study, the older athlete represents a better grade of safe attitude, but the score of CAI is at the moderate level of safe attitude toward sports concussion management.

In addition, the results of this study suggest that the maturity influences athletes' attitude and safe attitude toward sports concussion. This may be due to the increased levels of awareness on the effects of concussion injury and greater maturity and more knowledgeable (Taylor & Sanner, 2017) in U18 adolescent athletes. In addition, according to (Martin, Hrubeniuk, Witiw, MacDonald, & Leiter, 2017), these U18 athletes are likely to have a different risk profile compared to U15 athletes due to their sporting experience, competition attitude and relationship to the impact of injury and status on play. Thus, the educational programs related to sports concussions should be emphasized more broadly and more focused on U15 adolescent athletes and lower age who are actively involved in sports. In addition, consideration should be given to extending the intervention of education on sports concussion to the elementary school level for athletes under 12 years old. These sports concussion education programs are expected to enhance the safety of sports concussions, reduce the risk of injury, and even enhance the effectiveness of early management of concussion injuries (Ennis, et al., 2018, King et al., 2014; Register-mihalik et al., 2013) among talented and highly motivated young athletes.

The results of this study cannot be generalized to the general population as the design of study used purposive sampling to select students involved in contact and non-contact sports. In addition, the representation of non-contact sports athletes under age 15 years old is unequal if compared to athlete in group under 18 years old. There is 20 percent invalid report following first screening of survey report that has been discarded concerning the secondary student athletes' readiness in completing the self-reported survey in this study. Furthermore, the attitude of safe behavior for reporting or not reporting the sports concussion assessed in this study merely base

upon athletes' perception based on self-reported questionnaire. We acknowledge that the attitude of safe behavior possibly relies more on internal factor of each athlete. Therefore, the investigation on this matter in the future should consider external factors that include coaches, parents, and teammate pressures that might have influence reporting of concussion among high school athletes (Register-Minhalik et al., 2013).

A further study is needed to include a larger sample size that focus on the sports type of contact sports or non-contact to develop better understanding on the impact of gender on knowledge level and attitude towards sports concussion. Although the researchers' findings do not prove the influence of gender on both aspects of the study, it is possible that the level of knowledge and attitude toward concussion among adolescent athletes in Malaysia is at a higher level, especially for athletes involved in sports at higher levels. In addition, this study includes a greater number of contact sports athletes than non-contact sports that may affect the findings. This study should be extended to include more sports athletes of all ages, as suggested in recent studies by (Kroschus, Baugh, Stein, Austin, & Calzo, 2017) and from various levels of competition to further assess gender influences. Further studies are needed to delve deeper into this issue to determine the need for developing education modules and interventions for sports concussion injury in adolescent sports schools in Malaysia to increase the knowledge of sports concussion injuries. The equality in general knowledge and attitude towards concussion among genders and age are good kick start to introduce awareness of concussion especially in sport activities. Interestingly, the greater attitude towards concussion among U18 athletes provide positive impacts to the improved awareness on the characteristics and symptoms of concussion. With the trajectory, this age population may improve awareness of concussion to other athletes in other age phase. The identical homogeneous symptoms can assist other athletes or coaches to initially detect the possibility of concussion activity. Furthermore, the early and appropriate intervention will definitely improve chances of recovery and minimize the risk of secondary complication that might derive from this phenomenon.

## **CONCLUSION**

The current study is the first study to examine the level of knowledge and attitude of sports concussion among secondary school athletes' samples. The study finds moderate level of CKI and CAI for regardless of gender, age categories (U15, U18) and sport's types (contact or non-contact sports) among secondary school athletes in Malaysia. Structured sports concussion education program to improve the level of knowledge and attitude among secondary school athletes needs to be implemented. The findings also provide a good foundation and rationale for future research to explore the knowledge attitude and practice of sports concussion management among Malaysian coaches and parents.

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