Sport injury prevalence and risk by level of play and sports played among a representative population of French adolescents. A school-based study

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Sport injury prevalence and risk by level of play and sports played among a representative population of French adolescents. A school-based study

Prévalence et risque de blessure en sport par niveau de pratique et sport pratiqué auprès d'une population représentative d'adolescents Français. Une étude menée en milieu scolaire

ENGLISH ABSTRACT

Background: Sports practice has both benefits and physical risks. In France, data relating to adolescent sports injury are rare. The main purpose of this article is to study the prevalence and risk of injuries by level of play and sports in the south-east of France.

Methods: Data collection was conducted in French schools among adolescent in 2015 and 2017 (n=1849; aged 14-19). Only sports players were included (n=1366). Two level of play were created. Low level group included adolescents playing sport either outside or within a club, at or below the local level of competition. High level group included adolescents playing sport within a club at the state (regional) level of competition or higher. Odds-ratio and their 95% confidence interval adjusted for variables selected using stepwise regression procedures were calculated to determine the injury risk of high-level athletes compared with those at low-levels, for each sport. We also calculated the injury risk of each sport compared with the entire sample, by level of play.

Results: At the highest level, almost all sports activities presented a higher prevalence of injured athletes than at the lowest level of play. The increases in injury risk was highest on tennis, basket-ball, dance, athletics and volley-ball. When comparing sports, at the lowest level, handball, boxing, soccer and gymnastics practitioners were more at risk than the rest of the sample. At the highest level of play, only basket-ball players were more at-risk. Dancing is the less dangerous sport in terms of injury outcome, regardless the level.

Conclusion: From the state level of competition, injury risk increases significantly across the most sports. Meanwhile, differences appeared regarding prevalence, severity and nature of injuries sustained. It would be useful to perform such analysis on a greater sample size, ideally representative of the national population of adolescents.

Keywords: adolescent health; sports injury; athletic injuries; sports

FRENCH ABSTRACT

Position du problème: La pratique sportive comporte à la fois des bénéfices et des risques corporels. En France, les données concernant les blessures subies en sport par les adolescents sont rares. L'objectif principal de cet article est d'étudier la prévalence et les risques de blessures par niveau de pratique et sport dans le sud-est de la France.

Methode: Une collection de donnée a été réalisé dans des établissements scolaires Français auprès d'adolescents en 2015 et 2017 (n=1849; aged 14-19). Seuls les sportifs ont été inclus (n=1366). Deux niveaux de pratique ont été formés. Le groupe de faible niveau comportait les adolescents pratiquant leur sport soit en dehors d'un club ou dans un club, au niveau de compétition départemental ou inférieur. Le groupe de haut niveau comportait les adolescents pratiquant leur sport dans un club au niveau de compétition régional ou plus. Les odds-ratios et leurs intervalles de confiance à 95% ajustés avec des variables sélectionnées en utilisant des analyses de régressions par étapes ont été calculés pour déterminer le risque de blessure des sportifs de plus haut niveau par rapport à ceux de plus faible niveau, par sport. Nous avons aussi calculé le risque de blessure pour chaque activité sportive comparé à l'échantillon total, par niveau de pratique.

Resultats: Au plus haut niveau de pratique, presque toutes les activités sportives présentaient une plus importante prévalence d'athlètes blessés qu'au plus faible niveau. L'augmentation du risque de blessure était le plus important en tennis, basket-ball, danse, athlétisme et volley-ball. En comparant les sports, au plus faible niveau, les pratiquants de handball, boxe, football et gymnastique avait un risque plus élevé de blessure que les autres pratiquants. Au plus haut niveau de pratique, seuls les joueurs de basket-ball étaient plus à risque. La danse est l'activité sportive la moins dangereuse en terme de survenue de blessures, quelque soit le niveau de pratique.

Conclusion: A partir du niveau de compétition régional, le risque de blessure augmente significativement dans la plupart des activités sportives. Dans le même temps, des différences sont apparues concernant la prévalence, la sévérité et la nature des blessures subies. Il pourrait être utile de réaliser des analyses similaires sur des échantillons plus important, idéalement représentatif de la population adolescente nationale.

Keywords: santé de l'adolescent; blessures sportives; blessures athlétiques; sports

Introduction

Sports-related injuries limit, hinder and/or prevent sustained sport activity. These injuries may also be a health risks for adolescent [1,2]. In many countries (for e. g. Canada, United States of America, Sweden), the adolescents groups most vulnerable to injury have been identified [3-5]. The more (i) the total amount of practise (ii) the level of play and (iii) the frequency and the strength of impact (involved in team and contact sports) the higher the injury prevalence [6]. In contrast, age, sex and body mass index, 'BMI', are not consistently related to injury [7-11].

In France, national population-based epidemiologic studies of sports injury are rare. Their rarity points to « a lack of social concern » [12] (p. 21) to a phenomenon which accounted for one half of the non-road and non-work related accidents for 0-24 years olds in 1998. They mainly measure the use of emergency units related to sex, age and the sport played [13-15] or the accidents reported by a global population without considering specifically adolescents [15]. No data are available on the number, severity and nature of sport injuries among a representative population of adolescents. The international literature is very informative about this research subject but scientific advances, no matter how successful they may be in one context, cannot be fully transposed to other countries. As Wiese-Bjornstal said, the risk of injury could vary according to sport cultures, largely determined by sport specificities, countries and local particularities [16].

Although French national population-based studies are lacking, however, regionally, a data collection was carried out among the school adolescent population in the south-eastern region of France. Initial published analysis [17] showed that age and sex were not related to injuries whereas hours of playing per week and collective sports were risks factors. Originally, the results showed that club sports did not uniformly expose adolescents to

injury. Injury prevalence was similar among adolescents playing outside-clubs and those playing in clubs at the local level of competition or below. However, at the state (or regional) level, the risk of injury increased significantly. This study highlighted the general influence of the level of competition and a threshold effect in injury risk (number and severity) at the state level of competition. However, it is still unclear whether this effect is observable in each specific sport activity. Previous findings showed that increases in level of competition did not increase adolescent injury risk in all sports. For example, the risk of injury for experts and novice in taekwondo were similar [18]. In judo, a study showed an increases in injury risk with the level of play [19] but results are different across the studied samples [20]. The risk is also greater for high level practitioners in soccer [21], gymnastics [22-23], mixed-martial arts [24], baseball [25], netball [26] and rugby football [27,28]. However, these studies used different definitions of high-level and low-level athletes. Some studies compared adolescents playing in Olympic teams [22] or professional teams [21] with those playing at the national level or one division below, or in a recreational context. Others studies compared the injury risk at a national level of competition with those playing at a lower level [28]. To our knowledge, no school-based studies have measured the injury risk using the state level and higher as a "high-level" population. It would be interesting for public health officials to know in which sports the injury risk is greater at these levels of competition compared to the lowest level of play. Results could help the development of sports injury prevention programs, as well as help physicians in sports medicine and parents to influence the commitment of adolescents in sport.

The main purpose of the present study was to conduct secondary analysis on this sample [17] to determine the injury prevalence by level of play (low/high) and by sport. Firstly, we aimed to identify sports in which a high-level of play (state level and higher) implied a

greater injury risk. Secondly, we estimated the odds-ratio for injury by sports (i) at low-level and (ii) at high-level.

Methods

Participants and Procedure

Comparing with 2015 (n=1343), the sample size has increased in 2017 by 506 students who answered the same survey in the same schools as in the original survey. The final sample included 1424 high-school students and 425 first-year university students. Only adolescents who agreed to participate and returned signed parental informed consent forms, or those aged 18 years and over, answered the survey (overall response rate: 98.7%). Participants responded to the survey under the supervision of a physical education teacher and a researcher. The data collection was approved by the Aix-Marseille University Ethics Committee (n°2019-23-05-003) and authorized by the Superintendent of Schools. Adolescents were asked to report sociodemographic, anthropomorphic variables (age, sex, height, weight), and informations related to their preferred sport participation (hours of play per week, context of participation and level of competition). For a detailed protocol, see Luiggi et al. [17]. In the present study, among all the participants, only those who declared (i) to play sport outside of mandatory physical education classes at school for at least one hour per week, (ii) what sport they preferred to practice, (iii) their level of competition, were included in the analysis (n=1366).

This sample included 611 girls et 755 boys with a mean age of 17.0 (SD=1.7). 424 participants declared to not play sport at least one hour a week. 17 participants did not report their level of competition. 42 participants play sport but did not report sport they practice. The body mass index 'BMI' was calculated by dividing weight (kg) by height squared $(m)^2$. Boys and girls were classified as 'not overweight', 'overweight' or 'obese' according to the

International Obesity Task Force cut-offs for girls and boys and as a function of their age [29]. This sample included respectively 2.3% of underweight and 6.0% of obese adolescents.

Independent Variables

Level of play (low/high)

According to the previous study conducted on the influence of level of competition on injury risk among this adolescent population in 2015, two groups were created. The first one included adolescents with a low injury risk (adolescents playing outside-clubs or within clubs below the departmental level of competition) (n=876). The second included adolescents with a high injury risk (adolescents playing in clubs above the state level of competition) (n=442). Adolescents who declared to play sport outside-clubs and take part in competition were excluded from the level of competition analysis (n=48).

Sports

A total of 83 different sports activities were reported by adolescents. We reduced the number of sport from 83 to 24. The least practiced sports (n<15) were combined into more general categories. For example, a "Boxing" category was created which included adolescents who declared to practice "Boxing", "Thaï boxing" or "French boxing". The 24 sports and sports categories identified were athletics, badminton, basket-ball, bodybuilding, boxing, climbing, cycling activities, dancing activities, fitness activities, gymnastics, handball, horse riding, judo, martial arts, rugby football, running activities, skiing activities, soccer, surfing/windsurfing, tennis, urban activities, and volley-ball. A category « Others » was also created. For the detailed sports activities included in each category, see additional file 1.

Outcomes

Adolescents were asked to report how many injuries they sustained during the past 12 months while playing their favorite sport. They were also asked to report the nature (sprain, overuse, tendon strain, muscle strain, fracture, dislocation) and the severity of injuries (minor, moderate, severe). Two outcomes were used. The first was (i) All Sport Injury 'ASI', irrespective of the need for medical attention or time loss from adolescents' activity. The second outcome used was (ii) injury treated by a medical practitioner –Medically Treated Injury 'MTI'.

Data Analysis

Data analyses were performed with R 3.5.0. First, anthropomorphic and sociodemographic characteristics were given by sports and levels of play. Second, we calculated injury prevalence for ASI, and for MTI, by level of play. Third, we calculated odds-ratios 'OR' for ASI and for MTI, and their 95% confidence interval '95% CI' by sports (injury odds of high-level players / injury odds of low-level players). Fourth, we calculated ORs and 95% CI measuring ASI and MTI injury odds by sports compared to injury odds of all the other sports. These analyses were conducted twice. At the lowest level of play, then at the highest. As recommended by Peduzzi et al. [30], these analyses were performed only when the two compared groups have had a minimum size of 10. Otherwise, not applicable 'NA' was entered into the results table. Finally, additional file 4 details the nature and number of injuries by sports with ORs and 95% CI describing odds of specific injury (sprain, tendon strain, etc) by sports comparing with odds of the rest of sample.

Adjustment variables

For the step three, analysis were performed separately for each sport. Given the relative low number of participants in some sports (between 19 and 197), we decided to limit the number of adjustment variables using a stepwise regression with the Akaike Information Criterion

(AIC) as the elimination criterion (for detailed procedures of variable selection see [31]). This procedure helps to avoid over-adjustment bias -or unnecessary adjustment- of the models [32]. The package stepAIC in R was used. Firstly, for each model (by sport), we selected candidates variables based on univariate analysis. The variables were the sex, age, BMI and hours of play per week 'HP' of participants.

These four variables were selected as adjustment variables candidates because some previous findings showed an association between them and injury. However, associations remained inconsistent. Only variables with a p-value <= 0.15 were selected for the next procedure. Second, we performed full models including all variables previously selected. Finally, we performed stepwise regressions. The adjusted ORs obtained from these final steps were used to estimate injury risk of adolescents playing at the highest level compared to those playing at the lowest.

For the step four, analyses were performed on the entire sample. Adjustment variables were the same for each model. They were selected based on univariate analysis between potential adjustment variables and each outcome. Only variables with p-value <= 0.15 were selected in the final models.

Selection of variables format

Age

No differences were observed in ASI or MTI prevalence between high-school and 1st year university students (ASI: respectively, 46.6% and 45.4%, Chi-square=0.062, p-value=0.804; MTI: respectively, 13.7% and 15.0%, Chi-square=0.293, p-value=0.588). These absences of effects suggested no threshold effect of age on the injury risk. Thus, further analysis were neither conducted separately between these two subgroups of students nor conducted using different age classes.

Body mass index

In addition, contrary with previous studies [7-9], no effect of an overweight BMI status was observed for ASI ($OR_{overweight}$: 0.81, p-value=0.35; OR_{obese}: 0.72, p-value=0.38) and MTI ($OR_{overweight}$: 1.21, p-value=0.53 ; OR_{obese}: 0.87, p-value=0.80) compared to sports players with a normal weight. Thus, BMI variable was kept continuous in the further models.

Hours of Play per week

After the model's comparison using 'HP' as categorical or continuous, no significant changes in the models' adjustments were found. Thus, the 'HP' was used as continuous in the further models.

Results

Sociodemographic and anthropomorphic characteristics of the studied sample by sport and level of play are provided in Table 1. The most practiced sports were soccer (14.9%), dancing (12.7%), basket-ball (6.8%), tennis (6.1%) and boxing (5.8%). Some activities were almost exclusively practiced by boys (for example, soccer and rugby football) whilst others by girls (for example, dancing and horse riding).

With respect to injury, 46.5% of adolescents declared to have had an injury within the past 12 months. More precisely, 14.6% had sustained a medically treated injury and only 2% had been treated in hospital. Prevalence of injured athletes by sport and level of play are detailed in Table 2. In Table 2, are also provided the injury risk (ASI and MTI) for high level players compared to low level players. Figure 1 and 2 gave a visual overview of these results. In general, adolescents playing at the highest level were 1.8 (95% CI: 1.4-2.3) and 2.5 (95% CI: 1.8-3.5) times more likely to have had respectively, an ASI or a MTI. For ASI, the increasing risk was significant and pronounced in athletics (OR:10.0, 95% CI: 1.98-77.92),

volley-ball (OR:11.0, 95% CI: 1.50-229.91), judo (OR:9.6, 95% CI: 1.58-86.91), basket-ball (OR:5.1, 95% CI: 2.08-13.33), and others martial arts (OR:4.8, 95% CI: 1.29-20.66). For MTI, the increasing risk was significant in tennis (OR:9.0, 95% CI: 1.42-94.50), basket-ball (OR:5.0, 95% CI: 1.63-18.94) and dancing (OR:3.7, 95% CI: 1.12-11.60). Although a greater prevalence of injured athletes was observed in the others sports, the odds-ratios were not significantly higher between high-level and low-level players.

In additional file 2, Table 1 and Table 2 are available results of all univariate analysis between predictors and injury, followed by models including only variables with a p-value <= 0.15, followed by results of final models using stepwise regression procedures. ASI and MTI ORs from these last models were those presented in the last paragraph.

Table 3 provides the odds of injury of each sport compared with the odds for all the other sports by level of play. Figure 3 and 4 gave a visual overview of ORs and 95% CI, for ASI and MTI, at the lowest level of play. At the low level of play, swimmers were 2.5 times less likely to have sustained an injury in the past 12 months (95% CI: 1.25-7.14). At the other extreme, those who preferred boxing, gymnastics and handball reported a higher risk of ASI. In gymnastics, they were 4.0 times more likely to have had an ASI compared to all the other sports (95% CI: 1.27-14.78). A greater risk was also observed, for MTI, in handball (OR:3.2, 95% CI: 1.10-7.95) and soccer (OR:1.8, 95% CI: 1.03-3.14). At the highest level of play, injury risk was similar for all activities. However, as in low level of play, we observed that swimmers (OR:0.4, 95% CI: 0.15-0.88) and skiers (OR:0.3, 95% CI: 0.07-0.93) were significantly less at risk of ASI compared to all the other sports. Contrary with these activities, at the highest level of play, basket-ball players were the most at risk compared to all the other sports. They were at 2.4 greater risk of ASI (95% CI: 1.20-5.29). In additional file 3, Table 1 to 4 are available results of the full models including adjustment variables effects.

Finally and for information, Table 1 in additional file 4 presented the numbers and nature of injuries for each sport. Table 2 showed the ORs for each nature of injury by sport compared to all the other sports. To sum up, 1180 injuries have been reported. Sprain is the most common injury (38.8%), followed by muscle strain (18.3%), overuse symptoms (15.9%), tendon strain (14.8%), then fractures (8.6%) and dislocations (3.6%). Once again significant differences appeared between sports. With regards to injury severity, we observed that horse riders, rugby football players and soccer players were at greater risk of fractures (respectively, OR:2.5, 95% CI: 1.53-4.22; OR:2.2, 95% CI: 1.6-3.01; OR:1.3, 95% CI: 1.16-1.48). While dancing activities were significantly less at-risk (around 2 times less fractures reported). Regarding dislocations, they were more frequent in cycling (OR:3.0, 95% CI: 1.66-5.45), judo (OR:2.8, 95% CI: 1.3-6.05), martial arts (OR:2.6, 95% CI: 1.22-5.63), rugby football (OR:4.7, 95% CI: 3.25-6.92), skiing (OR:6.0, 95% CI: 1.73-20.94) and volley-ball (OR:3.0, 95% CI: 1.66-5.45).

Discussion

This study aimed to investigate the level of play effects in sport injury risk among a French adolescent population representative of the third biggest area of France. Results showed that prevalence of injured athletes increased notably at the highest level of play –state level of competition or higher- compared with the lower level. Meanwhile, the increases in risk were not significant in many sports. We observed that injury risk for ASI was significantly higher with the increases in level for 5 sports out of 24. Results also never showed a significantly lower injury risk –ASI or MTI- at the highest level compared with the lowest, except in gymnastic. This surprising effect in gymnastic was like those of Kolt and Kirkby [22] who observed that elite gymnasts were at a lower risk than sub-elites when controlling for the hours of play. Concerning MTI, tennis, basket-ball, and dance practitioners presented a significant higher risk at the highest level of play. For ASI, a greater risk also appeared in

athletics, basket-ball, volley-ball, judo and others martial arts activities. Mixed-martial arts [24] practiced at the highest level have already been shown to put adolescents at greater risk of injury than when played at low level. Concerning rugby football, previous studies have shown that players at the highest level were at greater risk than those at the lowest level [27,28]. Our study shows that when controlling for hours of play per week, the ASI risk was similar between high-level and low-level players. However, the risk of moderate to severe injury was greater and highlight the high-intensity of contact presents in rugby football at the highest level of play [33].

Others results from our study should be compared with studies measuring how the level of play influences the risk of injury for different sports. To our knowledge, such studies do not exist for all sports. It would be interesting to develop systematic studies measuring this influence in order to inform public health officials and sports federations regarding to the hypothetical increasing health risks of competition in each sport. This need is even more important considering that improving knowledge about injury in adolescent elite sport is a major issue [34]. However, at present, sports injury studies have been mainly performed among professional, semi-professional or athletes playing at Olympic level. It could be interesting to determine at which level of competition adolescent athletes are at greater risk of injury, in each sport activity. Such findings would be especially interesting with focusing on injuries with long-term implications [2]. It would help to initiate appropriate injury prevention programs [1,35,36], surveillance [37] and research.

Regarding the odds of injury by sports at each level of play, we observed that at the highest level, injury prevalence and risk were similar between sports. Only volley-ball and basketball players were at a significantly greater risk. Meanwhile, and consistent with previous findings, non-contact sports such as dance and swimming activities were the less dangerous sports. Surprisingly, at this level of play, skiers were also at less risk than other

sports players. That contradicts a previous study that showed the high prevalence of severe injury in winter sports [14]. This result may be explained by the area of our surveys. Adolescents lived in the department of Bouches-du-Rhône and in this area ski resort are at approximatively 2 to 3 hours of driving. It is likely that their amount of participation is lower than one of adolescents living near mountains. That could explain their low injury risk observed in the present study. At the lowest level of play, we also observed that non-contact sports activities were health protective, whilst contact sports exposed adolescents to injury. For example, swimming and badminton were sport activities with significantly less proportions of adolescents sustaining at least one injury in the past 12 months. On the other hand, and still consistent with previous findings, we observed that handball [38], gymnastics [5] and boxing activities presented significantly higher proportions of injured adolescents. These sports are commonly classified as contact sports and these activities have already been identified to put adolescents at greater risk of injury. This observation was confirmed by the nature of injuries by sports. Fractures and dislocations were clearly more frequent in contact sports. Significant differences were observed in rugby, martial arts, skiing, soccer and horse riding compared with the rest of the sample. Once again, appropriate interventions on adolescent participation such as proper self-protection equipment [39], or changes in rules, could reduce such risks.

Limitations

Firstly, these results must be interpreted with caution. The present study offered a relatively low statistical power in some activities (low sample size) which could have been a source of type II (false negative) errors. In addition, the relative important numbers of statistical analyses conducted may have increased the type I (false positive) errors. In addition, sample size was too small to perform complete analyses for all sports. For example, the martial arts category included different combat sports which may have different injury risk [18,20,24].

It would be useful to increase sample size in order (i) to reduce likelihood of type II errors and (ii) to assess precisely the injury risk in each specific sport activity across levels of competition.

Secondly, in this sample we excluded all adolescents that reported to not play sport at least one hour a week. Some adolescents who play sport but that are currently injured may have been excluded of the sample due to our selection criteria. Thus, prevalence of injury may have been underestimated in some sports. Further studies should consider this issue and develop a survey that could consider currently injured sports players.

Thirdly, following prior analyses that showed no increased risk for overweight/obese adolescents compared to those with a normal weight, we decided to enter BMI variable in a linear form. This choice assumes a linear effect of BMI whilst previous findings showed a threshold effect [7,10]. Even if models' sensibility analysis showed no differences between BMI in a linear form or non-linear, it is likely that model adequation would be different sport by sport. Further studies could investigate systematically BMI effects in linear and non-linear form to deepen understanding his role in injury risk by sports participation of adolescents.

Fourthly, adolescents were asked to self-report numbers and severity of injury they have had in the past 12 months. This methodology is common in retrospective studies in sport injury [4-11]. Severity is measured through the type of medical attending that have been provided. However, seeking medical attention could have been influenced by adolescents or parents' perceptions of the severity of the injury, as well, as the sport specific risk culture [16]. It has been shown that some activities emphasize the importance of pain and injury. In results, some athletes continue to play despite pain or injury. These influences could have both either minimized or accentuated the objective severity of the injury. Not in terms of

medical attention but in terms of physical damages. Further studies in adolescent sport injury would be more precise with investigating severity of injury with the help of a medical staff.

Fifthly, our results should be considered as specific to the study location. They do not necessarily relate to activities more often practiced elsewhere in France, such as skiing or sailing. It could be interesting to develop national studies measuring adolescent sport injuries. Such information would be useful to develop more appropriate injury prevention programs.

Finally, the 12-month retrospective report is a potential bias for this study. Although it offers a representative view of the injury phenomenon, this study design suffers from injury recall bias [40]. Further studies should measure the influence of level of competition on injury risk with longitudinal methodology.

Conclusions

Our study offers a picture of adolescents injury risk and prevalence in sports in the third biggest department of France (Bouches-du-Rhône). Sport injury prevention programs should be developed across all sports activities when played at the state level of competition and higher. This increasing risk was especially high in tennis and basket-ball. Finally, contact sports present a high injury risk even at the lowest level of play: a continued attention on the adolescent injury risk should be done toward them. In contrast, for physicians, non-contact sports could be efficiently promoted for adolescents with health fragilities, especially those at greater risk of injury due to their intrinsic characteristics (see [1]). Others activities due to their higher injury risk should be promoted with cautious. The Committee of Sports Medicine and Fitness [41] provided important decision elements regarding high-intensity and contact sports activities.

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Table 1 Anthropomorphics and sociodemographic characteristics of the studied sample by sport and level of play

	Low-level of play					High-level of play					All
	n	Age	Girls (%)	Height	Weight	n	Age	Girls (%)	Height	Weight	
ATHLETICS	12	16.3	66.7%	166.5	54.8	21	17.8	34.8%	175.0	63.5	33
BADMINTON	26	16.5	38.5%	169.1	59.1	5	17.8	33.3%	177.0	66.2	31
BASKETBALL	45	16.9	28.9%	174.4	61.6	45	16.6	23.9%	175.7	66.1	90
BODYBUILDING	54	17.7	22.2%	175.5	67.3	1	18.0	0.0%	178.0	53.0	55
BOXING	61	16.7	34.4%	171.8	62.7	15	16.7	25.0%	172.6	62.4	76
CLIMBING	14	16.6	78.6%	163.1	56.1	3	17.3	50.0%	163.3	55.7	17
CYCLING	26	17.6	15.4%	175.9	64.8	10	18.6	18.2%	171.4	63.0	36
DANCING	135	16.4	97.0%	163.7	53.6	32	16.7	93.9%	162.9	49.9	167
FITNESS	25	17.1	80.0%	168.7	58.6	1	19.0	50.0%	169.0	72.0	26
GYMNASTICS	14	17.1	71.4%	164.1	57.2	20	16.8	86.4%	163.0	52.7	34
HANDBALL	23	18.2	65.2%	171.4	60.7	31	17.7	45.2%	174.7	65.7	54
HORSE RIDING	36	17.2	100.0%	165.6	53.7	15	16.9	100.0%	167.7	55.3	51
JUDO	9	17.2	22.2%	173.9	61.2	15	17.1	26.7%	170.9	61.7	24
MARTIAL ARTS	30	16.6	30.0%	172.7	61.9	15	16.9	13.3%	175.2	65.1	45
OTHERS	28	16.6	32.1%	171.1	61.7	25	17.2	21.9%	175.7	69.7	53
RUGBY FOOTBALL	19	17.5	5.3%	179.9	77.8	30	17.2	9.4%	177.4	76.0	49
RUNNING	37	17.5	62.2%	170.8	59.4	9	18.1	33.3%	171.9	59.8	46
SKIING	13	18.2	76.9%	170.0	64.8	12	18.4	58.3%	170.8	61.2	25
SOCCER	126	17.0	9.5%	175.6	66.6	71	16.8	10.8%	172.0	64.3	197
SURFING/WINDSURFING	16	17.6	43.8%	171.9	57.7	6	17.5	50.0%	171.3	63.0	22
SWIMMING	38	16.8	57.9%	172.9	60.1	24	17.0	45.8%	172.6	61.0	62
TENNIS	59	17.1	35.6%	171.9	61.5	21	17.5	18.2%	177.0	67.0	80
URBAN ACTIVITIES	16	15.4	12.5%	168.3	56.8	3	17.0	40.0%	171.7	58.3	19
VOLLEYBALL	14	17.4	57.1%	170.4	60.7	12	17.2	53.8%	170.0	58.7	26
ALL	876	17.0	47.6%	170.9	61.0	442	17.2	36.3%	172.3	63.2	1318

Note. Low level of play: outside-club, no competition; club, local level or below. High-level of play: club, state level and higher

Table 2 Injury prevalence and odds-ratios describing the relationship between level of play and injury adjusted for variables in column ADJ_{ASI} and ADJ_{MTI}

	Low-level of play		High-level of play		OR (High-level / Low-level)				ADJ_{ASI}	ADJ_{MTI}
	ASI	MTI	ASI	MTI	OR_{ASI}	95% CI	OR_{MTI}	95% CI		
ATHLETICS	**16.7% (2)**	0.0% (0)	**66.7% (14)**	19.0% (4)	**10.0****	**1.98-77.92**	NA	NA	N	
BADMINTON	23.1% (6)	3.8% (1)	60.0% (3)	40.0% (2)	NA	NA	NA	NA		
BASKETBALL	**40.0% (18)**	**8.9% (4)**	**75.6% (34)**	**33.3% (15)**	**5.1*****	**2.08-13.33**	**5.0****	**1.63-18.94**	N	N
BODYBUILDING	37.0% (20)	9.3% (5)	100.0% (1)	0.0% (0)	NA	NA	NA	NA		
BOXING	55.7% (34)	3.3% (2)	66.7% (10)	13.3% (2)	1.5	0.47-5.58	3.0	0.30-29.03	B	HP
CLIMBING	57.1% (8)	7.1% (1)	33.3% (1)	0.0% (0)	NA	NA	NA	NA		
CYCLING	50.0% (13)	15.4% (4)	70.0% (7)	30.0% (3)	0.3	0.01-3.39	2.4	0.39-13.48	HP	N
DANCING	35.6% (48)	**6.7% (9)**	50.0% (16)	**18.8% (6)**	1.2	0.49-2.80	**3.7***	**1.12-11.60**	B;HP	A
FITNESS	36.0% (9)	16.0% (4)	0.0% (0)	0.0% (0)	NA	NA	NA	NA		
GYMNASTICS	64.3% (9)	**21.4% (3)**	70.0% (14)	**30.0% (6)**	1.3	0.29-5.63	0.0	0.00-0.70	N	A;HP
HANDBALL	60.9% (14)	26.1% (6)	64.5% (20)	25.8% (8)	0.7	0.18-2.43	0.8	0.20-2.94	HP	HP
HORSE RIDING	38.9% (14)	11.1% (4)	60.0% (9)	26.7% (4)	1.7	0.45-6.39	2.9	0.60-14.33	HP	N
JUDO	**22.2% (2)**	11.1% (1)	**73.3% (11)**	33.3% (5)	**9.6***	**1.58-86.91**	4.0	0.50-85.06	N	N
MARTIAL ARTS	**36.7% (11)**	6.7% (2)	**73.3% (11)**	20.0% (3)	**4.8***	**1.29-20.66**	3.5	0.52-29.27	N	N
OTHERS	**28.6% (8)**	3.6% (1)	**60.0% (15)**	8.0% (2)	**3.8***	**1.23-12.32**	1.1	0.06-28.24	N	B
RUGBY FOOTBALL	42.1% (8)	21.1% (4)	56.7% (17)	43.3% (13)	0.9	0.21-3.68	2.0	0.43-11.40	HP	HP
RUNNING	29.7% (11)	5.4% (2)	22.2% (2)	11.1% (1)	NA	NA	NA	NA		
SKIING	23.1% (3)	7.7% (1)	33.3% (4)	0.0% (0)	1.7	0.29-10.66	NA	NA		
SOCCER	48.4% (61)	15.9% (20)	56.3% (40)	26.8% (19)	1.1	0.57-2.01	1.6	0.74-3.40	HP	HP
SURFING/WINDSURFING	25.0% (4)	0.0% (0)	33.3% (2)	33.3% (2)	NA	NA	NA	NA		
SWIMMING	18.4% (7)	7.9% (3)	41.7% (10)	16.7% (4)	1.0	0.18-4.91	0.2	0.01-2.87	HP	A;HP
TENNIS	30.5% (18)	**3.4% (2)**	61.9% (13)	**33.3% (7)**	2.2	0.69-6.93	**9.0***	**1.42-94.50**	HP	HP
URBAN ACTIVITIES	68.8% (11)	18.8% (3)	100.0% (3)	33.3% (1)	NA	NA	NA	NA		
VOLLEYBALL	**50.0% (7)**	14.3% (2)	91.7% (11)	25.0% (3)	**11.0***	**1.50-229.91**	2.0	0.28-17.74	N	
ALL	**39.5% (346)**	**9.6% (84)**	**60.6% (268)**	**24.9% (110)**	**1.8*****	**1.4-2.3**	**2.5*****	**1.8-3.5**	A;HP	B;HP

Note. OR_{ASI}: Odds-ratio for all sports injury; OR_{MTI}: Odds-ratio for medically treated injury; ADJ_{ASI}: Adjustment variables for ASI; ADJ_{MTI}: Adjustment variables for MTI. A: Age; B: Body Mass Index; HP: Hours of Play per Week; S: Sexe; N: No adjustment variables kept. Reading: At the low-level of play, 40.0% of basket-ball players reported to have sustain at least one injury in the past 12 months. **Bold values** indicate a significate higher injury risk –ASI or MTI- for high-level players compared with low-level players.

Table 3 Odds-ratio and 95% confidence interval describing the injury odds of each sport compared to all the other sports by level of play

	Low-level of play		High-level of play	
	ASI[a]	MTI[b]	ASI[b]	MTI[c]
ATHLETICS	0.3 (0.05-1.18)	NA	1.2 (0.49-3.27)	0.6 (0.18-1.78)
BADMINTON	0.4 (0.14-1.02)	0.4 (0.02-1.79)	NA	NA
BASKETBALL	0.9 (0.46-1.61)	0.9 (0.25-2.19)	**2.4* (1.20-5.29)**	1.6 (0.81-3.20)
BODYBUILDING	0.8 (0.45-1.48)	0.9 (0.30-2.12)	NA	NA
BOXING	**1.9* (1.13-3.32)**	0.3 (0.05-0.99)	1.4 (0.47-4.46)	0.5 (0.07-1.81)
CLIMBING	2.2 (0.75-6.82)	0.8 (0.04-4.05)	NA	NA
CYCLING	1.4 (0.61-3.15)	1.5 (0.42-4.16)	1.2 (0.32-5.93)	0.9 (0.19-3.53)
DANCING	0.9 (0.58-1.38)	0.7 (0.33-1.42)	0.7 (0.32-1.41)	1.0 (0.36-2.51)
FITNESS	0.9 (0.36-2.03)	1.9 (0.53-5.14)	NA	NA
GYMNASTICS	**4.0* (1.27-14.78)**	3.2 (0.70-10.72)	1.5 (0.60-4.42)	1.6 (0.54-4.19)
HANDBALL	**2.5* (1.06-6.26)**	**3.2* (1.10-7.95)**	1.1 (0.54-2.56)	1.0 (0.42-2.38)
HORSE RIDING	1.2 (0.55-2.36)	1.3 (0.37-3.37)	1.0 (0.36-3.11)	1.3 (0.36-4.10)
JUDO	0.5 (0.07-2.08)	NA	1.9 (0.64-7.05)	1.7 (0.50-4.84)
MARTIAL ARTS	1.0 (0.43-2.07)	0.7 (0.12-2.57)	1.8 (0.59-6.48)	0.7 (0.15-2.31)
OTHERS	0.6 (0.26-1.48)	0.4 (0.02-1.82)	1.0 (0.43-2.30)	**0.2* (0.03-0.72)**
RUGBY FOOTBALL	1.1 (0.37-2.86)	2.1 (0.47-6.56)	0.9 (0.41-1.94)	2.1 (0.88-4.77)
RUNNING	0.8 (0.36-1.59)	0.6 (0.10-2.07)	NA	NA
SKIING	0.4 (0.07-1.52)	NA	**0.3* (0.07-0.93)**	NA
SOCCER	1.3 (0.87-1.98)	**1.8* (1.03-3.14)**	0.8 (0.48-1.36)	1.2 (0.63-2.11)
SURFING/WINDSURFING	0.6 (0.16-1.77)	NA	NA	1.3 (0.17-6.80)
SWIMMING	**0.4* (0.14-0.80)**	0.9 (0.22-2.67)	**0.4* (0.15-0.88)**	0.5 (0.14-1.44)
TENNIS	0.7 (0.38-1.22)	0.3 (0.06-1.13)	1.1 (0.46-2.88)	1.6 (0.60-4.07)
URBAN ACTIVITIES	2.2 (0.76-7.33)	1.7 (0.38-5.69)	NA	NA
VOLLEYBALL	1.8 (0.58-5.59)	1.7 (0.26-6.51)	7.4 (1.42-135.89)	1.1 (0.23-3.74)

Note. At a high-level of play, rugby players were 2.3 more likely to report a medically treated injury than the rest of sample. **Bold values** indicate a significate higher injury risk –ASI or MTI- for a specific sport compared to all the other sports. *p<0.05; **p<0.01; ***p<0.001. [a]: Adjusted for age, sex and hours of play per week; [b]: Adjusted for hours of play per week; [c]: Adjusted for age, body mass index and hours of player per week.

Additional File 1. Sport categories according to sport declared by adolescents

Sport categories	Sport declared	n by categories	n by sports
ATHLETICS	ATHLETICS	34	34
BADMINTON	BADMINTON	32	32
BASKETBALL	BASKET-BALL	94	94
BODYBUILDING	BODYBUILDING	56	56
BOXING	BOXING	78	51
BOXING	FRENCH BOXING		8
BOXING	KRAV MAGA		3
BOXING	MIXED-MARTIAL ARTS		4
BOXING	SAMBO BOXING		1
BOXING	THAI BOXING		11
CLIMBING	CLIMBING	17	17
CYCLING	BIKING	38	7
CYCLING	CROSS-COUNTRY CYCLING		22
CYCLING	CYCLING		9
DANCING	BALLET DANCE	172	5
DANCING	DANCING		149
DANCING	HIP-HOP DANCE		10
DANCING	MODERN JAZZ DANCE		3
DANCING	ORIENTAL DANCE		1
DANCING	ZUMBA DANCE		4
FITNESS	AEROBIC	27	3
FITNESS	FITNESS		20
FITNESS	STRENGHT TRAINING		1
FITNESS	YOGA		3
GYMNASTICS	ARTISTIC GYMNASTIC	37	8
GYMNASTICS	GYMNASTIC		27
GYMNASTICS	RYTHMIC GYMNASTIC		2
HANDBALL	HANDBALL	55	55
HORSE RIDING	HORSE RIDING	52	52
JUDO	JUDO	24	24
MARTIAL ARTS	AIKIDO	45	3
MARTIAL ARTS	JUJITSU		4
MARTIAL ARTS	KARATE		16
MARTIAL ARTS	KENDO		1
MARTIAL ARTS	KUNG FU		1
MARTIAL ARTS	MARTIAL ARTS		6
MARTIAL ARTS	SELF DEFENSE		5
MARTIAL ARTS	TAEKWONDO		8
MARTIAL ARTS	YOSEIKAN BUDO		1
OTHERS	AIRSOFT	53	1
OTHERS	AMERICAN FOOTBALL		5
OTHERS	BASEBALL		0
OTHERS	FENCING		4
OTHERS	FIGURE SKATING		3

OTHERS	GOLF		3
OTHERS	HIKING		1
OTHERS	ICE HOCKEY		2
OTHERS	ICE SKATING		1
OTHERS	KAYAK		1
OTHERS	MOTOCROSS RIDING		5
OTHERS	ROLLER HOCKEY		1
OTHERS	ROWING		4
OTHERS	SAILING		8
OTHERS	SCUBA DIVING		1
OTHERS	SHOOTING SPORT		1
OTHERS	SQUASH		5
OTHERS	TABLE TENNIS		3
OTHERS	TRAMPOLINING		2
OTHERS	WATERPOLO		2
RUGBY FOOTBALL	RUGBY FOOTBALL	52	52
RUNNING	ORIENTEERING RACE		3
RUNNING	RUNNING	50	45
RUNNING	TRAIL RUNNING		2
SKIING	CROSS-COUNTRY SKIING		2
SKIING	FREESTYLE SKIING	25	1
SKIING	SKIING		22
SOCCER	SOCCER	207	207
SURFING/WINDSURFING	KITESURFING		1
SURFING/WINDSURFING	SURFING	22	9
SURFING/WINDSURFING	WINDSURFING		12
SWIMMING	RESCUE SWIMMING		1
SWIMMING	SWIMMING	65	57
SWIMMING	SYNCHRONIZED SWIMMING		7
TENNIS	TENNIS	81	81
URBAN ACTIVITIES	BMX		5
URBAN ACTIVITIES	BMX BICROSS		1
URBAN ACTIVITIES	LONGBOARDING		2
URBAN ACTIVITIES	PARKOUR	21	5
URBAN ACTIVITIES	ROLLER DANCE		1
URBAN ACTIVITIES	ROLLER SKATING		1
URBAN ACTIVITIES	SKATEBOARDING		6
VOLLEYBALL	VOLLEY-BALL	29	29
N 24	83	1366	1366

Additional file 2. Table 1. Results of ASI univariate analysis, full models, and final models following stepwise regression procedures

	Univariates ORs	95% CI	p-value	Full models ORs	95% CI	p-value	Final models ORs	95% CI	p-value
ATHLETICS									
Intercept	NA			0.29	0.04-1.56	0.177	**0.20***	**0.03-0.76**	**0.038**
Age	0.98	0.66-1.45	0.923						
Sex[a]	1.61	0.42-6.44	0.493						
BMI	1.18	0.85-1.7	0.339						
HP	1.18	0.97-1.48	0.110	0.88	0.62-1.23	0.466			
High level[b]	**10.00****	**1.98-77.92**	**0.011**	**21.24***	**1.65-450.81**	**0.029**	**10.00****	**1.98-77.92**	**0.011**
BADMINTON									
Intercept									
Age									
Sex[a]									
BMI					NA				
HP									
High level[b]									
BASKETBALL									
Intercept				0.61	0.23-1.57	0.317	0.67	0.36-1.20	0.183
Age	0.88	0.70-1.10	0.258						
Sex[a]	1.50	0.59-3.84	0.394						
BMI	1.08	0.93-1.26	0.294						
HP	1.13	0.99-1.32	0.086	1.02	0.87-1.20	0.829			
High level[b]	**4.64*****	**1.92-11.83**	0.0009	**4.93****	**1.91-13.60**	**0.001**	**5.10*****	**2.08-13.33**	**0.0005**
BODYBUILDING									
Intercept									
Age									
Sex[a]					NA				
BMI									

	HP									
	High level[b]									
BOXING										
	Intercept				**130.89***	**2.23-17271.32**	**0.031**	**130.89***	**2.23-17271.32**	**0.031**
	Age	0.90	0.68-1.17	0.434						
	Sex[a]	0.57	0.21-1.49	0.261						
	BMI	0.83	0.67-0.99	0.061	**0.80***	**0.64-0.97**	**0.039**	**0.80***	**0.64-0.97**	**0.039**
	HP	1.02	0.87-1.21	0.780						
	High level[b]	1.59	0.5-5.61	0.445	1.54	0.47-5.58	0.488	1.5	0.47-5.58	0.488
CLIMBING										
	Intercept									
	Age									
	Sex[a]									
	BMI					NA				
	HP									
	High level[b]									
CYCLING										
	Intercept				0.27	0.06-1.02	0.074	0.27	0.06-1.02	0.074
	Age	0.93	0.59-1.44	0.753						
	Sex[a]	1.29	0.21-7.91	0.778						
	BMI	0.85	0.62-1.16	0.315						
	HP	**1.21***	**1.04-1.47**	**0.025**	1.34	1.05-1.93	0.055	1.34	1.05-1.93	0.055
	High level[b]	2.33	0.52-12.73	0.286	0.27	0.01-3.39	0.362	0.28	0.01-3.39	0.362
DANCING										
	Intercept				8.82	0.46-245.51	0.177	8.82	0.46-245.51	0.177
	Age	0.95	0.79-1.15	0.626						
	Sex[a]	2.61	0.42-20.2	0.301						
	BMI	**0.86***	**0.73-0.99**	0.053	0.86	0.72-1.00	0.062	0.86	0.72-1.00	0.062

	HP	1.11	0.96-1.28	0.150	1.12	0.96-1.33	0.157	1.12	0.96-1.33	0.157
	High level[b]	1.81	0.83-3.97	0.134	1.17	0.49-2.80	0.719	1.17	0.49-2.80	0.719
FITNESS										
	Intercept									
	Age									
	Sex[a]									
	BMI					NA				
	HP									
	High level[b]									
GYMNASTICS										
	Intercept				1.80	0.62-5.86	0.292	1.80	0.62-5.86	0.292
	Age	0.98	0.65-1.45	0.905						
	Sex[a]	2.40	0.31-49.91	0.457						
	BMI	1.10	0.87-1.42	0.440						
	HP	1.12	0.85-1.51	0.434						
	High level[b]	1.30	0.29-5.63	0.726	1.30	0.29-5.63	0.726	1.30	0.29-5.63	0.726
HANDBALL										
	Intercept				0.00	0.00-1.34	0.086	0.28	0.05-1.27	0.124
	Age	**1.52***	**1.07-2.32**	0.030	1.25	0.83-2.01	0.312			
	Sex[a]	1.42	0.47-4.43	0.540						
	BMI	1.26	1.01-1.64	0.054	1.15	0.89-1.52	0.298			
	HP	**1.44****	**1.11-2.04**	**0.018**	1.32	1.01-1.93	0.090	**1.46***	**1.11-2.17**	**0.026**
	High level[b]	1.17	0.38-3.58	0.784	0.79	0.19-3.05	0.731	0.69	0.18-2.43	0.574
HORSE RIDING										
	Intercept				0.38	0.13-0.99	0.058	0.38	0.13-0.99	0.058
	Age	1.07	0.70-1.68	0.752						
	Sex[a]	NA	NA	NA						
	BMI	0.81	0.57-1.12	0.216						

	HP	1.20	1-1.51	0.070	1.17	0.97-1.47	0.132	1.17	0.97-1.47	0.132
	High level[b]	2.36	0.7-8.45	0.172	1.68	0.45-6.39	0.441	1.68	0.45-6.39	0.441
JUDO										
	Intercept				0.29	0.04-1.18	0.118	0.29	0.04-1.18	0.118
	Age	0.99	0.53-1.80	0.960						
	Sex[a]	1.25	0.19-8.48	0.813						
	BMI	1.11	0.75-1.7	0.601						
	HP	0.95	0.65-1.37	0.778						
	High level[b]	**9.63***	**1.58-86.91**	**0.022**	**9.63***	**1.58-86.91**	**0.022**	**9.63***	**1.58-86.91**	**0.022**
MARTIAL ARTS										
	Intercept				0.58	0.27-1.20	0.149	0.58	0.27-1.20	0.149
	Age	0.92	0.58-1.44	0.709						
	Sex[a]	1.20	0.3-4.89	0.793						
	BMI	0.99	0.8-1.23	0.955						
	HP	1.06	0.92-1.26	0.435						
	High level[b]	**4.75***	**1.29-20.66**	**0.022**	**4.75***	**1.29-20.66**	**0.022**	**4.75***	**1.29-20.66**	**0.022**
OTHERS										
	Intercept				**0.40***	**0.17-0.88**	**0.029**	**0.40***	**0.17-0.88**	**0.029**
	Age	0.90	0.63-1.28	0.555						
	Sex[a]	1.42	0.43-4.93	0.570						
	BMI	1.08	0.9-1.32	0.414						
	HP	1.08	0.94-1.29	0.325						
	High level[b]	**3.75***	**1.23-12.32**	**0.024**	**3.75***	**1.23-12.32**	**0.024**	**3.75***	**1.23-12.32**	**0.024**
RUGBY FOOTBALL										
	Intercept				0.003	0.00-2.22	0.107	**0.15***	**0.02-0.69**	**0.023**
	Age	0.99	0.71-1.39	0.953						
	Sex[a]	0.50	0.06-2.83	0.449						
	BMI	1.20	0.97-1.51	0.103	1.18	0.89-1.61	0.264			

	HP	**1.39***	**1.08-1.86**	**0.017**	1.37	0.99-1.96	0.067	**1.46***	**1.09-2.07**	**0.017**
	High level[b]	1.80	0.57-5.91	0.323	1.21	0.26-5.78	0.807	0.9	0.21-3.68	0.886
RUNNING										
	Intercept									
	Age									
	Sex[a]									
	BMI					NA				
	HP									
	High level[b]									
SKIING										
	Intercept				0.30	0.07-0.98	0.067	0.30	0.07-0.98	0.067
	Age	1.24	0.43-3.75	0.686						
	Sex[a]	0.80	0.09-5.07	0.819						
	BMI	0.92	0.64-1.31	0.652						
	HP	1.02	0.85-1.24	0.794						
	High level[b]	1.67	0.29-10.66	0.570	1.67	0.29-10.66	0.570	1.67	0.29-10.66	0.570
SOCCER										
	Intercept				**0.49***	**0.25-0.92**	**0.030**	**0.49***	**0.25-0.92**	**0.030**
	Age	0.95	0.82-1.09	0.438						
	Sex[a]	0.82	0.33-2	0.670						
	BMI	0.98	0.89-1.08	0.711						
	HP	**1.14***	**1.02-1.27**	**0.020**	**1.15***	**1.03-1.30**	**0.018**	**1.15***	**1.03-1.30**	**0.018**
	High level[b]	1.37	0.77-2.48	0.286	1.07	0.57-2.01	0.829	1.07	0.57-2.01	0.829
SURFING/WINDSURFING										
	Intercept									
	Age									
	Sex[a]					NA				
	BMI									

	HP								
	High level[b]								
SWIMMING									
	Intercept				**0.13*** **	**0.04-0.36**	**0.0002**	**0.13*** **	**0.04-0.36**	**0.0002**
	Age	0.97	0.72-1.33	0.868					
	Sex[a]	0.72	0.23-2.16	0.566					
	BMI	0.87	0.67-1.11	0.276					
	HP	**1.18***	**1.05-1.36**	**0.012**	1.18	1.01-1.44	0.060	1.18	1.01-1.444	0.060
	High level[b]	**3.16***	**1.01-10.43**	**0.050**	1.01	0.18-4.91	0.988	1.01	0.18-4.91	0.988
TENNIS									
	Intercept				**0.16*** **	**0.05-0.42**	**0.0006**	**0.16*** **	**0.05-0.42**	**0.0006**
	Age	0.93	0.71-1.23	0.625					
	Sex[a]	0.78	0.3-2.05	0.608					
	BMI	0.87	0.71-1.06	0.183					
	HP	**1.42*** **	**1.14-1.84**	**0.004**	**1.35***	**1.07-1.76**	**0.017**	**1.35***	**1.07-1.76**	**0.017**
	High level[b]	**3.7***	**1.33-10.88**	**0.014**	2.18	0.69-6.93	0.180	2.18	0.69-6.93	0.180
URBAN ACTIVITIES									
	Intercept								
	Age								
	Sex[a]					NA			
	BMI								
	HP								
	High level[b]								
VOLLEYBALL									
	Intercept				0.55	0.12-2.14	0.404	1.00	0.34-2.92	1.000
	Age	0.75	0.39-1.25	0.324					
	Sex[a]	4.28	0.8-33.84	0.114	4.11	0.57-42.55	0.185		
	BMI	1.21	0.86-1.81	0.299					

HP	1.21	0.86-1.95	0.353						
High level[b]	**11***	**1.5-229.91**	**0.041**	**13.34***	**1.66-300.70**	**0.035**	**11.00***	**1.50-229.91**	**0.040**

Note. [a]reference category: Girls; [b]reference category: Low-level of play. **Bold values** indicate a significate different injury risk. *p<0.05; **p<0.01; ***p<0.001.

Additional file 2. Table 2. Results of MTI univariate analysis, full models, and final models following stepwise regression procedures

	Univariates ORs	95% CI	p-value	Full models ORs	95% CI	p-value	Final models ORs	95% CI	p-value
ATHLETICS									
Intercept									
Age									
Sex[a]					NA				
BMI									
HP									
High level[b]									
BADMINTON									
Intercept									
Age									
Sex[a]					NA				
BMI									
HP									
High level[b]									
BASKETBALL									
Intercept				**0.01***	**0.00-0.58**	**0.031**	**0.10*****	**0.03-0.25**	**0.000**
Age	0.93	0.71-1.22	0.590						
Sex[a]	1.04	0.35-3.53	0.951						
BMI	1.19	0.99-1.45	0.065	1.11	0.92-1.35	0.280			
HP	1.11	0.95-1.29	0.203						
High level[b]	**5.13****	**1.67-19.4**	**0.008**	**4.49***	**1.42-17.23**	**0.024**	**5.00****	**1.63-18.94**	**0.009**
BODYBUILDING									
Intercept									
Age									
Sex[a]					NA				
BMI									

	HP									
	High level[b]									
BOXING										
	Intercept				**0.01******	**0.00-0.08**	**0.000**	**0.01*****	**0.00-0.08**	**0.000**
	Age	1.42	0.76-3.06	0.312						
	Sex[a]	1.53	0.19-31.81	0.718						
	BMI	0.80	0.41-1.22	0.435						
	HP	1.32	0.98-1.8	0.059	1.27	0.93-1.76	0.124	1.27	0.93-1.76	0.117
	High level[b]	4.54	0.51-40.79	0.148	3.02	0.30-29.03	0.307	3.02	0.30-29.03	0.313
CLIMBING										
	Intercept									
	Age									
	Sex[a]					NA				
	BMI									
	HP									
	High level[b]									
CYCLING										
	Intercept				**0.18**	**0.05-0.48**	**0.002**	**0.18**	**0.05-0.48**	**0.002**
	Age	0.95	0.57-1.64	0.834						
	Sex[a]	1.40	0.18-29.14	0.775						
	BMI	1.05	0.72-1.51	0.787						
	HP	1.10	0.95-1.28	0.197						
	High level[b]	2.36	0.39-13.48	0.329	2.36	0.39-13.48	0.329	2.36	0.39-13.48	0.329
DANCING										
	Intercept				13.81	0.07-3021.18	0.330	13.81	0.07-3021.18	0.330
	Age	0.74	0.53-1.02	0.068	0.72	0.51-1.00	0.054	0.72	0.51-1.00	0.054
	Sex[a]	2.73	0.13-20.12	0.383						
	BMI	0.83	0.61-1.06	0.192						

	HP	1.07	0.83-1.32	0.575						
	High level[b]	**3.23***	**1.01-9.77**	**0.039**	**3.68***	**1.12-11.60**	**0.026**	**3.68***	**1.12-11.60**	**0.026**
FITNESS										
	Intercept									
	Age									
	Sex[a]					NA				
	BMI									
	HP									
	High level[b]									
GYMNASTICS										
	Intercept				**0.00***	**0-0.02**	**0.022**	**0.00***	**0-0.02**	**0.022**
	Age	1.47	0.92-2.56	0.130	1.71	0.93-3.6	0.106	1.71	0.93-3.6	0.106
	Sex[a]	0.75	0.04-6.07	0.809						
	BMI	1.08	0.84-1.39	0.527						
	HP	1.38	1.01-2.01	0.062	**3.56***	**1.5-16.56**	**0.022**	**3.56***	**1.5-16.56**	**0.022**
	High level[b]	1.57	0.33-8.8	0.579	0.02	0.00-0.7	0.075	0.02	0.00-0.70	0.075
HANDBALL										
	Intercept				0.00	0-4.01	0.151	0.12	0.02-0.43	0.003
	Age	1.46	0.95-2.56	0.130	1.35	0.82-2.54	0.291			
	Sex[a]	1.88	0.56-6.69	0.312						
	BMI	1.19	0.93-1.55	0.174						
	HP	1.21	1.03-1.49	0.034	1.18	0.99-1.46	0.085	**1.22**	**1.04-1.51**	0.029
	High level[b]	0.99	0.29-3.49	0.981	0.96	0.24-4.02	0.956	0.77	0.20-2.94	0.698
HORSE RIDING										
	Intercept				**0.13*****	**0.04-0.32**	**0.000**	**0.13*****	**0.04-0.32**	**0.000**
	Age	0.98	0.56-1.82	0.945						
	Sex[a]	NA	NA	NA						
	BMI	0.99	0.63-1.52	0.965						

	HP	1.13	0.91-1.38	0.235					
	High level[b]	2.91	0.6-14.33	0.176	2.91	0.60-14.33	0.176	2.91	0.60-14.33	0.176
JUDO									
	Intercept				0.13	0.01-0.68	0.050	0.13	0.01-0.68	0.050
	Age	1.13	0.58-2.54	0.732					
	Sex[a]	NA	NA	NA					
	BMI	0.85	0.51-1.35	0.502					
	HP	1.04	0.67-1.5	0.819					
	High level[b]	4.00	0.5-85.06	0.246	4	0.50-85.06	0.246	4	0.50-85.06	0.246
MARTIAL ARTS									
	Intercept				0.07	0.01-0.24	0.000	0.07	0.01-0.24	0.000
	Age	1.06	0.54-2.41	0.872					
	Sex[a]	0.44	0.06-3.69	0.400					
	BMI	0.87	0.59-1.22	0.446					
	HP	0.95	0.64-1.18	0.709					
	High level[b]	3.50	0.52-29.27	0.199	3.5	0.52-29.27	0.199	3.5	0.52-29.27	0.199
OTHERS									
	Intercept				0.00	0-0.13	0.017	0.00	0-0.13	0.017
	Age	1.05	0.49-2.32	0.896					
	Sex[a]	0.86	0.08-19.27	0.903					
	BMI	1.32	0.98-1.89	0.070	1.31	0.96-1.92	0.092	1.31	0.96-1.92	0.092
	HP	1.04	0.75-1.24	0.704					
	High level[b]	2.35	0.21-52.46	0.497	1.11	0.06-28.24	0.938	1.11	0.06-28.24	0.938
RUGBY FOOTBALL									
	Intercept				**0.07*** **	**0.01-0.38**	**0.005**	**0.07*** **	**0.01-0.38**	**0.005**
	Age	0.93	0.66-1.33	0.692					
	Sex[a]	0.48	0.08-2.88	0.407					
	BMI	1.06	0.86-1.32	0.588					

	HP	1.32	1.03-1.73	0.037	1.30	0.98-1.80	0.090	1.30	0.98-1.80	0.090
	High level[b]	2.87	0.81-11.94	0.117	2.03	0.43-11.40	0.390	2.03	0.43-11.40	0.390
RUNNING										
	Intercept									
	Age									
	Sex[a]					NA				
	BMI									
	HP									
	High level[b]									
SKIING										
	Intercept									
	Age									
	Sex[a]					NA				
	BMI									
	HP									
	High level[b]									
SOCCER					**0.09*** **	**0.03-0.20**	**0.000**	**0.09*** **	**0.03-0.20**	**0.000**
	Intercept									
	Age	1.10	0.92-1.32	0.297						
	Sex[a]	0.82	0.3-2.63	0.717						
	BMI	1.05	0.93-1.17	0.400						
	HP	**1.17***	**1.03-1.34**	**0.019**	**1.16***	**1.01-1.34**	**0.036**	**1.16***	**1.01-1.34**	**0.036**
	High level[b]	1.94	0.95-3.95	0.068	1.59	0.74-3.40	0.231	1.59	0.74-3.40	0.231
SURFING/WINDSURFING										
	Intercept									
	Age					NA				
	Sex[a]									
	BMI									

	HP								
	High level[b]								
SWIMMING									
	Intercept				0.00	0-0.38	0.051	0.00	0-0.38	0.051
	Age	1.48	0.95-2.5	0.105	1.45	0.87-2.67	0.180	1.45	0.87-2.67	0.180
	Sex[a]	1.28	0.28-5.9	0.744						
	BMI	0.89	0.61-1.24	0.513						
	HP	**1.17***	**1.03-1.37**	**0.022**	**1.32***	**1.06-1.77**	**0.031**	**1.32***	**1.06-1.77**	**0.031**
	High level[b]	2.33	0.47-12.86	0.298	0.23	0.01-2.87	0.298	0.23	0.01-2.87	0.298
TENNIS										
	Intercept				0.00	0-3.09	0.102	**0.00**	**0.00-0.02**	**0.000**
	Age	1.30	0.84-2.19	0.276						
	Sex[a]	1.75	0.39-12.35	0.505						
	BMI	1.22	0.91-1.64	0.189	1.16	0.69-1.97	0.556			
	HP	**1.89*****	**1.37-2.9**	**0.001**	**1.85****	**1.28-3**	**0.004**	**1.86****	**1.29-3.00**	**0.003**
	High level[b]	**14.25****	**3.06-103.04**	**0.002**	**8.71***	**1.38-90.97**	**0.033**	**8.99***	**1.42-94.50**	**0.032**
URBAN ACTIVITIES										
	Intercept									
	Age									
	Sex[a]					NA				
	BMI									
	HP									
	High level[b]									
VOLLEY-BALL										
	Intercept				**0.17***	**0.03-0.61**	**0.019**	**0.17***	**0.03-0.61**	**0.019**
	Age	1.29	0.7-2.99	0.476						
	Sex[a]	0.79	0.09-5.61	0.812						
	BMI	1.16	0.76-1.82	0.499						

HP	0.87	0.51-1.27	0.538						
High level[b]	2.00	0.28-17.74	0.494	2.00	0.28-17.74	0.494	2.00	0.28-17.74	0.494

Note. [a]reference category: Girls; [b]reference category: Low-level of play. **Bold values** indicate a significate different injury risk. *p<0.05; **p<0.01; ***p<0.001.

Additional file 3. Table 1. Odds-ratio and 95% confidence interval adjusted for age, sex and HP, describing the ASI odds of each sport compared to all the other sports, at the lowest level of play

	ORs	95% CI	p-value
ATHLETICS			
Intercept	2.53	0.62-10.41	0.197
Age	**0.90***	**0.82-0.97**	**0.011**
Sex[a]	1.11	0.83-1.48	0.468
HP	**1.13*****	**1.07-1.2**	**0.000**
ATHLETICS	0.30	0.05-1.18	0.128
BADMINTON			
Intercept	2.54	0.62-10.43	0.194
Age	**0.90***	**0.82-0.97**	**0.011**
Sex[a]	1.14	0.85-1.51	0.384
HP	**1.13*****	**1.07-1.2**	**0.000**
BADMINTON	0.41	0.14-1.02	0.073
BASKETBALL			
Intercept	2.36	0.58-9.66	0.230
Age	**0.90***	**0.83-0.98**	**0.013**
Sex[a]	1.13	0.85-1.5	0.415
HP	**1.14*****	**1.07-1.2**	**0.000**
BASKETBALL	0.87	0.46-1.61	0.653
BODYBUILDING			
Intercept	2.23	0.55-9.18	0.264
Age	**0.90***	**0.83-0.98**	**0.017**
Sex[a]	1.13	0.85-1.51	0.394
HP	**1.14*****	**1.07-1.2**	**0.000**
BODYBUILDING	0.83	0.45-1.48	0.532
BOXING			
Intercept	2.05	0.5-8.44	0.319
Age	**0.90***	**0.83-0.98**	**0.020**
Sex[a]	1.09	0.82-1.46	0.538
HP	**1.13*****	**1.07-1.2**	**0.000**
BOXING	**1.93***	**1.13-3.32**	**0.017**
CLIMBING			
Intercept	2.23	0.55-9.1	0.265
Age	**0.90***	**0.83-0.98**	**0.015**
Sex[a]	1.14	0.85-1.52	0.374
HP	**1.14*****	**1.07-1.2**	**0.000**
CLIMBING	2.21	0.75-6.82	0.151
CYCLING			
Intercept	2.40	0.59-9.84	0.222
Age	**0.90***	**0.82-0.98**	**0.012**
Sex[a]	1.11	0.83-1.48	0.485
HP	**1.13*****	**1.07-1.2**	**0.000**

CYCLING	1.39	0.61-3.15	0.429
DANCING			
Intercept	2.53	0.6-10.71	0.207
Age	**0.90***	**0.82-0.98**	**0.012**
Sex[a]	1.08	0.79-1.49	0.611
HP	**1.13*****	**1.07-1.2**	**0.000**
DANCING	0.90	0.58-1.38	0.622
FITNESS			
Intercept	2.34	0.57-9.55	0.236
Age	**0.90***	**0.83-0.98**	**0.014**
Sex[a]	1.12	0.84-1.49	0.456
HP	**1.13*****	**1.07-1.2**	**0.000**
FITNESS	0.89	0.36-2.03	0.781
GYMNASTICS			
Intercept	2.34	0.57-9.58	0.236
Age	**0.90***	**0.82-0.98**	**0.011**
Sex[a]	1.15	0.86-1.53	0.342
HP	**1.14*****	**1.07-1.2**	**0.000**
GYMNASTICS	**3.95***	**1.27-14.78**	**0.024**
HANDBALL			
Intercept	2.72	0.66-11.21	0.166
Age	**0.89****	**0.82-0.97**	**0.007**
Sex[a]	1.15	0.86-1.53	0.342
HP	**1.13*****	**1.07-1.2**	**0.000**
HANDBALL	**2.52***	**1.06-6.26**	**0.039**
HORSE RIDING			
Intercept	2.33	0.57-9.53	0.237
Age	**0.90***	**0.83-0.98**	**0.013**
Sex[a]	1.14	0.85-1.52	0.396
HP	**1.13*****	**1.07-1.2**	**0.000**
HORSE RIDING	1.16	0.55-2.36	0.687
JUDO			
Intercept	2.32	0.57-9.49	0.239
Age	**0.90***	**0.83-0.98**	**0.014**
Sex[a]	1.13	0.85-1.5	0.413
HP	**1.13*****	**1.07-1.2**	**0.000**
JUDO	0.47	0.07-2.08	0.360
MARTIAL ARTS			
Intercept	2.34	0.57-9.56	0.236
Age	**0.90***	**0.83-0.98**	**0.013**
Sex[a]	1.12	0.84-1.5	0.431
HP	**1.13*****	**1.07-1.2**	**0.000**
MARTIAL ARTS	0.96	0.43-2.07	0.927
OTHERS			
Intercept	2.41	0.59-9.84	0.221

Age	**0.90***	**0.83-0.98**	**0.012**
Sex[a]	1.13	0.85-1.51	0.403
HP	**1.13*****	**1.07-1.2**	**0.000**
OTHERS	0.65	0.26-1.48	0.320
RUGBY FOOTBALL			
Intercept	2.35	0.57-9.6	0.235
Age	**0.90***	**0.83-0.98**	**0.013**
Sex[a]	1.12	0.84-1.49	0.448
HP	**1.13*****	**1.07-1.2**	**0.000**
RUGBY FOOTBALL	1.06	0.37-2.86	0.905
RUNNING			
Intercept	2.28	0.56-9.33	0.249
Age	**0.90***	**0.83-0.98**	**0.016**
Sex[a]	1.12	0.84-1.49	0.455
HP	**1.13*****	**1.07-1.2**	**0.000**
RUNNING	0.78	0.36-1.59	0.509
SKIING			
Intercept	2.20	0.54-8.99	0.273
Age	**0.90***	**0.83-0.98**	**0.016**
Sex[a]	1.10	0.82-1.46	0.534
HP	**1.14*****	**1.08-1.21**	**0.000**
SKIING	0.37	0.07-1.52	0.191
SOCCER			
Intercept	2.28	0.56-9.33	0.249
Age	**0.90***	**0.83-0.98**	**0.014**
Sex[a]	1.06	0.78-1.43	0.716
HP	**1.13*****	**1.07-1.2**	**0.000**
SOCCER	1.31	0.87-1.98	0.198
SURFING/WINDSURFING			
Intercept	2.29	0.56-9.35	0.248
Age	**0.90***	**0.83-0.98**	**0.015**
Sex[a]	1.12	0.84-1.5	0.422
HP	**1.13*****	**1.07-1.2**	**0.000**
SURFING/WINDSURFING	0.59	0.16-1.77	0.379
SWIMMING			
Intercept	2.58	0.63-10.59	0.189
Age	**0.90***	**0.82-0.98**	**0.011**
Sex[a]	1.10	0.83-1.47	0.497
HP	**1.13*****	**1.07-1.2**	**0.000**
SWIMMING	**0.36***	**0.14-0.80**	**0.018**
TENNIS			
Intercept	2.33	0.57-9.54	0.237
Age	**0.90***	**0.83-0.98**	**0.015**
Sex[a]	1.14	0.85-1.52	0.376
HP	**1.13*****	**1.07-1.2**	**0.000**

TENNIS	0.69	0.38-1.22	0.212
URBAN ACTIVITIES			
Intercept	2.01	0.48-8.32	0.337
Age	**0.91***	**0.83-0.99**	**0.026**
Sex[a]	1.10	0.83-1.47	0.504
HP	**1.13*****	**1.07-1.2**	**0.000**
URBAN ACTIVITIES	2.22	0.76-7.33	0.159
VOLLEY-BALL			
Intercept	2.36	0.58-9.66	0.230
Age	**0.90***	**0.83-0.98**	**0.012**
Sex[a]	1.12	0.84-1.5	0.422
HP	**1.13*****	**1.07-1.2**	**0.000**
VOLLEY-BALL	1.77	0.58-5.59	0.312

Note. [a]reference category: Girls. **Bold values** indicate a significate different injury risk. *p<0.05; **p<0.01; ***p<0.001.

Additional file 3. Table 2. Odds-ratio and 95% confidence interval adjusted for HP, describing the MTI odds of each sport compared to all the other sports, at the lowest level of play

	ORs	95% CI	p-value
ATHLETICS			
Intercept	**0.07*** **	**0.05-0.1**	**0.000**
SP.HEB	**1.11****	**1.03-1.18**	**0.004**
ATHLETICS	NA	NA	NA
BADMINTON			
Intercept	**0.07*** **	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.19**	**0.003**
BADMINTON	0.36	0.02-1.79	0.326
BASKETBALL			
Intercept	**0.07*** **	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.19**	**0.003**
BASKETBALL	0.85	0.25-2.19	0.764
BODYBUILDING			
Intercept	**0.07*** **	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.19**	**0.003**
BODYBUILDING	0.89	0.3-2.12	0.818
BOXING			
Intercept	**0.07*** **	**0.05-0.11**	**0.000**
HP	**1.11****	**1.03-1.19**	**0.003**
BOXING	0.30	0.05-0.99	0.098
CLIMBING			
Intercept	**0.07*** **	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.18**	**0.003**
CLIMBING	0.79	0.04-4.05	0.817
CYCLING			
Intercept	**0.07*** **	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.18**	**0.004**
CYCLING	1.50	0.42-4.16	0.477
DANCING			
Intercept	**0.07*** **	**0.05-0.11**	**0.000**
HP	**1.1****	**1.03-1.18**	**0.005**
DANCING	0.72	0.33-1.42	0.380
FITNESS			
Intercept	**0.07*** **	**0.04-0.1**	**0.000**
HP	**1.11****	**1.03-1.19**	**0.003**
FITNESS	1.88	0.53-5.14	0.264
GYMNASTICS			
Intercept	**0.07*** **	**0.04-0.1**	**0.000**
HP	**1.11****	**1.03-1.19**	**0.003**
GYMNASTICS	3.18	0.7-10.72	0.084
HANDBALL			
Intercept	**0.07*** **	**0.04-0.1**	**0.000**

HP	**1.1****	**1.03-1.18**	**0.005**
HANDBALL	**3.16***	**1.1-7.95**	**0.020**
HORSE RIDING			
Intercept	**0.07*****	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.19**	**0.003**
HORSE RIDING	1.28	0.37-3.37	0.656
JUDO			
Intercept	**0.07*****	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.18**	**0.003**
JUDO	NA	NA	NA
MARTIAL ARTS			
Intercept	**0.07*****	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.18**	**0.003**
MARTIAL ARTS	0.74	0.12-2.57	0.687
OTHERS			
Intercept	**0.07*****	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.18**	**0.003**
OTHERS	0.38	0.02-1.82	0.341
RUGBY FOOTBALL			
Intercept	**0.07*****	**0.04-0.1**	**0.000**
HP	**1.11****	**1.03-1.19**	**0.003**
RUGBY FOOTBALL	2.08	0.47-6.56	0.260
RUNNING			
Intercept	**0.07*****	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.18**	**0.004**
RUNNING	0.61	0.1-2.07	0.506
SKIING			
Intercept	**0.07*****	**0.05-0.1**	**0.000**
HP	**1.11****	**1.04-1.19**	**0.003**
SKIING	NA	NA	NA
SOCCER			
Intercept	**0.06*****	**0.04-0.09**	**0.000**
HP	**1.1****	**1.03-1.18**	**0.006**
SOCCER	**1.83***	**1.03-3.14**	**0.033**
SURFING/WINDSURFING			
Intercept	**0.07*****	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.18**	**0.004**
SURFING/WINDSURFING	NA	NA	NA
SWIMMING			
Intercept	**0.07*****	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.18**	**0.003**
SWIMMING	0.92	0.22-2.67	0.899
TENNIS			
Intercept	**0.07*****	**0.05-0.11**	**0.000**
HP	**1.1****	**1.03-1.18**	**0.005**
TENNIS	0.34	0.06-1.13	0.142

URBAN ACTIVITIES			
Intercept	**0.07*** **	**0.05-0.1**	**0.000**
HP	**1.1****	**1.03-1.18**	**0.005**
URBAN ACTIVITIES	1.73	0.38-5.69	0.412
VOLLEY-BALL			
Intercept	**0.07*** **	**0.05-0.1**	**0.000**
HP	**1.11****	**1.03-1.19**	**0.003**
VOLLEY-BALL	1.70	0.26-6.51	0.493

Note. [a]reference category: Girls. **Bold values** indicate a significate different injury risk. *p<0.05; **p<0.01; ***p<0.001.

Additional file 3. Table 3. Odds-ratio and 95% confidence interval adjusted for HP, describing the ASI odds of each sport compared to all the other sports, at the highest level of play

	ORs	95% CI	p-value
ATHLETICS			
Intercept	1.18	0.78-1.76	0.431
HP	1.04	0.99-1.1	0.160
ATHLETICS	1.21	0.49-3.27	0.693
BADMINTON			
Intercept	1.18	0.78-1.76	0.436
HP	1.04	0.99-1.1	0.142
BADMINTON	NA	NA	NA
BASKETBALL			
Intercept	1.08	0.71-1.62	0.725
HP	1.04	0.99-1.1	0.130
BASKETBALL	**2.41***	**1.2-5.29**	**0.019**
BODYBUILDING			
Intercept	1.16	0.77-1.75	0.463
HP	1.04	0.99-1.1	0.134
BODYBUILDING	NA	NA	NA
BOXING			
Intercept	1.16	0.77-1.74	0.483
HP	1.04	0.99-1.1	0.135
BOXING	1.37	0.47-4.46	0.577
CLIMBING			
Intercept	1.19	0.79-1.78	0.407
HP	1.04	0.99-1.1	0.146
CLIMBING	NA	NA	NA
CYCLING			
Intercept	1.19	0.78-1.78	0.415
HP	1.04	0.98-1.1	0.172
CYCLING	1.23	0.32-5.93	0.771
DANCING			
Intercept	1.25	0.82-1.89	0.303
HP	1.04	0.98-1.09	0.194
DANCING	0.67	0.32-1.41	0.289
FITNESS			
Intercept	1.19	0.79-1.79	0.390
HP	1.04	0.99-1.1	0.159
FITNESS	NA	NA	NA
GYMNASTICS			
Intercept	1.16	0.77-1.73	0.487
HP	1.04	0.99-1.1	0.143
GYMNASTICS	1.54	0.6-4.42	0.387
HANDBALL			
Intercept	1.16	0.77-1.75	0.470

HP	1.04	0.99-1.1	0.140
HANDBALL	1.15	0.54-2.56	0.729
HORSE RIDING			
Intercept	1.17	0.78-1.77	0.442
HP	1.04	0.99-1.1	0.142
HORSE RIDING	1.02	0.36-3.11	0.969
JUDO			
Intercept	1.14	0.75-1.71	0.541
HP	1.04	0.99-1.1	0.125
JUDO	1.92	0.64-7.05	0.271
MARTIAL ARTS			
Intercept	1.16	0.77-1.74	0.468
HP	1.04	0.99-1.1	0.153
MARTIAL ARTS	1.77	0.59-6.48	0.337
OTHERS			
Intercept	1.18	0.78-1.77	0.433
HP	1.04	0.99-1.1	0.142
OTHERS	0.98	0.43-2.3	0.952
RUGBY FOOTBALL			
Intercept	1.19	0.79-1.79	0.410
HP	1.04	0.99-1.1	0.146
RUGBY FOOTBALL	0.88	0.41-1.94	0.740
RUNNING			
Intercept	1.17	0.78-1.77	0.440
HP	1.05	0.99-1.11	0.101
RUNNING	NA	NA	NA
SKIING			
Intercept	1.17	0.78-1.76	0.443
HP	1.05	0.99-1.11	0.101
SKIING	**0.29***	**0.07-0.93**	**0.045**
SOCCER			
Intercept	1.23	0.81-1.87	0.335
HP	1.04	0.99-1.1	0.158
SOCCER	0.80	0.48-1.36	0.411
SURFING/WINDSURFING			
Intercept	1.17	0.77-1.75	0.459
HP	1.04	0.99-1.1	0.112
SURFING/WINDSURFING	NA	NA	NA
SWIMMING			
Intercept	1.14	0.76-1.72	0.520
HP	1.05	1-1.11	0.062
SWIMMING	**0.37***	**0.15-0.88**	**0.025**
TENNIS			
Intercept	1.17	0.77-1.76	0.465
HP	1.04	0.99-1.1	0.139
TENNIS	1.11	0.46-2.88	0.814

URBAN ACTIVITIES			
Intercept	1.14	0.76-1.72	0.517
HP	1.04	0.99-1.1	0.124
URBAN ACTIVITIES	NA	NA	NA
VOLLEY-BALL			
Intercept	1.13	0.75-1.7	0.543
HP	1.04	0.99-1.1	0.144
VOLLEY-BALL	7.40	1.42-135.89	0.057

Note. [a]reference category: Girls. **Bold values** indicate a significate different injury risk. *p<0.05; **p<0.01; ***p<0.001.

Additional file 3. Table 4. Odds-ratio and 95% confidence interval adjusted for age, BMI and HP, describing the MTI odds of each sport compared to all the other sports, at the highest level of play

	ORs	95% CI	p-value
ATHLETICS			
Intercept	**0.02****	**0-0.32**	**0.005**
Age	1.02	0.89-1.18	0.729
BMI	1.09	1-1.19	0.051
HP	1.05	0.99-1.12	0.075
ATHLETICS	0.63	0.18-1.78	0.422
BADMINTON			
Intercept	**0.03****	**0-0.33**	**0.006**
Age	1.02	0.89-1.17	0.796
BMI	**1.09***	**1-1.19**	**0.044**
HP	1.05	0.99-1.12	0.081
BADMINTON	NA	NA	NA
BASKETBALL			
Intercept	**0.02****	**0-0.28**	**0.004**
Age	1.03	0.9-1.19	0.648
BMI	1.09	1-1.18	0.059
HP	1.05	0.99-1.12	0.088
BASKETBALL	1.64	0.81-3.2	0.156
BODYBUILDING			
Intercept	**0.03****	**0-0.32**	**0.006**
Age	1.02	0.89-1.18	0.753
BMI	**1.09***	**1-1.19**	**0.049**
HP	1.05	0.99-1.11	0.091
BODYBUILDING	NA	NA	NA
BOXING			
Intercept	**0.03****	**0-0.34**	**0.006**
Age	1.02	0.89-1.17	0.797
BMI	**1.09***	**1-1.19**	**0.045**
HP	1.05	0.99-1.11	0.094
BOXING	0.49	0.07-1.81	0.348
CLIMBING			
Intercept	**0.03****	**0-0.32**	**0.005**
Age	1.02	0.89-1.18	0.769
BMI	**1.09***	**1-1.19**	**0.043**
HP	1.05	0.99-1.11	0.090
CLIMBING	NA	NA	NA
CYCLING			
Intercept	**0.02****	**0-0.32**	**0.005**
Age	1.02	0.89-1.18	0.762
BMI	**1.09***	**1-1.19**	**0.045**
HP	1.05	0.99-1.12	0.089
CYCLING	0.92	0.19-3.53	0.905

DANCING			
Intercept	**0.03****	**0-0.33**	**0.006**
Age	1.02	0.89-1.18	0.769
BMI	**1.09***	**1-1.19**	**0.047**
HP	1.05	0.99-1.12	0.089
DANCING	1.01	0.36-2.51	0.976
FITNESS			
Intercept	**0.02****	**0-0.3**	**0.005**
Age	1.02	0.89-1.18	0.744
BMI	**1.09***	**1-1.19**	**0.040**
HP	1.05	0.99-1.11	0.097
FITNESS	NA	NA	NA
GYMNASTICS			
Intercept	**0.02****	**0-0.29**	**0.004**
Age	1.02	0.89-1.18	0.767
BMI	**1.10***	**1.01-1.2**	**0.037**
HP	1.05	0.99-1.12	0.087
GYMNASTICS	1.59	0.54-4.19	0.370
HANDBALL			
Intercept	**0.03****	**0-0.32**	**0.006**
Age	1.02	0.89-1.18	0.777
BMI	**1.09***	**1-1.19**	**0.045**
HP	1.05	0.99-1.12	0.087
HANDBALL	1.05	0.42-2.38	0.911
HORSE RIDING			
Intercept	**0.02****	**0-0.31**	**0.005**
Age	1.02	0.89-1.18	0.769
BMI	**1.09***	**1-1.19**	**0.040**
HP	1.05	0.99-1.12	0.083
HORSE RIDING	1.34	0.36-4.1	0.624
JUDO			
Intercept	**0.02****	**0-0.31**	**0.005**
Age	1.02	0.89-1.18	0.779
BMI	**1.09***	**1-1.19**	**0.044**
HP	1.05	0.99-1.12	0.078
JUDO	1.65	0.5-4.84	0.374
MARTIAL ARTS			
Intercept	**0.03****	**0-0.33**	**0.006**
Age	1.02	0.89-1.17	0.791
BMI	**1.09***	**1-1.19**	**0.043**
HP	1.05	0.99-1.12	0.081
MARTIAL ARTS	0.70	0.15-2.31	0.591
OTHERS			
Intercept	**0.02****	**0-0.27**	**0.004**
Age	1.01	0.88-1.17	0.867
BMI	**1.11***	**1.02-1.22**	**0.018**

HP	1.05	0.99-1.12	0.081
OTHERS	**0.20***	**0.03-0.72**	**0.036**
RUGBY FOOTBALL			
Intercept	**0.03***	**0-0.43**	**0.011**
Age	1.03	0.9-1.19	0.674
BMI	1.07	0.97-1.17	0.168
HP	1.06	1-1.12	0.069
RUGBY FOOTBALL	2.08	0.88-4.77	0.087
RUNNING			
Intercept	**0.03****	**0-0.32**	**0.005**
Age	1.03	0.89-1.18	0.710
BMI	1.09	1-1.19	0.055
HP	1.05	0.99-1.12	0.079
RUNNING	NA	NA	NA
SKIING			
Intercept	**0.02****	**0-0.27**	**0.004**
Age	1.04	0.9-1.2	0.614
BMI	1.09	1-1.19	0.058
HP	1.06	1-1.12	0.068
SKIING	NA	NA	NA
SOCCER			
Intercept	**0.02****	**0-0.31**	**0.005**
Age	1.02	0.89-1.18	0.754
BMI	**1.09***	**1-1.19**	**0.045**
HP	1.05	0.99-1.12	0.082
SOCCER	1.17	0.63-2.11	0.600
SURFING/WINDSURFING			
Intercept	**0.03****	**0-0.32**	**0.005**
Age	1.02	0.89-1.18	0.767
BMI	**1.09***	**1-1.19**	**0.044**
HP	1.05	0.99-1.11	0.093
SURFING/WINDSURFING	1.29	0.17-6.8	0.774
SWIMMING			
Intercept	**0.03***	**0-0.38**	**0.008**
Age	1.02	0.88-1.17	0.827
BMI	1.09	1-1.19	0.056
HP	1.06	1-1.13	0.057
SWIMMING	0.51	0.14-1.44	0.246
TENNIS			
Intercept	**0.03****	**0-0.33**	**0.006**
Age	1.02	0.89-1.17	0.812
BMI	**1.09***	**1-1.19**	**0.045**
HP	1.05	0.99-1.12	0.072
TENNIS	1.62	0.6-4.07	0.316
URBAN ACTIVITIES			
Intercept	**0.02****	**0-0.31**	**0.005**

Age	1.02	0.89-1.18	0.767
BMI	**1.09***	**1-1.19**	**0.042**
HP	1.05	0.99-1.12	0.083
URBAN ACTIVITIES	NA	NA	NA
VOLLEY-BALL			
Intercept	**0.03****	**0-0.32**	**0.005**
Age	1.02	0.89-1.18	0.770
BMI	**1.09***	**1-1.19**	**0.044**
HP	1.05	0.99-1.12	0.087
VOLLEY-BALL	1.08	0.23-3.74	0.914

Note. [a]reference category: Girls. **Bold values** indicate a significate different injury risk. *p<0.05; **p<0.01; ***p<0.001.

Additional file 4. Table 1 Nature and numbers of injuries by sport

	Sprain	Overuse	Tendon strain	Muscle strain	Fracture	Dislocation	All
ATHLETICS	**17.1% (6)**	17.1% (6)	17.1% (6)	**40.0% (14)**	8.6% (3)	0.0% (0)	100.0% (35)
BADMINTON	33.3% (5)	**33.3% (5)**	13.3% (2)	**13.3% (2)**	0.0% (0)	6.7% (1)	100.0% (15)
BASKETBALL	**53.4% (78)**	**11.0% (16)**	**11.6% (17)**	**11.6% (17)**	9.6% (14)	2.7% (4)	100.0% (146)
BODYBUILDING	**29.7% (11)**	18.9% (7)	**21.6% (8)**	16.2% (6)	8.1% (3)	5.4% (2)	100.0% (37)
BOXING	**47.8% (33)**	**24.6% (17)**	**8.7% (6)**	**10.1% (7)**	8.7% (6)	0.0% (0)	100.0% (69)
CLIMBING	12.5% (1)	**37.5% (3)**	**37.5% (3)**	12.5% (1)	0.0% (0)	0.0% (0)	100.0% (8)
CYCLING	**27.5% (11)**	17.5% (7)	**20.0% (8)**	15.0% (6)	10.0% (4)	**10.0% (4)**	100.0% (40)
DANCING	**26.6% (25)**	**24.5% (23)**	**20.2% (19)**	**24.5% (23)**	**3.2% (3)**	1.1% (1)	100.0% (94)
FITNESS	33.3% (5)	20.0% (3)	**26.7% (4)**	13.3% (2)	6.7% (1)	0.0% (0)	100.0% (15)
GYMNASTICS	38.5% (15)	17.9% (7)	15.4% (6)	23.1% (9)	5.1% (2)	0.0% (0)	100.0% (39)
HANDBALL	**49.6% (60)**	14.0% (17)	13.2% (16)	**15.7% (19)**	6.6% (8)	0.8% (1)	100.0% (121)
HORSE RIDING	**26.9% (7)**	19.2% (5)	**23.1% (6)**	11.5% (3)	**19.2% (5)**	0.0% (0)	100.0% (26)
JUDO	**50.0% (16)**	3.1% (1)	15.6% (5)	12.5% (4)	9.4% (3)	**9.4% (3)**	100.0% (32)
MARTIAL ARTS	**23.5% (8)**	**26.5% (9)**	17.6% (6)	11.8% (4)	11.8% (4)	**8.8% (3)**	100.0% (34)
OTHERS	34.2% (13)	15.8% (6)	10.5% (4)	15.8% (6)	**18.4% (7)**	5.3% (2)	100.0% (38)
RUGBY FOOTBALL	**46.8% (22)**	**8.5% (4)**	0.0% (0)	**12.8% (6)**	**17.0% (8)**	**14.9% (7)**	100.0% (47)
RUNNING	40.0% (6)	**40.0% (6)**	0.0% (0)	20.0% (3)	0.0% (0)	0.0% (0)	100.0% (15)
SKIING	27.3% (3)	9.1% (1)	18.2% (2)	18.2% (2)	9.1% (1)	**18.2% (2)**	100.0% (11)
SOCCER	37.3% (75)	**11.4% (23)**	**9.5% (19)**	**27.4% (55)**	**10.9% (22)**	3.5% (7)	100.0% (201)
SURFING/WINDSURFING	30.0% (6)	10.0% (2)	**25.0% (5)**	25.0% (5)	10.0% (2)	0.0% (0)	100.0% (20)
SWIMMING	**24.2% (8)**	**24.2% (8)**	**27.3% (9)**	21.2% (7)	3.0% (1)	0.0% (0)	100.0% (33)
TENNIS	**47.3% (26)**	**10.9% (6)**	**27.3% (15)**	**9.1% (5)**	3.6% (2)	1.8% (1)	100.0% (55)
URBAN ACTIVITIES	33.3% (3)	11.1% (1)	0.0% (0)	**44.4% (4)**	11.1% (1)	0.0% (0)	100.0% (9)
VOLLEYBALL	37.5% (15)	12.5% (5)	**22.5% (9)**	15.0% (6)	2.5% (1)	**10.0% (4)**	100.0% (40)
All	38.8% (458)	15.9% (188)	14.8% (175)	18.3% (216)	8.6% (101)	3.6% (42)	100.0% (1180)

Note. **Bold values** indicate a significant higher injury nature risk compared to all the other sports, according to ORs and 95% CI available in additional file 2, table 2

Additional file 4. Table 2 ORs and 95% CI describing the relationship between injury nature and sport played

	Sprain	Overuse	Tendon strain	Muscle strain	Fracture	Dislocation
ATHLETICS	**0.3 (0.22-0.49)**	1.1 (0.73-1.64)	1.2 (0.79-1.79)	**3.0 (2.33-3.80)**	1.0 (0.48-2.09)	0.4 (0.01-21.39)
BADMINTON	0.8 (0.43-1.43)	**2.6 (1.45-4.81)**	0.9 (0.28-2.77)	**0.7 (0.22-2.15)**	0.4 (0.01-20.79)	1.9 (0.23-16.59)
BASKETBALL	**1.8 (1.70-1.92)**	**0.6 (0.56-0.75)**	**0.8 (0.66-0.87)**	**0.6 (0.51-0.68)**	1.1 (0.95-1.35)	0.8 (0.44-1.33)
BODYBUILDING	**0.7 (0.51-0.87)**	1.2 (0.86-1.76)	**1.6 (1.14-2.19)**	0.9 (0.58-1.29)	0.9 (0.45-1.96)	1.5 (0.52-4.58)
BOXING	**1.4 (1.28-1.63)**	**1.7 (1.46-2.04)**	**0.5 (0.38-0.79)**	**0.5 (0.36-0.70)**	1.0 (0.70-1.49)	0.2 (0-10.55)
CLIMBING	0.2 (0.02-2.13)	**3.2 (1.10-9.12)**	**3.4 (1.20-9.93)**	0.6 (0.07-6.06)	0.7 (0.01-43.7)	1.7 (0.02-113.04)
CYCLING	**0.6 (0.46-0.77)**	1.1 (0.79-1.59)	**1.4 (1.04-1.98)**	0.8 (0.53-1.17)	1.2 (0.67-2.09)	**3.0 (1.66-5.45)**
DANCING	**0.6 (0.51-0.64)**	**1.7 (1.51-1.94)**	**1.5 (1.26-1.68)**	**1.4 (1.28-1.64)**	**0.4 (0.18-0.71)**	0.3 (0.04-2.22)
FITNESS	0.8 (0.43-1.43)	1.3 (0.58-3.02)	**2.1 (1.06-4.13)**	0.7 (0.22-2.15)	0.8 (0.09-6.37)	0.9 (0.01-53.78)
GYMNASTICS	1.0 (0.79-1.23)	1.2 (0.81-1.64)	1 (0.70-1.56)	1.3 (1.00-1.80)	0.6 (0.20-1.66)	0.3 (0.01-19.09)
HANDBALL	**1.6 (1.44-1.67)**	0.9 (0.74-1.00)	0.9 (0.75-1.02)	**0.8 (0.73-0.95)**	0.8 (0.57-1.00)	0.2 (0.03-1.71)
HORSE RIDING	**0.6 (0.39-0.86)**	1.3 (0.76-2.07)	**1.7 (1.11-2.67)**	0.6 (0.28-1.23)	**2.5 (1.53-4.22)**	0.5 (0.01-29.36)
JUDO	**1.6 (1.23-2.03)**	0.2 (0.02-1.30)	1.1 (0.66-1.71)	0.6 (0.36-1.13)	1.1 (0.53-2.32)	**2.8 (1.30-6.05)**
MARTIAL ARTS	**0.5 (0.35-0.67)**	**1.9 (1.40-2.59)**	1.2 (0.82-1.85)	0.6 (0.34-1.05)	1.4 (0.80-2.54)	**2.6 (1.22-5.63)**
OTHERS	0.8 (0.65-1.04)	1.0 (0.66-1.48)	0.7 (0.39-1.18)	0.8 (0.56-1.25)	**2.4 (1.68-3.47)**	1.5 (0.51-4.45)
RUGBY FOOTBALL	**1.4 (1.17-1.65)**	**0.5 (0.28-0.85)**	0.1 (0-3.24)	**0.7 (0.44-0.96)**	**2.2 (1.6-3.01)**	**4.7 (3.25-6.92)**
RUNNING	1.1 (0.61-1.82)	**3.5 (2.02-6.14)**	0.2 (0-11.11)	1.1 (0.49-2.55)	0.4 (0.01-20.79)	0.9 (0.01-53.78)
SKIING	0.6 (0.24-1.46)	0.5 (0.06-4.61)	1.6 (0.47-5.34)	1.0 (0.30-3.32)	1.1 (0.12-9.42)	**6.0 (1.73-20.94)**
SOCCER	0.9 (0.89-0.99)	**0.7 (0.61-0.76)**	**0.6 (0.53-0.68)**	**1.7 (1.58-1.79)**	**1.3 (1.16-1.48)**	1 (0.70-1.37)
SURFING/WINDSURFING	0.7 (0.42-1.08)	0.6 (0.19-1.76)	**1.9 (1.12-3.27)**	1.5 (0.87-2.54)	1.2 (0.39-3.6)	0.7 (0.01-39.04)
SWIMMING	**0.5 (0.36-0.70)**	**1.7 (1.21-2.36)**	**2.2 (1.58-2.94)**	1.2 (0.83-1.73)	0.3 (0.04-2.57)	0.4 (0.01-22.76)
TENNIS	**1.4 (1.22-1.64)**	**0.6 (0.44-0.94)**	**2.2 (1.78-2.61)**	**0.4 (0.29-0.69)**	0.4 (0.14-1.14)	0.5 (0.06-3.88)
URBAN ACTIVITIES	0.8 (0.29-2.11)	0.7 (0.07-6.06)	0.3 (0.01-20.2)	**3.6 (1.46-8.72)**	1.3 (0.14-12.37)	1.5 (0.02-97.78)
VOLLEYBALL	0.9 (0.76-1.17)	0.8 (0.48-1.19)	**1.7 (1.24-2.24)**	0.8 (0.53-1.17)	0.3 (0.04-2.09)	**3.0 (1.66-5.45)**

Note. Injured rugby football players were 2.2 times more likely to report a fracture than the entire sample; Bold values indicate a significant higher injury nature risk compared to all the other sports