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Injury risk is different in team and individual youth sport

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ABSTRACT

Objectives: This study compared sports injury incidence in young high-level athletes from various team and individual sports and investigated if sport participation patterns are linked to injuries.
Design: Prospective cohort follow-up.
Methods: Pupils from a public sports school (12–19 years) were recruited over two separate school years (2008–2009: 42 weeks, $n = 199$ athletes; 2009–2010: 40 weeks, $n = 89$ athletes). Training and competition volume and intensity were recorded via a personal sports diary. Sports injuries (time-loss definition) were registered by medical staff members using a standardized questionnaire.
Results: Injury incidence was significantly higher in team compared with individual sports (6.16 versus 2.88 injuries/1000 h, respectively), as a result of a higher incidence of both traumatic (RR = 2.17; CI95% = 1.75–2.70; $p < 0.001$), and overuse injuries (RR = 2.06; CI95% = 1.46–2.91; $p < 0.001$). A Cox proportional hazards regression revealed that team sports participation had a hazard ratio of 2.00 (CI95% = 1.49–2.68; $p < 0.001$) compared to individual sports, with additionally previous injury being a risk and age a protective factor. The number of competitions per 100 days was significantly higher in team sports, whereas the number of intense training sessions per 100 days was significantly lower. In team sports, the number of competitions per 100 days was positively associated with injuries (HR = 1.072; CI95% [1.033; 1.113]; $p < 0.001$), while in individual sports the number of competitions per 100 days had a protective effect (HR = 0.940; CI95% [0.893; 0.989]; $p = 0.017$).
Conclusions: Team sports participation entailed a higher injury risk, whatever the injury category. Further research should elucidate the role of characteristics related to sport participation in injury causation.

1. Introduction

Physical activity in children and adolescents is largely promoted throughout the world for its many benefits on physical[1] and psychological development.[1–3] When practicing freely at a leisure-time level, youngsters regulate their practice volume and intensity according to their individual desire and tolerance.[4] Organized sports imply more rigorous training plans with predefined frequencies, volumes and intensities.[5] These conditions become more stringent when aiming to perform at an international level, bringing about their share of sports injuries. The influence of overscheduling as a potential contributing factor to sports injuries has been recently investigated.[4] The results of that study showed that overuse injuries were significantly related to a higher number of practices within the preceding 2 days compared to acute injuries. Furthermore, athlete or parent perception of excessive sporting activities and insufficient rest in the days prior to injury was associated with overuse and fatigue-related injuries. Considering these findings, it is pertinent to analyze further the characteristics of sport participation (e.g. volume, intensity and number of competitions) and their relationship to sports injuries.

The type of sport practiced by the young athlete represents an additional component beside the aforementioned practice-related injury risk. Although in principle modifiable, type of sport is fixed when analyzing injury risk on a per sport basis. Sports injury incidence in young athletes – expressed in injuries per 1000 exposure hours – varies across different sport disciplines: between 1.6 and 2.5 in gymnastics,[6,7] 2.3 in tennis,[8] 3.4 in basketball[9] and between 5.6 and 10.4 in soccer.[10,11] Based on these results one might conclude that there is a difference in injury risk between team and individual sports. In fact, these sport categories have dissimilar characteristics; in most team sports two groups oppose each other on the playing field, with a generally greater possibility of contact between players/athletes compared with individual sports. Some

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studies already showed that the injury problematic is different according to sport type. Emery et al.[12] found that in high school adolescents, the most serious injuries occurred in team sports like basketball, hockey and soccer. Our own one-year retrospective study in young high-level athletes from different disciplines revealed that, in girls injury incidence was higher in team sports compared with individual and racket sports.[13] In a large prospective follow-up at the National Collegiate Athletic Association (NCAA), Hootman et al.[14] concluded that the difference between training- and competition-related injury rate was much higher in sports with traditional player contact than in those with no player contact.

The pattern of sport participation in youth sports, i.e. volume and intensity of sporting activities and the number of competitions, have not yet been evaluated regarding their influence on injuries. It is anticipated that the sport participation pattern is different in team and individual sports. Therefore, the goal of the current study was twofold: (1) to determine overall injury incidence for team and individual sports in the framework of an injury surveillance program at a public sport school and (2) to describe characteristics of sport participation (training and competition volume and intensity) and to investigate their relationship to the occurrence of injuries in team and individual sports. Our main hypothesis was that injury risk would be different in team and individual sports. Furthermore, we hypothesized that characteristics related to sport participation would be different in the two sports categories and yield a specific injury risk factor pattern.

2. Methods

This prospective cohort study focused on a convenience sample of athletes (12–19 years) from a public sport school during the years 2008–2009 and 2009–2010. The sport disciplines represented were athletics, badminton, basketball, canoeing/kayaking, cycling, figure skating, gymnastics, handball, judo, karate, table tennis, tennis, triathlon, soccer, swimming and volleyball.

Two separate observation periods (42 and 40 weeks, respectively) were organized during the respective school years, from the end of September until the beginning of July. A total of 288 athletes were recruited for this study, each being followed-up over one school year (2008–2009: $n = 199$ athletes; 2009–2010: $n = 89$ athletes). This sample size was deemed sufficient to answer our main hypothesis considering the following assumptions: given a desired power of 0.8 and an α-level of 0.05, to detect a significant difference for injury incidence between team and individual sports, based on expected injury incidences of 1.75/1000 h and 0.93/1000 h, respectively,[13] the total number required is 57 athletes for team and 30 athletes for individual sports. Inclusion criteria were as follows: the athlete had to be enrolled in the sport school, written informed consent to participate in the study had to be provided and compliance with the data collection procedure had to be met (cf. below). The protocol had been previously approved by the National Ethics Committee of Research (CNER No 200707/06).

Personal data (age, gender, sport practiced and injury history over 3 years prior to the study) were gathered using a short questionnaire. Throughout the follow-up, the athletes were instructed to fill out daily a personal sports diary specifically designed for the purposes of this study. Each day contained pre-printed information to collect data about several possible practice units. Tick boxes and pre-formatted space allowed for time-efficient recording of sport context and start/end time. Possible sport participation contexts had previously been identified. Subjective training intensity was determined on a 4-level scale defined by 4 "smiley"-icons standing for "light", "moderate", "intense" and "very intense" training, respectively. The coaches did not have systematic access to this data.

When injured, the athletes were instructed to tick the appropriate box in their sports diary on the day of injury. In this study, a sports injury was operationally defined as a physical complaint that forces the athlete to interrupt or modify his/her usual sporting activities for at least one unit (time-loss definition).[15] Although this injury definition can be unambiguously understood and reported by young athletes, the occurrence of sports injuries was systematically monitored via regular contacts of the investigators with two physical therapists present daily at the sport school. Injury characteristics were gathered using a standardized questionnaire filled out directly with the athlete, based on the latest consensus reports on sports injury data collection in epidemiological studies.[16,17] Variables included start and end date, body part involved and type of injury. Furthermore, injuries were categorized into overuse injuries (micro trauma caused by chronic overload, without a single, identifiable cause) and traumatic injuries.[16,17] Injury severity was defined, based on days of absence from usual sport participation, as slight (0–3 days), minor (4–7 days), moderate (8–28 days) or major (>28 days) in accordance with prior literature.[16,18]

The training diaries were collected on a weekly basis by two investigators who encoded all data into an electronic database. Weekly appointments were made with every school class to collect the pupils' sports diaries, and the procedure was actively supported by the school policy and the teachers. Each reported training unit was cross-checked with known time schedules of the sport school, the respective sport federation and the sport club of each athlete. When the information was incomplete or incoherent, a direct contact was made with the athlete, school staff or trainer to verify and update the data. Information pertaining to sports injuries was systematically cross-checked with the athletes, the physical therapists at the sport school or the national trainers. Duplicate recordings were eliminated, questionnaires were checked for completeness, and ambiguous cases were deliberated within the research team.

Total sporting activity was computed separately for training and competition. Pre-competition warm-up and post-competition cool-down were considered as training exposure. If several competitions took place on the same day, the reported minutes of exposure were added up and regarded as one single competition (e.g. during tournaments or disciplines with different heats). For example, a tennis tournament with 5 matches played over 3 days would have been recorded as 3 competitions. Injury incidence was calculated as injuries per 1000 h of exposure. For all training sessions, the last two levels of the 4-grade rating scale ("intense training" and "very intense training") were used to classify a session as "intense". All competitions were qualified a priori as "intense". The following indicators related to sport participation were calculated: number of competitions per 100 days, number of intense trainings per 100 days and number of light trainings per 100 days. These indicators were computed for each athlete as average values throughout the observation period, either until the first occurrence of a time-loss injury or until the end of the observation period.

Athletes were instructed to fill out their sports diary in a regular and complete way. To be considered valid, data had to be reported within a maximum relative time lapse of 2 weeks to minimize recall bias. Those athletes who had less than 80% of valid sessions at the end of the follow-up period were considered non-compliant to the study and excluded from the calculations.

All data are presented as percent or mean ± standard deviation (SD). Proportions and injury incidence were compared between team and individual sports using the χ^2 test. A Cox proportional hazards regression (forward LR method) was used to investigate risk factors for sports injury. Exposure volume to sports (h) was used as the main variable and taken either until first injury (event of interest) or the end of the observation period. Comparisons of characteristics related to sport participation between team sports and individual sports were performed using an independent