

Special Edition
**“Injuries in the Growing Athlete -
 Current Evidence and Trends”**

Editorial

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Sports Injuries in Youth Athletes: The Past and Present Continuous Concern

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Regular physical activity and sports participation amongst youth is a desirable behavior to optimize growth, develop motor proficiency, prevent obesity, improve health, prevent chronic diseases in later life and enhance the overall quality of life (QoL). An interesting paradox reported in health and sports research reveals that while a larger section of youth is getting increasingly predisposed to less physically active and more sedentary pursuits thereby increasing the risk of childhood obesity¹ and subsequent health problems, apparently the participation rates in competitive youth sport has by-and-large been steady over past 2 decades. Reports indicate that about 45 million youth aged between 6-18 participate in sports in the US² with about 75% of families having at least one child participating in organized sport.³ Furthermore, a 21% increase in high school sports participation has been reported over a 10 year period.⁴ Similar high rates of youth sports participation has also been reported in other countries with 76.4% in Canada,⁵ 60% in Australia⁶ and 83% children and adolescents in the UK⁷ participating in some form of extracurricular or organized sport outside of school hours.

Sports participation during childhood and adolescence is meant for fun, socialization and a well-balanced development. However, the inclusion of competitive element tends to shift this balance and alter the priorities of sports participation. The young athletes begin to specialize in a specific sport at an early age, undergo organized and intense training up to 16-22 hours a week all year round and compete at various levels of participation on a regular basis. Furthermore, organization of youth-centered mega sports events like the Asian Youth Games and Youth Olympic Games in recent years and with increasing recognition and monetary rewards for successful youth athletes in such events raises the likelihood of more and more youngsters aspiring to achieve elite levels of performance standards. In addition, factors like parental goals and ambitions and the lure of university scholarships and professional contracts also intensifies the pursuits of early athletic success and enlistment in specialized training at a young age. It has also been found that some youth choose to play for more than one team or play more than one sport, thus subjecting their growing and ‘yet to functionally mature’ bodies to high stresses of training and competitions. These factors, along with high rates of organized and competitive youth sports participation especially during the years of growth-related physical and physiological changes make the young athletes highly vulnerable to sports injuries in terms for both injury risk and severity. Not surprisingly, sport has been reported to be the leading cause of youth injuries and hospital emergency visits⁸ with recent reports suggesting about 37 pediatric sports and recreational injuries treated per hour in the United States.⁹

While physical activity and sport participation provides substantial immunity against morbidity and mortality related to obesity, metabolic diseases and cancer,¹⁰⁻¹² injuries can hinder physical activity participation amongst youth both in short as well as in the long-term. Moreover, injuries especially to the lower extremity can lead to increased risk of early osteoarthritis,¹³⁻¹⁴ adversely affect physical activity participation and deprive the youth of optimal health and QoL in the later years. Injuries also lead to about 8% youth drop out from sports annually.¹⁵ Furthermore, with high rates of youth sports participation, youth sports injuries also impose a substantial burden on the healthcare economy. Data from the year 2003 Injury Cost Model of the US Consumers Product Safety Commission shows that the top 5 high school sports cost an estimated \$588 million dollars in direct expenses and \$6.6 billion dollars in indirect expenses.⁴ Therefore, youth sports injury presents a situation of alarming concern and

its prevention should be a public health priority. It has been suggested that reduction of only a moderate proportion of youth sports injuries can be significant for athletes' health as well as long-term healthcare costs.¹⁶ This calls for a concerted effort from sports medicine practitioners and researchers, physical therapists, youth coaches, youth sports administrators, school sports organizers, and National and International youth sports governing bodies.

The youth athletes by virtue of their participation in intense training and competitions subject themselves to the risks of both acute and overuse injuries. Moreover, it is unequivocally agreed that the higher vulnerability of injuries in youth is greatly predisposed by growth-related aspects like presence of musculoskeletal immaturity, adolescent growth spurt causing discrepancy between bone growth and mineralization,¹⁷ non-linearity of growth and differential maturational status,¹⁸ and inadequate perceptual and cognitive ability of risk identification.¹⁹ While most acute injuries are of minor severity, they may still lead to discomfort, pain and short-term dysfunctions and restrictions in physical activity and sport participation. A few injuries however, like anterior cruciate ligament injury, physeal injury and concussion present a much serious concern due their potential of causing long-term adverse effects both in terms of health outcomes and treatment and rehabilitation costs.²⁰

In addition to the acute injuries, of greater concern are the overuse injuries that result from repetitive microtrauma without a specific attributable event²¹ and with insufficient time being allowed for healing, repair and functional restoration of the affected part. While previous studies have reported that overuse injuries account for about 50% of youth sports injuries,²² our recent study on youth swimmers and cricketers found that 59% of injuries to the shoulder and elbow were of overuse nature. Growth-related factors, early sports specialization, intense training schedules, low awareness levels, insidious onset and non-specific presentation significantly enhance the risk of overuse injuries in young athletes. This notion is substantiated by increased incidence of overuse injuries with increase in the competitive youth sport participation rates.²³ Owing to the ongoing growth-related physical and physiological changes, the youth are subjected to the risk of unique overuse injuries like apophysitis and physeal stress injuries.^{24,25} The more commonly occurring overuse injuries involve the tibial apophysitis (Osgood-Schlatter disease (OSD)), calcaneal apophysitis (Severs disease) and the medial epicondylar apophysitis of elbow (Little Leaguers Elbow (LLE)), but these tend to be self-limiting and mostly resolve with skeletal maturity. However, other overuse injuries like stress fractures of the pars interarticularis of the spine, neck femur, anterior tibia and tarsal navicular, physeal stress injuries of proximal humerus and proximal tibia, and osteochondritis dissecans can present a substantial risk and lead to a significant amount of sports time lost as well as jeopardize future sports participation.²

Despite the substantial body of evidence on the growth-related, intrinsic and extrinsic risk factors, the injury burden, the severity potential and long-term adverse effects of sports-related injuries in youth, the existing literature on injury prevention seems to be insufficient, with many aspects of youth sport injury epidemiology still in the need of greater insights. One of the key deficits is the lack of global data on both youth sports participation and injury rates. The majority of data on youth sport has been generated from US population-based studies. Apart from these, data on youth sport is available from only a few selected European countries and seemingly no data being available from the Asian youth sport populations. If youth sport injury is to be effectively dealt as a public health issue, a larger body of global evidence is required to understand the actual global burden and implications of the problem. From the available epidemiological evidence, there is also an apparent lack of appropriate denominators for injury rates in youth sport²⁶ as well as for youth sport participation.²⁷ Owing to insufficient information on the extent of exposure or level of participation in youth sport, often non-participants are included in the denominator to calculate the injury incidence leading to inaccurate risk estimation and lowered reliability of the conclusions on sports safety.²⁶ While the most appropriate denominator is the measured time at risk,²⁶ such data are infrequently reported owing to the challenges related to the demands of time and resources. Other areas in the need of stronger evidence are age and gender-specific data on body part affected, type, nature and patterns youth sports injuries. In addition, there are differences in the research design, types of data reported, methods of data collection and analysis between different studies. This leads to heterogeneity in the type and nature of evidence generated and makes it difficult to make valid comparisons between studies. Lastly, youth sports injuries are an outcome of a complex interaction between multiple categories of risk factors many of which may not have been accounted for in the existing studies.²⁸ This may lead to incomplete insights on injury risk, underestimate the injury rates, and eventually be a deterrent to the development of successful injury prevention strategies. Future studies need to consider longer-term, prospective, well-controlled cohort studies of inclusive nature adopting valid data collection methods and appropriate denominators to provide reliable estimates of injury risk, deeper insights on risk factor interactions and enhance participation safety and provide a more comprehensive basis for development of effective youth sport injury prevention programs.

REFERENCES

1. Tremblay MS, LeBlanc AG, Kho ME, et al. Systematic review of sedentary behavior and health indicators in school-aged children and youth. *Int J Behav Nutr Phys Act.* 2011; 8: 98. doi: [10.1186/1479-5868-8-98](https://doi.org/10.1186/1479-5868-8-98)

2. DiFiori JP, Benjamin HJ, Brenner J, et al. Overuse injuries and burnout in youth sports: A position statement from the American Medical Society for Sports Medicine. *Clin J Sport Med.* 2014; 24: 3-20. doi: [10.1097/JSM.0000000000000060](https://doi.org/10.1097/JSM.0000000000000060)
3. Adirim TA, Cheng TL. Overview of injuries in the young athlete. *Sports Med.* 2003; 33: 75-81. doi: [10.2165/00007256-200333010-00006](https://doi.org/10.2165/00007256-200333010-00006)
4. McGuine T. Sports injuries in high school athletes: A review of injury-risk and injury-prevention research. *Clin J Sports Med.* 2006; 16(6): 488-499.
5. Guèvremont A, Findlay L, Kohen D. Organized extracurricular activities of Canadian children and youth. *Health Rep.* 2008; 19: 65-69.
6. Australian Bureau of Statistics. Sports Participation. 2012. Web site. <http://www.abs.gov.au/ausstats/abs@.nsf/Products-4901.0~Apr+2012~Main+Features~Sports+participation?OpenDocument>. Accessed September 3, 2016
7. National Statistic UK. Department of Culture, Media and Sport. Taking Part 2012/2013 Annual Child Report. Statistical Release 2013. Web site. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/231004/Taking_Part_Year_8_2012_13_Child_Report.pdf. Accessed September 3, 2016
8. Emery CA. Injury prevention in paediatric sport-related injuries: A scientific approach. *Br J Sports Med.* 2010; 44(1): 64-69. doi: [10.1136/bjism.2009.068353](https://doi.org/10.1136/bjism.2009.068353)
9. Schwebel DC, Brezausk CM. Child development and pediatric sport and recreational injuries by age. *J Ath Tr.* 2014; 49(3): 780-785. doi: [10.4085/1062-6050-49.3.41](https://doi.org/10.4085/1062-6050-49.3.41)
10. Blair SN, Kohl HW III, Barlow CE, et al. Changes in physical fitness and all-cause mortality. A prospective study of healthy and unhealthy men. *JAMA.* 1995; 273: 1093-1098. doi: [10.1001/jama.1995.03520380029031](https://doi.org/10.1001/jama.1995.03520380029031)
11. Paffenberger RS Jr, Kampert JB, Lee I-M, Hyde RT, Leung RW, Wing AL. Changes in physical activity and other lifeway patterns influencing longevity. *Med Sci Sports Exerc.* 1994; 26: 857-865. Web site. <http://www.popline.org/node/287075>. Accessed August 3, 2016
12. Lee I-M, Paffenberger RS Jr. Physical activity and its relation to cancer risk: A prospective study of college alumni. *Med Sci Sports Exerc.* 1994; 26: 831-837.
13. Drawer F, Fuller CW. Propensity for osteoarthritis and lower limb joint pain in retired professional soccer players. *Br J Sports Med.* 2001; 35: 402-408. doi: [10.1136/bjism.35.6.402](https://doi.org/10.1136/bjism.35.6.402)
14. Roos EW. Joint injury causes osteoarthritis in young adults. *Curr Opin Rheumatol.* 2005; 17: 195-200. Web site. http://journals.lww.com/co-rheumatology/Abstract/2005/03000/Joint_injury_causes_knee_osteoarthritis_in_young.16.aspx. Accessed August 3, 2016
15. Grimmer KA, Jones D, Williams J. Prevalence of adolescent injury from recreational exercise: An Australian perspective. *J Adolesc Health.* 2000; 27: 266-272. doi: [10.1016/S1054-139X\(00\)00120-8](https://doi.org/10.1016/S1054-139X(00)00120-8)
16. Verhagen EA, van Tulder M, van der Beek AJ, et al. An economic evaluation of a proprioceptive balance board training programme for the prevention of ankle sprains in volleyball. *Br J Sports Med.* 2005; 39: 111-115. doi: [10.1136/bjism.2003.011031](https://doi.org/10.1136/bjism.2003.011031)
17. Bailey DA, Wedge JH, McCulloch RG, et al. Epidemiology of fractures of the distal end of radius in children as associated with growth. *J Bone Joint Surg Am.* 1989; 71: 1225-1231. Web site. <http://jbjs.org/content/71/8/1225>. Accessed August 3, 2016
18. Malina RM, Bouchard C, Bar-Or O. Growth, maturation, and physical activity. *Human Kinetics.* 2004: 267-273.
19. Emery CA, Hagel B, Morrongiello BA. Injury prevention in child and adolescent Sport: Whose responsibility is it? *Clin J Sport Med.* 2006; 16(6): 514-521. doi: [10.1097/01.jsm.0000251179.90840.58](https://doi.org/10.1097/01.jsm.0000251179.90840.58)

20. Caine D, Purcell L, Maffulli N. The child and adolescent athlete: A review of three potentially serious injuries. *BMC Sports Sci Med Rehabil.* 2014; 6: 22. doi: [10.1186/2052-1847-6-22](https://doi.org/10.1186/2052-1847-6-22)
21. Fuller CW, Ekstrand J, Junge A, et al. Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Br J Sports Med.* 2006; 40: 193-201. doi: [10.1136/bjism.2005.025270](https://doi.org/10.1136/bjism.2005.025270)
22. Dalton SE. Overuse injuries in adolescent athletes. *Sports Med.* 1992; 13: 58-70. doi: [10.2165/00007256-199213010-00006](https://doi.org/10.2165/00007256-199213010-00006)
23. Cuff S, Loud K, O'Riordan MA. Overuse injuries in high school athletes. *Clin Pediatr (Phila).* 2010; 49: 731-736. doi: [10.1177/0009922810363154](https://doi.org/10.1177/0009922810363154)
24. Caine D, DiFiori J, Maffulli N. Physeal injuries in children's and youth sports: Reasons for concern. *Br J Sports Med.* 2006; 40: 749-760. doi: [10.1136/bjism.2005.017822](https://doi.org/10.1136/bjism.2005.017822)
25. DiFiori J. Overuse injury of the physis: A growing problem. *Clin J Sports Med.* 2010; 20: 336-337. doi: [10.1097/JSM.0b013e3181ebb55d](https://doi.org/10.1097/JSM.0b013e3181ebb55d)
26. Carter EA, Westerman BJ, Hunting KL. Risk of injury in basketball, football, and soccer players, ages 15 years and older, 2003-2007. *J Ath Tr.* 2011; 46(4): 484-488. Web site. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3418954/>. Accessed August 3, 2016
27. Roberts WO. Overuse injuries and burnout in youth sports. *Clin J Sports Med.* 2014; 24(1): 1-2. doi: [10.1097/JSM.0000000000000061](https://doi.org/10.1097/JSM.0000000000000061)
28. Caine D, Maffulli N, Caine C. Epidemiology of injury in child and adolescent sports: Injury rates, risk factors, and prevention. *Clin Sports Med.* 2008; 27: 19-50. doi: [10.1016/j.csm.2007.10.008](https://doi.org/10.1016/j.csm.2007.10.008)