ACTIVE & SAFE

Evidence Summary:
Track & Field

Tatum Priyambada Mitra BSc BKin & Krystle Wittevrongel BA BSc MPP

Version 1
February 2018

BC INJURY research and prevention unit

The British Columbia Injury Research and Prevention Unit (BCIRPU) was established by the Ministry of Health and the Minister's Injury Prevention Advisory Committee in August 1997. BCIRPU is housed within the Evidence to Innovation research theme at BC Children's Hospital (BCCH) and supported by the Provincial Health Services Authority (PHSA) and the University of British Columbia (UBC). BCIRPU's vision is *to be a leader in the production and transfer of injury prevention knowledge and the integration of evidence-based injury prevention practices into the daily lives of those at risk, those who care for them, and those with a mandate for public health and safety in British Columbia.*

Author: Tatum Priyambada Mitra & Krystle Wittevrongel

Editors: Sarah A Richmond, Amanda Black

For any questions regarding this report, contact:

BC Injury Research and Prevention Unit
F508 – 4480 Oak Street
Vancouver, BC V6H 3V4
Email: bcinjury1@cw.bc.ca
Phone: (604) 875-3776
Fax: (604) 875-3569
Website: www.injuryresearch.bc.ca

Suggested Citation:

Priyambada Mitra T, Wittevrongel K, Black A, Richmond SA, Pike I, Babul S. *Evidence Summary: Track & Field.* Active & Safe Central. BC Injury Research and Prevention Unit: Vancouver, BC; 2018. Available at http://activesafe.ca/.

UBC BC Children's Hospital Research Institute

Evidence synthesis tool

SPORT:	Track and field	**Target Group:**	Mostly high school and collegiate levels however, more information is needed on masters athletes.
Injury Types and Mechanisms:	Injuries during sprints, distance running, and jumping events are the most common and account for over 65% of all track and field injuries (Nattiv, 2000). The most common sites of injury include the ankle and knee, and the most common mechanism of injury is due to overuse and overtraining (Nattiv, 2000). The remaining 35% of injuries are a result of sprints and hurdles, jumps, pole vault, and throws and include acute injuries such as hamstring strains and ankle sprains and overuse injuries such as achilles and patellar tendinopathy, back pain, shoulder and elbow injuries, patellar cartilage lesions, iliotibial syndrome and stress fractures (Nattiv, 2000).		

Incidence/ Prevalence	**Risk/ Protective Factors**	**Interventions**	**Implementation/ Evaluation**	**Resources**
The current knowledge of injury risk within track and field is based on limited research using different methods in various events. Comparisons between the studies is difficult due to the lack of standardized methodology (Edouard & Alonso, 2013; Nattiv, 2000). According to the studies available, the prevalence of injuries within track and field ranges from 3.1 to 169.8 per 100 athletes per year (Alonso et al., 2012; Edouard & Alonso, 2013; Fourchet, Horobeanu et al., 2011; Nattiv, 2000; Opar, Drezner, & Shield, 2015; Pierpoint et al., 2016). Most of the injuries within track and field occur during practice which can be explained by the fact most of the season is training and practice while competitive events are few and	Current risk and protective factors for injury within track and field include: stress fractures, gender differences, previous history of injury, age, proper coaching, and overtraining (Nattiv, 2000; Alonso et al., 2012; Edouard & Alonso, 2013; Jacobsson et al., 2012; Tyflidis et al., 2012; Pierpoint et al., 2016). **Stress Fractures** Due to the nature of running in track and field events, stress fractures are common (Nattiv, 2000). Additional risk factors for stress fractures include low bone mineral density (BMD), menstrual irregularities, dietary factors and a prior history of stress fractures (Nattiv, 2000). To help prevent stress fractures, preventative measures such as ensuring	There is limited information on interventions used within track and field to reduce injuries. When considering common injuries such as hamstring strains within track and field, studies have suggested focusing on prevention mechanisms (Alonso et al., 2012; Edouard & Alonso, 2013; Jacobsson et al., 2012; Nattiv, 2000). For example, sprinting, strength imbalances, flexibility, fatigue, age, ethnicity (particular racial or anatomical predisposition) and severity of previous injury can all contribute to hamstring strains and these factors should be considered in the prevention and management of these types of injuries. Another common injury within track and field athletes are ankle sprains, which can be managed through proper neuromuscular, balance and proprioception	Limited information of interventions or implementations of injury prevention programs exist in the literature for the sport of track and field. Prevention strategies should be focused on how to minimalize specific or overuse injuries such as hamstring strains and ankle injuries (Edouard & Alonso, 2013; Nattiv, 2000). Hamstring injuries are extremely common and prevention of strains should include strengthening of the hamstring and surrounding muscle groups (Edouard & Alonso, 2013; Malliaropoulos et al., 2012). For preventing ankle injuries, balancing and stability programs that increase proprioception and increase strength are recommended for the sport (Edouard & Alonso, 2013; Malliaropoulos et al., 2012). Prevention strategies for highly technical track and field events such as pole-vaulting, hurdles, and	

far between (Edouard & Alonso, 2013). **Explosive Events** Common injuries are dependent on the event. For more explosive events such as sprint, hurdles, and jumps, there is a higher chance of acute injuries like strains and sprains, while for middle or long-distance runs, there is a higher likelihood of chronic and overuse injury (Edouard & Alonso, 2013). **Running and Jumping Events** There are no known incidence rates for running and jumping injuries within track and field. The most common type of acute injuries in running events tend to be thigh injuries such as hamstring strains, while overuse (or chronic) injuries include achilles tendinopathy (Alonso et al., 2012; Edouard & Alonso, 2013; Malliaropoulos et al., 2012; Nattiv, 2000). **Throwing Events** Throwing events in track and field include: javelin, shot put, discus and hammer. At the high school level specifically, injuries related to throwing represent 6.7% of girls track and field injuries and 5.9% of boys track and field injuries (Pierpoint	adequate calcium nutrition, proper caloric intake and energy balance, and partaking in proper weight bearing exercises to optimize bone health are necessary (Nattiv, 2000). More research is needed to determine factors leading to improvements in bone density and fracture reduction in athletes at risk. **Gender Differences** Multiple studies have stated that males seems to have higher risk of injury than females (Alonso et al., 2012; Edouard & Alonso, 2013). However, other studies within high school populations have shown that females may be more susceptible to lower extremity injuries as compared to males (Pierpoint et al., 2016). More research is needed on risk factors for injury in terms of the differences between male and female track athletes. **Previous Injuries** Among the risk factors for track and field injury, a previous history of injury is a predisposing factor to re-injury according to multiple studies (Edouard & Alonso, 2013;	exercises (Alonso et al., 2012; Edouard & Alonso, 2013; Jacobsson et al., 2012; Nattiv, 2000). Stress fractures are also common, and some studies suggest that proper nutrition, proper calcium intake, and resistance training can prevent stress fractures (Nattiv, 2000). Another approach for injury prevention stated within the literature is to focus on specific events that have higher injury risk and work on technique, body position and biomechanics within those events (Edouard & Alonso, 2013; Malliaropoulos et al., 2012). For technical track and field events such as pole vaulting or hurdles, tactile skills and mastery of movements is a key part of injury prevention (Edouard & Alonso, 2013; Malliaropoulos et al., 2012). Preventative strengthening and recovery programs, proper periodization of training and scheduling of recovery periods are methods that can be used to prevent overuse injuries (Edouard & Alonso, 2013). More research is needed to identify risk factors for all age groups and effectively develop primary prevention programs for all events within track and field. **Economic** There are no studies on the	throwing events include perfecting technique (Edouard & Alonso, 2013). More information is needed on how to implement injury prevention strategies specific for track and field athletes.	

2016). The most common types of injuries within throwing events are overuse and chronic injuries (Alonso et al., 2012; Edouard & Alonso, 2013). The sites of the body that are most susceptible to injury during throwing events include the shoulder (rotator cuff tears, rotator cuff tendinopathy, genohurmeral dislocation, pectoralis major strain) elbow (UCL injury, Ulnar nerve traction neuritis) and lower back (lumbar spondlylolysis, lumbar muscle strain, lumbar spondlylosis, lumbar spondylolisthesis. (Alonso et al., 2012; Edouard & Alonso, 2013; Meron 2017). Lower body injuries including meniscal tears and ankle sprains are also considered common in shot put, discus and hammer (Meron 2017). **Pole Vaulting Events** The incidence rate for pole vaulting injuries ranges between 7.99- 16.33 injuries per 1,000 participants, depending on the level of participation within (Rebella, 2015; Tyflidis et al., 2012). The most common sites of injury during pole vaulting events include the lower back, hamstring, knee and ankle	Jacobsson et al., 2012; Nattiv, 2000; Anastasios Tyflidis et al., 2012). However more information is needed on the mechanisms for this. **Age** Athletes over the age of 26 have been shown to have higher risk of injury in competition (Edouard & Alonso, 2013). It has also been shown in multiple studies that masters athletes are more susceptible to injury (Rebella, 2015; Tyflidis et al., 2012). **Proper Coaching** Injury prevalence and incidence has been reported to be lower in cases when training is supervised by coaching staff and when athletes have mastered the technical skills (Edouard & Alonso, 2013). More information is needed about coaching credentials and certificates requirements within track and field. **Overtraining** A majority of the track and field season is spent primarily training and practicing, thus overtraining is problematic (Nattiv, 2000). Multiple studies have stated that overuse injuries are the most common	economic costs of injury or injury prevention within the sport of track and field.		

(Opar, Drezner, & Shield, 2015; Rebella, 2015; Tyflidis et al., 2012) **High School Athletes** One study determined the incidence of injury within high school track and field is 0.84 injuries per 1,000 athlete exposures (Pierpoint et al., 2016). Girls had higher injury rates than boys (rate ratio, 1.37; 95% CI, 1.27-1.48) and 36.2% of girls suffered overuse injuries as compared to 27.5% of boys (Pierpoint et al., 2016). The most common site of injury for high school athletes were the ankle and knee (Pierpoint et al., 2016). Of all track and field injuries, 65% occurred within sprinting, distance running, and jumping events (Fourchet et al., 2011; Nattiv, 2000; Pierpoint et al., 2016). **University and Collegiate Level** There is no known incidence rate of overall track and field injuries within the university or collegiate athletes. For elite athletes, the incidence rate of injury is 134.5 injuries per 1,000 registered athletes, with 48% of the injuries resulting in time loss from sport (Pollock et al., 2016). For pole vaulting, the incidence	type of injuries seen within track and field (Alonso et al., 2012; Edouard & Alonso, 2013; Jacobsson et al., 2012). Overtraining can act as a risk factor for injury for athletes (Jacobsson et al., 2012).			

rate at the college level is 7.99 injuries per 1,000 collegiate athletes (Rebella, 2015). Other events have a lack of information on the number of injuries seen within collegiate and elite levels. The most common injury sites within the collegiate and elite level were in the lower extremities, such as ankles and knees (Fourchet et al., 2011; Jacobsson et al., 2012; Nattiv, 2000; Anastasios Tyflidis et al., 2012). **Masters Athletes** No epidemiological data was found regarding the incidence rate for track and field events in masters athletes overall and there is a lack of information about injury frequency, prevalence, and common sites of injuries from track and field events within this population. One study on pole-vaulting found the incidence of injuries was 16.33 per 1,000 masters athletes, but there is no information on other events (Rebella, 2015; Tyflidis et al., 2012). Opar et al. (2015) found in a three-year epidemiological study that masters athletes had a reduced likelihood of minor				

orthopaedic injury as compared to high school and college athletes. This stands in contrast to the broader literature which consistently indicates older athletes and those at the masters level have an increased likelihood of sustaining injuries of this type (Opar et al., 2015).				
Works Cited: Alonso, J.M., Edouard, P., Fischetto, G., Adams, B., Depiesse, F., & Mountjoy, M. (2012). Determination of future prevention strategies in elite track and field: analysis of Daegu 2011 IAAF Championships injuries and illnesses surveillance. *British Journal of Sports Medicine*, 46: 505-514. Edouard, P., & Alonso, J.M. (2013). Epidemiology of track and field injuries. *New Studies in Athletics*, 28, 85–92. Fourchet, F., Horobeanu, C., Loepelt, H., Taiar, R., & Millet, G.P. (2011). Foot, ankle, and lower leg injuries in young male track and field athletes. *International Journal of Athletic Therapy and Training*, 16(3): 19–23. Jacobsson, J., Timpka, T., Kowalski, J., Nilsson, S., Ekberg,	**Works Cited:** Alonso, J.M., Edouard, P., Fischetto, G., Adams, B., Depiesse, F., & Mountjoy, M. (2012). Determination of future prevention strategies in elite track and field: analysis of Daegu 2011 IAAF Championships injuries and illnesses surveillance. *British Journal of Sports Medicine*, 46: 505-514. Edouard, P., & Alonso, J.M. (2013). Epidemiology of track and field injuries. *New Studies in Athletics*, 28, 85–92. Fourchet, F., Horobeanu, C., Loepelt, H., Taiar, R., & Millet, G.P. (2011). Foot, ankle, and lower leg injuries in young male track and field athletes. *International Journal of Athletic Therapy and Training*, 16(3): 19–23. Jacobsson, J., Timpka, T., Kowalski, J., Nilsson, S., Ekberg,	**Works Cited:** Alonso, J.M., Edouard, P., Fischetto, G., Adams, B., Depiesse, F., & Mountjoy, M. (2012). Determination of future prevention strategies in elite track and field: analysis of Daegu 2011 IAAF Championships injuries and illnesses surveillance. *British Journal of Sports Medicine*, 46: 505-514. Edouard, P., & Alonso, J.M. (2013). Epidemiology of track and field injuries. *New Studies in Athletics*, 28, 85–92. Jacobsson, J., Timpka, T., Kowalski, J., Nilsson, S., Ekberg, J., & Renström, P. (2012). Prevalence of musculoskeletal injuries in Swedish elite track and field athletes. *American Journal of Sports Medicine*, 40(1): 163–169. Nattiv, A. (2000). Stress fractures and bone health in track and field athletes. *Journal of Science and Medicine in Sport*, 3(3): 268–279	**Works Cited:** Alonso, J.M., Edouard, P., Fischetto, G., Adams, B., Depiesse, F., & Mountjoy, M. (2012). Determination of future prevention strategies in elite track and field: analysis of Daegu 2011 IAAF Championships injuries and illnesses surveillance. *British Journal of Sports Medicine*, 46: 505-514. Edouard, P., & Alonso, J.M. (2013). Epidemiology of track and field injuries. *New Studies in Athletics*, 28, 85–92. Malliaropoulos, N., Mendiguchia, J., Pehlivanidis, H., Papadopoulou, S., Valle, X., Malliaras, P., & Maffulli, N. (2012). Hamstring exercises for track and field athletes: injury and exercise biomechanics, and possible implications for exercise selection and primary prevention. *British Journal of Sports Medicine*, 46:846-851.	

J., & Renström, P. (2012). Prevalence of musculoskeletal injuries in Swedish elite track and field athletes. *American Journal of Sports Medicine*, 40(1): 163–169.	J., & Renström, P. (2012). Prevalence of musculoskeletal injuries in Swedish elite track and field athletes. *American Journal of Sports Medicine*, 40(1): 163–169.			
Malliaropoulos, N., Mendiguchia, J., Pehlivanidis, H., Papadopoulou, S., Valle, X., Malliaras, P., & Maffulli, N. (2012). Hamstring exercises for track and field athletes: injury and exercise biomechanics, and possible implications for exercise selection and primary prevention. *British Journal of Sports Medicine*, 46:846-851.	Malliaropoulos, N., Mendiguchia, J., Pehlivanidis, H., Papadopoulou, S., Valle, X., Malliaras, P., & Maffulli, N. (2012). Hamstring exercises for track and field athletes: injury and exercise biomechanics, and possible implications for exercise selection and primary prevention. *British Journal of Sports Medicine*, 46:846-851.			
Meron A, Saint-Phard D. Track and Field Throwing Sports: Injuries and Prevention. *Current Sports Medicine Reports*, 2017;16:391–6.	1 Meron A, Saint-Phard D. Track and Field Throwing Sports: Injuries and Prevention. *Current Sports Medicine Reports*, 2017;16:391–6.			
Nattiv, A. (2000). Stress fractures and bone health in track and field athletes. *Journal of Science and Medicine in Sport*, 3(3): 268–279.	Nattiv, A. (2000). Stress fractures and bone health in track and field athletes. *Journal of Science and Medicine in Sport*, 3(3): 268–279.			
Opar, D., Drezner, J., & Shield, A. (2015). Acute injuries in track and field athletes: a 3-year observational study at the Penn Relays Carnival with epidemiology and medical coverage implications. *American Journal of Sports Medicine*, 43(4): 816–822.	Opar, D., Drezner, J., & Shield, A. (2015). Acute injuries in track and field athletes: a 3-year observational study at the Penn Relays Carnival with epidemiology and medical coverage implications. *American Journal of Sports Medicine*, 43(4): 816–822.			

Pierpoint, L.A., Williams, C.M., Fields, S.K., & Comstock, R.D. (2016). Epidemiology of injuries in United States high school track and field: 2008-2009 through 2013-2014. *American Journal of Sports Medicine*, 44(6): 1463–1468. Pollock, N., Dijkstra, P., Calder, J., & Chakraverty, R. (2016). Plantaris injuries in elite UK track and field athletes over a 4-year period : a retrospective cohort study. *Knee Surgery, Sports Traumatology, Arthroscopy*, 24(7): 2287–2292. Rebella, G. (2015). A prospective study of injury patterns in collegiate pole vaulters. *American Journal of Sports Medicine*, 43(4): 808–815. Tyflidis, A., Kipreos, G., Tripolitsioti, A., & Stergioulas, A. (2012). Epidemiology of track & field injuries: a one-year experience in athletic schools. *Biology of Sport,* 29(4): 291–295.	Pierpoint, L.A., Williams, C.M., Fields, S.K., & Comstock, R.D. (2016). Epidemiology of injuries in United States high school track and field: 2008-2009 through 2013-2014. *American Journal of Sports Medicine*, 44(6): 1463–1468. Pollock, N., Dijkstra, P., Calder, J., & Chakraverty, R. (2016). Plantaris injuries in elite UK track and field athletes over a 4-year period : a retrospective cohort study. *Knee Surgery, Sports Traumatology, Arthroscopy*, 24(7): 2287–2292. Rebella, G. (2015). A prospective study of injury patterns in collegiate pole vaulters. *American Journal of Sports Medicine*, 43(4): 808–815. Tyflidis, A., Kipreos, G., Tripolitsioti, A., & Stergioulas, A. (2012). Epidemiology of track & field injuries: a one-year experience in athletic schools. *Biology of Sport,* 29(4): 291–295.			

Review of Sport Injury Burden, Risk Factors and Prevention

Track & Field

Incidence and Prevalence

Track and field encompasses multiple events including running, jumping, and throwing (Alonso et al., 2012; Edouard & Alonso, 2013; Fourchet, Horobeanu, Loepelt, Taiar, & Millet, 2011; Malliaropoulos et al., 2012). The prevalence and incidence of injury within the sport has been estimated to be between 3.1 to 169.8 per 1,000 athletes per year, although the incidence of injury risk for specific events is not known for every event (Edouard & Alonso, 2013; Nattiv, 2000). Injuries during sprints, distance running, and jumping events are the most common, accounting for over 65% of all track and field injuries (Nattiv, 2000). The most common sites for these injuries include the ankle and knee, with the mechanism of injury most often due to overuse and overtraining (Alonso et al., 2012; Nattiv, 2000). Adolescents who participate within track and field events have been shown to have a higher incidence of lower extremity injuries when compared to all other athletes in the sport. Approximately 40% of foot, ankle and lower leg injuries, 30% of knee injuries, and 10% of hamstring and thigh injuries are sustained by adolescents (Fourchet et al., 2011).

As a result of the short competitive season and the year-round training season, athletes are more likely to get hurt during training rather than in competition (Alonso et al., 2012; Edouard & Alonso, 2013; Nattiv, 2000). In addition, those who compete in more than one event tend to be more likely to sustain injury (Alonso et al., 2012). Within the sport of track and field, events that include more explosive actions such as sprint, hurdles and jumps result in a higher incidence of acute injury, while events that require more endurance such as the middle or long distance running result in an increased incidence of chronic pain and injury (Alonso et al., 2012; Edouard & Alonso, 2013; Nattiv, 2000; Pollock et al., 2016). Also, dependent on the track and field event, the common sites of injury change. For sprints and hurdling events hamstring strains, ankle sprains, and achilles tendinopathy are the most common; for pole vaulting events ankle sprains, back pain, concussions, severe head injuries and spinal cord traumas are the most common; for long distance running events chronic knee issues, patellar cartilage lesions, iliotibial syndrome, patellar tendinopathy, and other chronic ailments are the most common; and for throwing events, upper extremity strains, shoulder injuries, and lower back strains are common (Edouard & Alonso, 2013; Nattiv, 2000; Edouard & Alonso, 2013). Overall, throughout all track and field events lower limb injuries make up over 80% of the major injuries, with stress fractures being one of the most common (Alonso et al., 2012).

There are limitations within the literature in regard to what is known about injury prevalence and common injuries in each event within track and field events. The majority of the research is retrospective based on survey data and does not take into account exposure time. In addition, information is limited on the effect of different age groups within the sport of track and field.

Risk and Protective Factors

Risk factors for injury in track and field include age, gender, footwear and equipment, low bone mineral density (BMD), menstrual irregularities, dietary factors, improper technique, environmental factors, previous injury, and overtraining (Alonso et al., 2012; Nattiv, 2000).

There is limited research on how age affects performance and overall injury incidence, however, it is known that adolescent age groups involved in track and field have a higher predisposition for lower extremity injuries (Fourchet et al., 2011). In addition, after the age of 26, track and field athletes have a higher risk of injury (Edouard & Alonso, 2013). There are conflicting studies on the effect of sex on injuries in track and field (Alonso et al., 2012; Edouard & Alonso, 2013; Malliaropoulos et al., 2012; Nattiv, 2000; Pierpoint, Williams, Fields, & Comstock, 2016). One study stated that during practice girls had a higher injury rate than boys but there was no difference in injury rates between males and females during competition (Pierpoint et al., 2016). In contrast, another study found that males had a higher risk of injuries than females (Edouard & Alonso, 2013).

For running events, it is extremely important to consider the repeated motion and surface impact that may be translated through the body (Markström & Olsson, 2013). The type of footwear an athlete wears can decrease the force transferred to other parts of the body and can decrease the risk of injury later on (Markström & Olsson, 2013). There is limited information on other equipment used to help reduce injury risk in track and field most likely due to the fact minimal equipment is used within this sport.

Stress fractures due to overuse are one of the most common injuries seen in track and field (Nattiv, 2000). Risk factors for stress fractures also include gender, lower bone mineral density (BMD), menstrual irregularities, and dietary factors (Nattiv, 2000). Other risk factors for injury include improper technique when performing actions, which can be minimal when it comes to running, or extremely severe when it comes to actions such as in pole vaulting (Edouard & Alonso, 2013; Rebella, 2015). There was no mention of coaching within any of the literature, however, extrapolating knowledge from other sports, a key component of injury prevention is improving technique (Edouard & Alonso, 2013).

Another risk factor that increases injury risk would be a history of previous injury and incorrect rehabilitation and strengthening of the original injury site (Edouard & Alonso, 2013). Overtraining and overuse are the most common risk factors and causes for injury in track and field and as a result proper training and periodization can be protective factors (Edouard & Alonso, 2013; Fourchet et al., 2011; Opar, Drezner, & Shield, 2015). Other protective factors include proper biomechanics while performing techniques, proper bone health regulation, proper hydration, and appropriate footwear (Edouard & Alonso, 2013; Fourchet et al., 2011; Jacobsson et al., 2012; Nattiv, 2000).

Opportunities for Prevention: Effective Interventions, Cost-Effectiveness, Implementation and Evaluation

There is a limited amount of information on effective interventions to help prevent injuries within the sport of track and field. One study reviewed what is known about stress-fractures within the sport of track and field, and recommended a focus on the importance of bone health, increased calcium, proper nutrition and weight management. (Nattiv, 2000) In addition, proper recovery and rehabilitation programs for stress fractures are extremely important in helping prevent injuries (Edouard & Alonso, 2013; Nattiv, 2000). The injury prevention literature focuses on prevention strategies for specific injuries such as hamstring strains, ankle injuries, and how to minimalize overuse injuries based on expert recommendations and current literature (Edouard & Alonso, 2013; Nattiv, 2000).

As hamstring injuries are extremely common, prevention of strains should include strengthening the hamstring and surrounding muscle groups through eccentric exercises (Edouard & Alonso, 2013; Malliaropoulos et al., 2012). Ankle injuries are also common, and expert recommendations for prevention for these injuries include balancing and stability programs that increase proprioception and increase strength (Edouard & Alonso, 2013). Prevention of injury in highly technical track and field events such as pole-vaulting, hurdles, and throwing events include perfecting technique (Edouard & Alonso, 2013).

As most of the injuries seen in track and field events are the result of overuse, proper periodization that limits overtraining and the use of specialized programs to strengthen muscle groups that are needed for each specific event (Edouard & Alonso, 2013). Future studies in track and field are needed to help develop primary prevention programs specialized for each event (Jacobsson et al., 2012).

References

Alonso, J.M., Edouard, P., Fischetto, G., Adams, B., Depiesse, F., & Mountjoy, M. (2012). Determination of future prevention stratgues in elite track and field: analysis of Daegu 2011 AFFS Championships injuries and illnesses surveillance. *British Jounral of Sports Medicine* 46: 505-514. doi 10.1136/bjsports-2012-091008.

Edouard, P., & Alonso, J.M. (2013). Epidemiology of track and field injuries. *New Studies in Athletics* 28(1/2): 85–92.

Fourchet, F., Horobeanu, C., Loepelt, H., Taiar, R., & Millet, G.P. (2011). Foot, ankle, and lower leg injuries in young male track and field athletes. *International Journal of Athletic Therapy and Training* 16(3): 19–23.

Jacobsson, J., Timpka, T., Kowalski, J., Nilsson, S., Ekberg, J., & Renström, P. (2012). Prevalence of musculoskeletal injuries in Swedish elite track and field athletes. *American Journal of Sports Medicine* 40(1): 163–169.

Malliaropoulos, N., Mendiguchia, J., Pehlivanidis, H., Papadopoulou, S., Valle, X., Malliaras, P., & Maffulli, N. (2012). Hamstring exercises for track and field athletes: Injury and exercise biomechanics, and possible implications for exercise selection and primary prevention. *British Journal of Sports Medicine* 46:846-851. doi:10.1136/bjsports–2011-090474.

Nattiv, A. (2000). Stress fractures and bone health in track and field athletes. *Journal of Science and Medicine in Sport* 3(3): 268–279.

Opar, D., Drezner, J., & Shield, A. (2015). Acute injuries in track and field athletes: A 3-year observational study at the Penn Relays Carnival with epidemiology and medical coverage implications. *American Journal of Sports Medicine* 43(4): 816–822.

Pierpoint, L.A., Williams, C.M., Fields, S.K., & Comstock, R.D. (2016). Epidemiology of injuries in United States high school track and field: 2008-2009 through 2013-2014. *American Journal of Sports Medicine* 44(6): 1463–1468.

Pollock, N., Dijkstra, P., Calder, J., & Chakraverty, R. (2016). Plantaris injuries in elite UK track and field athletes over a 4-year period : A retrospective cohort study. *Knee Surgery, Sports Traumatology, Arthroscopy* 24(7): 2287–2292. doi: 10.1007/s00167-014-3409-3.

Rebella, G. (2015). A prospective study of injury patterns in collegiate pole vaulters. *American Journal of Sports Medicine* 43(4): 808–815.

Tyflidis, A., Kipreos, G., Tripolitsioti, A.D., & Stergioulas, A.T.H. (2012). Epidemiology of track & field injuries: a one year experience in athletic schools. *Biology of Sport* 29(4): 291.