Evidence Summary: Baseball

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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.*

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UBC BC Children's Hospital Research Institute

Evidence synthesis tool

SPORT:	Baseball	**Target Group:**	Youth; High School; Collegiate
Injury Mechanisms:	Sliding, pitching, hit by batted ball; hit by pitched ball; collision with another player; other non-contact injuries.		

Incidence/Prevalence	**Risk/Protective Factors**	**Interventions**	**Implementation/Evaluation**	**Resources**
Overall 0.17/1000 AE's for youth. 4.0/1000 AE's for high school. 3.4/1000 AE's at the collegiate level. 5.78/1000 AE's at the collegiate level (games only). **Sliding** In Collegiate baseball, there are 6.01 sliding-related injuries per 1000 slides. 1 sliding-related injury per 49.8 games, representing 13% of all game injuries. (Janda et al., 1993; Dick et al., 2007; Hosey et al., 2000) **Pitching** In Youth/High School baseball, 25% of pitchers have moderate elbow pain. 30% of pitchers have moderate shoulder pain. (Lyman & Fleisig, 2005; Lyman et al., 2001; Lyman et al., 2002; Valovich McLeod et al., 2011; Grantham et al., 2013; Drew et al., 2016) Pitching accounted for 15% of all reported game injuries and usually affected the elbow and shoulder. 59.5% of injuries were associated with throwing with 73.0% of these injuries due to pitching injuries. A very high percentage of elbow	**Increasing Game Pitches** For every 10 pitches thrown in a game above 75 pitches, there was a 6% increase in the odds of elbow pain. (Lyman & Fleisig, 2005; Lyman et al., 2001, Lyman et al., 2002) **Pitch Type** For shoulder and elbow pain in youth/high school pitchers, the *curveball* was associated with a 52% (OR=1.52, p=0.04) increased risk of shoulder pain and the *slider* was associated with an 86% (OR=1.86, p=0.03) increased risk of elbow pain. (Lyman et al., 2002). There is no evidence on an increased risk of injury by pitch type in Collegiate players. (Grantham et al., 2013) Risk factors for elbow and shoulder pain were increased AGE, increased WEIGHT, decreased HEIGHT, LIFTING WEIGHTS during the season, PLAYING BASEBALL OUTSIDE THE LEAGUE, decreased SELF-SATISFACTION, arm FATIGUE during the game pitched, and throwing fewer than 300 or more than 600 pitches during the	**Breakaway Bases** Breakaway bases significantly lowered the injury rate by 80%. Rate decreased from 1 sliding injury every 49.8 games to 1 sliding injury every 243 games. (Janda et al., 1993) **Face Guards** The use of face guards while batting reduces facial and eye injuries by 28-35%. (Danis et al., 2000) **Safety Balls** The use of safety balls was associated with a reduced risk of ball-related injury (adjusted rate ratio, 0.77; 95% CI, 0.64-0.93). (Marshall et al., 2003; Lyman & Fleisig et al., 2005)	**Coaching Education** 73% of coaches reported compliance with the USA Baseball Medical and Safety Advisory Committee pitching guidelines. This suggests a need for coach education regarding pitch counts. (Fazarale et al., 2012) **Estimated Pitch Counting Tool** Pitch counts can be accurately estimated in collegiate pitchers by using summative data available from a box score. (Shanley et al., 2015)	**Websites** http://www.nationwidechildrens.org/cirp-baseball 2008 USA Baseball Medical & Safety Advisory Committee Pitching Injury Guidelines: http://web.usabaseball.com/news/article.jsp?ymd=20090813&content_id=6409508&vkey=news_usab&gid= Baseball Canada Guidelines: http://www.baseball.ca/pitchers-arm-protection-and-pitch-count SportMed BC Guidelines: https://sportmedbc.com/article/baseball-injuries MLB Guidelines for Youth and Adolescent Pitchers: http://m.mlb.com/pitchsmart/pitching-guidelines

injuries associated with throwing occurred during pitching (78.4%). (Dick et al., 2007) **Hit by a Ball/Pitch** There is a risk of facial injury in youth players at 4.1 per 100,000 player-seasons. The absolute incidence of compensated injury per 100000 player-seasons was 28.02 (95% confidence interval (CI, 26.76-29.29) for ball-related injury and 2.71 (95% CI, 2.32-3.11) for facial injury. (Marshall et al., 2003; Lyman & Fleisig et al., 2005) In Collegiate play, The injury rate from being struck by a batted-ball is 0.56 per 1000 game AE's. (Dick et al., 2007) Approximately 11% of all game injuries involved being hit by a pitch. (Dick et al., 2007) **Concussion** In Youth/High School, there is a *reported* 0.06 concussions/1000 AE's. (Pfister et al., 2015)	season. (Lyman & Fleisig, 2005; Lyman et al., 2001; Drew et al., 2016) **Position** Pitchers are 3.6 times as likely to incur an upper extremity injury compared to position players. (RR = 3.6, 95% CI = 1.4, 8.9, *P* = .003). (Shanley et al., 2011) **Time of Season** The overall rate of injury was highest for the first months of the season. (Shanley et al., 2011) **Pre-Season Range of Motion** Range of motion testing identified adolescents at high risk for injury during the season. (Shanley et al., 2015) **Shoulder Strength** Preseason weakness of external rotation and supraspinatus (SS) strength is associated with in-season throwing-related injury resulting in surgical intervention in professional baseball pitchers. (Byram et al., 2010) **Chest Protectors** The use of chest protectors did not prevent sudden deaths caused by being struck by a baseball. Approximately 40% of commotio cordis (CC) cases in sports occurred while the athlete			

	was wearing a chest protector. (Classie et al., 2010; Lyman & Fleisig et al., 2005)			
Works Cited: Dick, R., Sauers, E. L., Agel, J., Keuter, G., Marshall, S. W., McCarty, K., & McFarland, E. (2007). Descriptive epidemiology of collegiate men's baseball injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. *Journal of Athletic Training*, 42(2), 183–93. Drew, M. K., & Finch, C. F. (2016). The relationship between training load and injury, illness and soreness: a systematic and literature review. *Sports Medicine*, 46(6), 861–883. Grantham, W. J., Iyengar, J. J., Byram, I. R., & Ahmad, C. S. (2013). The curveball as a risk factor for injury. *Sports Health*, 7(1), 19–26. Hosey, R. G., & Puffer, J. C. (2000). Baseball and softball sliding injuries. Incidence and the effect of technique in collegiate baseball and softball players. *American Journal of Sports Medicine*, 28(3), 360–363. Janda, D. H., Maguire, R., Mackesy, D., Hawkins, R. J., Fowler, P., &	**Works Cited:** Byram, I. R., Bushnell, B. D., Dugger, K., Charron, K., Harrell, F. E., & Noonan, T. J. (2010). Preseason shoulder strength measurements in professional baseball pitchers. *American Journal of Sports Medicine*, 38(7), 1375–1382. Classie, J.A., Distel, L.M., Borchers, J.R. (2010). Safety baseballs and chest protectors: A systematic review on the prevention of commotio cordis. *Physician and Sportsmedicine*, 38(1): 83-89. Drew, M. K., & Finch, C. F. (2016). The relationship between training load and injury, illness and soreness: a systematic and literature review. *Sports Medicine*, 46(6), 861–883. Grantham, W. J., Iyengar, J. J., Byram, I. R., & Ahmad, C. S. (2013). The curveball as a risk factor for injury. *Sports Health*, 7(1), 19–26. Lyman, S. L., Fleisig, G. S., Waterbor, J. W., Funkhouser, E. M., Pulley, L., Andrews, J. R., …	**Works Cited:** Danis, R. P. (2000). Acceptability of baseball face guards and reduction of oculofacial injury in receptive youth league players. *Injury Prevention*, 6(3), 232–234. Janda, D. H., Maguire, R., Mackesy, D., Hawkins, R. J., Fowler, P., & Boyd, J. (1993). Sliding-associated injuries in college and professional baseball—1990-11991. *Journal of the American Medical Association*, 269(15), 1925. Lyman, S., & Fleisig, G. S. (2005). Epidemiology of Pediatric Sports Injuries. In N. Maffulli & D. J. Caine (Eds.), Epidemiology of Pediatric Sports Injuries (Vol. 49, pp. 9–30). S. Karger AG. Marshall, S. W. (2003). Evaluation of safety balls and faceguards for the prevention of injuries in youth baseball. *Journal of the American Medical Association*, 289(5), 568.	**Works Cited:** Fazarale, J.J., Magnussen, R.A., Pedroza, A.D., Kaeding, C.C. (2012). Knowledge of and compliance with pitch count recommendations: A survey of youth baseball coaches. *Sports Health*, 4(3): 202-204. Shanley, E., Kissenberth, M.J., Thigpen, C.A., Bailey, L.B., Hawkins, R.J., Michener, L.A., Tokish, J.M., Raugh, M.J. (2015). Preseason shoulder range of motion screening as a predictor of injury among youth and adolescent baseball pitchers. *Journal of Shoulder and Elbow Surgery*, 24, 1005-1013.	

Boyd, J. (1993). Sliding-associated injuries in college and professional baseball—1990-11991. *Journal of the American Medical Association*, 269(15), 1925. Lyman, S. L., Fleisig, G. S., Waterbor, J. W., Funkhouser, E. M., Pulley, L., Andrews, J. R., … Roseman, J. M. (2001). Longitudinal study of elbow and shoulder pain in youth baseball pitchers. *Medicine and Science in Sports and Exercise*, 33(11), 1803–1810. Lyman, S., Fleisig, G. S., Andrews, J. R., & Osinski, E. D. (2002). Effect of pitch yype, pitch count, and pitching mechanics on risk of elbow and shoulder pain in youth baseball pitchers. *American Journal of Sports Medicine*, 30(4), 463–468 Lyman, S., & Fleisig, G. S. (2005). Epidemiology of Pediatric Sports Injuries. In N. Maffulli & D. J. Caine (Eds.), Epidemiology of Pediatric Sports Injuries (Vol. 49, pp. 9–30). S. Karger AG. Marshall, S. W. (2003). Evaluation of safety balls and faceguards for the prevention of injuries in youth baseball. *Journal of the American Medical Association*, 289(5), 568.	Roseman, J. M. (2001). Longitudinal study of elbow and shoulder pain in youth baseball pitchers. *Medicine and Science in Sports and Exercise*, 33(11), 1803–1810. Lyman, S., Fleisig, G. S., Andrews, J. R., & Osinski, E. D. (2002). Effect of pitch yype, pitch count, and pitching mechanics on risk of elbow and shoulder pain in youth baseball pitchers. *American Journal of Sports Medicine*, 30(4), 463–468 Lyman, S., & Fleisig, G. S. (2005). Epidemiology of Pediatric Sports Injuries. In N. Maffulli & D. J. Caine (Eds.), Epidemiology of Pediatric Sports Injuries (Vol. 49, pp. 9–30). S. Karger AG. Shanley, E., Michener, L. A., Ellenbecker, T. S., & Rauh, M. J. (2011). Incidence of shoulder and elbow injuries in high school softball and baseball players. *Journal of Athletic Training*, 45(4), 648–654. Shanley, E., Kissenberth, M.J., Thigpen, C.A., Bailey, L.B., Hawkins, R.J., Michener, L.A., Tokish, J.M., Raugh, M.J. (2015). Preseason shoulder range of motion screening as a predictor of injury among youth and			

Pfister, T., Pfister, K., Hagel, B., Ghali, W. A., & Ronksley, P. E. (2015). The incidence of concussion in youth sports: a systematic review and meta-analysis. *British Journal of Sports Medicine*, 50(5), 292–297. Shanley, E., Michener, L. A., Ellenbecker, T. S., & Rauh, M. J. (2011). Incidence of shoulder and elbow injuries in high school softball and baseball players. *Journal of Athletic Training*, 45(4), 648–654. Valovich McLeod, T. C., Decoster, L. C., Loud, K. J., Micheli, L. J., Parker, J. T., Sandrey, M. A., & White, C. (2011). National athletic trainers' association position statement: Prevention of pediatric overuse injuries. *Journal of Athletic Training*, 46(2), 206–220.	adolescent baseball pitchers. *Journal of Shoulder and Elbow Surgery*, 24, 1005-1013.			

Review of Sport Injury Burden, Risk Factors and Prevention

Baseball

Incidence and Prevalence

The overall injury rate in baseball is 0.17 injuries per 1000 athletes exposures (AE's) for youth, 4.0 injuries per 1000 AE's for high school; and 3.4 injuries per 1000 AE's at the collegiate level. At the collegiate level, game only injuries are at rate of 5.78 injuries per 1000 AE's. Note that an absolute injury rate for adult recreational athletes was not available in the literature, most likely because adult participants usually play softball (Dick et al., 2007; Hosey & Puffer, 2000; Lyman & Fleisig, 2005; Shanley et al., 2011).

Various mechanisms of injury have been documented in the literature and there are incidence data available, by mechanism. These include injuries from sliding, pitching, being hit by a ball, making contact with another player, or the ground.

Sliding Injuries - Collegiate

Sliding-related injuries are common in baseball, and are by far the most preventable type of injury. Lower extremity injuries are relatively uncommon among youth baseball players. As such, there is no incidence data within the literature. However, ankle and knee injuries caused by sliding are more frequent at higher age levels (Lyman & Fleisig, 2005).

In male collegiate athletes, 1 sliding injury occurs in every 49.8 games and is responsible for 13% of all game injuries. 7.6% of all game injuries are due to contact with a fixed base. It has been reported that 345 and 247 injuries resulted from head-first and feet-first slides, respectively. The overall injury rate for sliding was 6.01 per 1000 slides. The game injury rate was greatest for feet-first slides (7.31 per 1000 slides), followed by dive-backs (5.75 per 1000 dive-backs) and head-first slides (3.53 per 1000 slides) (Dick et al., 2007; Hosey & Puffer, 2000; Janda et al., 1993).

Pitching Injuries – Youth

The incidence of elbow and shoulder injury in youth baseball has been estimated at 25–35 injuries per 100 pitchers per season (Drew & Finch, 2016; Grantham et al., 2013; Lyman & Fleisig, 2005; S. Lyman, Fleisig, Andrews, & Osinski, 2002; S. L. Lyman et al., 2001; Valovich McLeod et al., 2011). Several studies have found high rates of mild to moderate elbow (25%) and shoulder pain (30%) in youth pitchers. Approximately 25% of youth baseball players participate as pitchers (Lyman et al., 2002). An increased risk of elbow and shoulder pain is seen with increasing season pitch counts (Lyman et al., 2002). These injuries are likely a result of overuse of the affected joints. It is proposed that cumulative microtrauma through the repetitive throwing motion results in medial epicondylitis and growth plate changes in the humerus. This has been

observed in diagnostic imaging studies in youth and high-school athletes. Researchers posit that severe pitching injuries seen in high school, college, and professional pitchers are likely due to cumulative trauma that began as children (Drew & Finch, 2016; Grantham et al., 2013; Lyman & Fleisig, 2005; Lyman et al., 2002; Lyman et al., 2001; Valovich McLeod et al., 2011).

Pitching Injuries – Collegiate

Pitching accounted for 15% of all reported game injuries and usually affected the elbow and shoulder. Of shoulder and elbow injuries, 59.5% were associated with throwing and 73.0% of these injuries were due to pitching injuries. A very high percentage of elbow injuries are associated with throwing and 78.4% of them occurred during pitching (Dick et al., 2007).

Hit by a Ball – Youth / High School

There is a risk of facial injury in youth players at 4.1 per 100,000 player-seasons. The absolute incidence of injury per 100,000 player-seasons was 28.02 (95% confidence interval [CI], 26.76-29.29) for ball-related injury and 2.71 (95% CI, 2.32-3.11) for facial injury (Lyman & Fleisig, 2005; Marshall et al., 2003).

Hit by a Ball – Collegiate

Approximately 10% of all game injuries involve being hit by a batted ball. The injury rate from being struck by a batted ball is 0.56 injuries per 1000 game AE's. Third basemen (n=36/146, 24.7%) and middle infielders (n=56/313, 17.9%) have the highest percentage of injuries resulting from impact with a batted ball. Pitchers have the greatest absolute number of injuries (n=100/717, 13.9%) due to being struck by a batted ball, and this position is associated for the most severe injuries (greater than 10 days time loss) from batted balls (n=13/49, 26.5%). In an effort to reduce batted-ball speed, the NCAA implemented a rule change for the 1999-2000 season; specific bat dimensions for weight, length, and diameter for example were imposed. Lastly, approximately 11% of all game injuries involved being hit by a pitch (Dick et al., 2007). There has been research on the use of safety baseballs to reduce the impact of being hit by a pitch; however, the authors concluded that softer baseballs deformed easier and would intrude the eye socket significantly more (Marshall et al., 2003; Vinger et al., 1999).

Other Injuries

At the collegiate level, approximately 9% of all game injuries involved contact with another player. The majority (approximately 45%) of game injuries resulted from contact with something other than a competitor, such as the ground, base, ball, bat, or wall, and another 42% of game injuries were from non-contact mechanisms, such as throwing or pulling a muscle while running. These other injuries include, but are not limited to, non-contact non-throwing (19%), contact with ground (10.9%), throwing (non-pitching) (5.3%), contact with a fixed base (7.6%), contact with boundary walls, railing, or dugout (2.6%), contact with a thrown ball non-pitching

(2.4%), contact with a teammate (2.0%), and contact with breakaway bases (0.6%) (Dick et al., 2007).

For youth and high school athletes, concussions occurred at an injury rate of 0.06 injuries per 1000 AE's. Baseball is among the sports with the lowest incidence of concussion. In addition to baseball, volleyball and cheerleading have the lowest incidence of concussion (Pfister et al., 2015).

Risk and Protective Factors

Pitches Thrown - Youth

For athletes ages 9-12 years, the risk of both elbow pain (OR=1.06, 95% CI: 1.00=1.12) and shoulder pain (OR=1.15, 95% CI: 1.08–1.23) increases per every 10 game pitches (Lyman et al., 2001). Athletes throwing more than 75 pitches per game are 3.2 times more likely to experience shoulder pain (OR=3.22, 95% CI: 1.84-5.61) compared to those who throw less than 25 pitches per game (Lyman & Fleisig, 2005; Lyman et al., 2001).

Pitch Type - Youth

For athlete's ages 9-14 years old, pitch type has been shown to increase the risk of shoulder and elbow pain. The curveball pitch was associated with a 52% increased risk of shoulder pain (OR=1.52, p=0.04) and the slider pitch was associated with an 86% increased risk of elbow pain (OR=1.86, p=0.03) (Lyman et al., 2002).

Pitch Type - Collegiate

There is no evidence that throwing various pitch types, for example a curveball, increases the risk of arm injury at the collegiate level (Grantham et al., 2013).

Position - Youth

Pitchers were 3.6 times as likely to incur an upper extremity injury as position players (RR =3.6, 95% CI: 1.4 - 8.9).

Safety Baseballs - Youth

Marshall et al., (2003) found that overall, use of safety balls was associated with a reduced risk of ball-related injury (RR=0.77; 95% CI: 0.64-0.93). This reduction was essentially due using a type of safety ball known as the reduced-impact ball (RR=0.72, 95% CI: 0.57-0.91). Safety balls appeared to be more effective in the minor division (ages 7-12 years) than in the regular division (ages 9-12 years) (Lyman & Fleisig, 2005; Marshall et al., 2003).

Pre-Season Shoulder Strength – Collegiate/Professional

Pre-season weakness of external rotation and supraspinatus (SS) strength is associated with in-season throwing-related injury resulting in surgical intervention in professional baseball pitchers. Thus, preseason strength data may help identify players at risk for injury and formulate strengthening plans for prevention. A statistically significant association was observed for prone external rotation (PER) strength (p= 0.003), seated external rotation (SER) strength (p= 0.048), and supraspinatus (SS) strength (p= 0.006) with throwing-related injury requiring surgical intervention. Supraspinatus strength was also significantly associated with incidence of any shoulder injury (p= 0.031). There was an association between the ratio of PER/internal rotation strength and incidence of shoulder injury (p= 0.037) and some evidence for an association with overall incidence of throwing-related injury (p= 0.051). No associations were noted in the subgroup of players with prior surgery (Byram et al., 2010).

Other Risk Factors

Other risk factors for elbow pain include increased age, increased weight, decreased height, lifting weights during the season, playing baseball outside the league, decreased self-satisfaction, arm fatigue during the game pitched, and throwing fewer than 300 or more than 600 pitches during the season (Lyman et al., 2001). Risk factors for shoulder pain included decreased satisfaction, arm fatigue during the game pitched, throwing more than 75 pitches in a game, and throwing fewer than 300 pitches during the season (Drew & Finch, 2016; Lyman & Fleisig, 2005; Lyman et al., 2001). Time of the competitive season was also a risk factor. The overall rate of injury was highest for the first month of the season (7.96 injuries per 1000 AEs, 95% CI: 5.4-11.3), followed by the third (4.72 injuries per 1000 AEs, 95% CI: 1.3-12.0) and second (3.0 injuries per 1000 AEs, 95% CI: 1.6- 5.0) months (Shanley et al., 2011).

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

Effective Interventions

Breakaway Bases

At the collegiate level, the use of breakaway bases significantly lowered the injury rate by 80%. The rate decreased from 1 sliding injury every 49.8 games to 1 sliding injury every 243 games. In addition, the amount of time loss from sliding injuries was significantly less while using breakaway bases (Janda et al., 1993).

The Centers for Disease Control and Prevention (CDC) estimated that by changing from stationary to breakaway bases across the United States, approximately 1.7 million injuries per year are prevented and over $2.0 billion in medical care costs per year is saved. The average

costs for a set of three breakaway bases is US$290/set compared to US$180/set for standard bases (Janda et al., 1993; Janda, Bir, & Kedroske, 2001).

Other recommendations that could be considered include: allowing athletes to over-run second base; implementing training on sliding technique, and; using low profile bases; (Janda et al., 1993; Janda, Wojtys, et al., 1990; Pollack et al., 2005) however, low profile bases may not be well received due to concerns about poor visualization by umpires to call a 'safe' versus an 'out' (Janda et al., 1993; Janda, Wojtys, et al., 1990; Pollack et al., 2005).

Pitch Limits

There are no intervention studies examining the impact of a pitch-count rule change on injuries on youth or any population. In theory, pitch limits would decrease the prevalence of elbow and shoulder pain, and likely prevent cumulative trauma injuries later in life. It has been observed that youth athletes who throw a curveball or slider have higher rates of shoulder pain. However, there is no evidence that prohibiting pitch types reduces the risk of arm injury. (Drew & Finch, 2016; Grantham et al., 2013; Lyman & Fleisig, 2005; Lyman et al., 2002; Lyman et al., 2001; Valovich McLeod et al., 2011).

Face Guards

The use of face guards while batting reduces facial and eye injuries by 28-35%. In one study, the intervention team coaches reported a 28.0% lower incidence of facial impacts/injuries compared to control teams (12.3% vs 15.7%, p= 0.04). This research suggests that the use of faceguards on helmets may reduce the incidence of oculofacial injury in youth baseball by 28%. There was no reported adverse effect of face guard use on player performance (Danis et al., 2000). In another study, the use of faceguards reduced the risk of facial injury by 35% (adjusted Rate Ratio= 0.65; 95% CI: 0.43 - 0.98). Metal and plastic guards appeared to be equally effective (Lyman & Fleisig, 2005; Marshall et al., 2003).

Ball Hardness

Softer baseballs may offer some protection in younger athletes. Softer baseballs result in a lower peak orbital force, but at higher speeds, they have been cited to intrude into the orbit significantly more. Younger players would not be able to achieve ball speeds that would put them at greater risk of deformity/risk of injury. The authors' conclude that there may be benefits of using a ball that is 15-20% of MLB hardness because it may reduce the potential for brain injury, may cause less pain on impact, and may reduce sudden death caused by a ball strike. Authors recommend that this ball should be used for youth athletes 14 years and under (Vinger et al., 1999).

Implementation and Evaluation

Face Guards

Lyman et al. (2005) explains that face guards are used by nearly all younger youth baseball leagues and many older youth baseball leagues. High school players have not consistently used face shields, likely because the ability to see high velocity pitches and breaking pitches is compromised even with a clear plastic visor. The balance between safety and performance is one concern that athletes have in all sports at all levels. Given that younger players are at higher risk of injury from pitched or batted balls, this shift from face shield use to non-use represents a shift in the balance between safety and performance (Lyman & Fleisig, 2005).

References

Byram, I. R., Bushnell, B. D., Dugger, K., Charron, K., Harrell, F. E., & Noonan, T. J. (2010). Preseason shoulder strength measurements in professional baseball pitchers. *American Journal of Sports Medicine*, *38*(7), 1375–1382. https://doi.org/10.1177/0363546509360404

Classie, J.A., Distel, L.M., Borchers, J.R. (2010). Safety baseballs and chest protectors: A systematic reiew on the prevention of commotio cordis. *Physician and Sportsmedicine*, 38(1): 83-89. http://dx.doi.org/10.3810/psm.2010.04.1765

Danis, R. P. (2000). Acceptability of baseball face guards and reduction of oculofacial injury in receptive youth league players. *Injury Prevention*, *6*(3), 232–234. https://doi.org/10.1136/ip.6.3.232

Dick, R., Sauers, E. L., Agel, J., Keuter, G., Marshall, S. W., McCarty, K., & McFarland, E. (2007). Descriptive epidemiology of collegiate men's baseball injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2003-2004. *Journal of Athletic Training*, *42*(2), 183–93.

Drew, M. K., & Finch, C. F. (2016). The relationship between training load and injury, illness and soreness: a systematic and literature review. *Sports Medicine*, *46*(6), 861–883. https://doi.org/10.1007/s40279-015-0459-8

Fazarale, J.J., Magnussen, R.A., Pedroza, A.D., Kaeding, C.C. (2012). Knowledge of and compliance with pitch count recommendations: A survey of youth baseball coaches. *Sports Health*, 4(3): 202-204. https://doi.org/10.1177/1941738111435632

Grantham, W. J., Iyengar, J. J., Byram, I. R., & Ahmad, C. S. (2013). The curveball as a risk factor for injury. *Sports Health*, *7*(1), 19–26. https://doi.org/10.1177/1941738113501984

Hosey, R. G., & Puffer, J. C. (2000). Baseball and softball sliding injuries. Incidence, and the effect of technique in collegiate baseball and softball players. *American Journal of Sports Medicine*, *28*(3), 360–363. https://doi.org/10.1177/03635465000280031301

Janda, D. H., Wojtys, E. M., Hankin, F. M., Benedict, M. E., & Hensinger, R. N. (1990). A three-phase analysis of the prevention of recreational softball injuries. *American Journal of Sports Medicine*, *18*(6), 632–635. https://doi.org/10.1177/036354659001800613

Janda, D. H., Maguire, R., Mackesy, D., Hawkins, R. J., Fowler, P., & Boyd, J. (1993). Sliding-associated injuries in college and professional baseball—1990-11991. *Journal of the American Medical Association*, *269*(15), 1925.

Lyman, S. L., Fleisig, G. S., Waterbor, J. W., Funkhouser, E. M., Pulley, L., Andrews, J. R., … Roseman, J. M. (2001). Longitudinal study of elbow and shoulder pain in youth baseball pitchers. *Medicine and Science in Sports and Exercise*, *33*(11), 1803–1810. https://doi.org/10.1097/00005768-200111000-00002

Lyman, S., Fleisig, G. S., Andrews, J. R., & Osinski, E. D. (2002). Effect of pitch yype, pitch count, and pitching mechanics on risk of elbow and shoulder pain in youth baseball pitchers. *American Journal of Sports Medicine*, *30*(4), 463–468. https://doi.org/10.1177/03635465020300040201

Lyman, S., & Fleisig, G. S. (2005). Epidemiology of Pediatric Sports Injuries. In N. Maffulli & D. J. Caine (Eds.), *Epidemiology of Pediatric Sports Injuries* (Vol. 49, pp. 9–30). S. Karger AG. https://doi.org/10.1159/isbn.978-3-318-01180-7

Marshall, S. W. (2003). Evaluation of safety balls and faceguards for the prevention of injuries in youth baseball. *Journal of the American Medical Association*, *289*(5), 568. https://doi.org/10.1001/jama.289.5.568

Pfister, T., Pfister, K., Hagel, B., Ghali, W. A., & Ronksley, P. E. (2015). The incidence of concussion in youth sports: A systematic review and meta-analysis. *British Journal of Sports Medicine*, *50*(5), 292–297. https://doi.org/10.1136/bjsports-2015-094978

Pollack, K. M., Canham-Chervak, M., Gazal-Carvalho, C., Jones, B. H., & Baker, S. P. (2005). Interventions to prevent softball related injuries: a review of the literature. *Injury Prevention, 11*(5), 277–281. https://doi.org/10.1136/ip.2004.007195

Shanley, E., Michener, L. A., Ellenbecker, T. S., & Rauh, M. J. (2011). Incidence of shoulder and elbow injuries in high school softball and baseball players. *Journal of Athletic Training*, *45*(4), 648–654. https://doi.org/10.1177/0363546512457626

Shanley, E., Kissenberth, M.J., Thigpen, C.A., Bailey, L.B., Hawkins, R.J., Michener, L.A., Tokish, J.M., Raugh, M.J. (2015). Preseason shoulder range of motion screening as a predictor of injury among youth and adolescent baseball pitchers. *Journal of Shoulder and Elbow Surgery*, 24, 1005-1013. http://dx.doi.org/10.1016/j.jse.2015.03.012

Valovich McLeod, T. C., Decoster, L. C., Loud, K. J., Micheli, L. J., Parker, J. T., Sandrey, M. A., & White, C. (2011). National athletic trainers' association position statement: Prevention of pediatric overuse injuries. *Journal of Athletic Training*, *46*(2), 206–220. https://doi.org/10.4085/1062-6050-46.2.206

Vinger, P. F., Duma, S. M., & Crandall, J. (1999). Baseball hardness as a risk factor for eye injuries. *Archives Of Ophthalmology*, *117*(3), 354–358. https://doi.org/10.1016/S0278-2391(99)90888-1