MARYLAND STATE DEPARTMENT OF EDUCATION
PREPARING WORLD CLASS STUDENTS

Jack R. Smith, Ph.D.
Interim State Superintendent of Schools

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December 1, 2015

The Honorable Larry Hogan
State House
100 State Circle
Annapolis, Maryland 21401-1925

The Honorable Thomas V. Mike Miller
H-107 State House
100 State Circle
Annapolis, Maryland 21401

The Honorable Michael E. Busch
H-101 State House
100 State Circle
Annapolis, Maryland 21401

RE: Task Force Report on Sports Injuries in High School Female Athletes (MSAR #10031)

Dear Governor Hogan, President Miller, and Speaker Busch:

The attached report is submitted in accordance with *2014 HB 1332, Task Force to Study Sports Injuries in High School Female Athletes.* The Bill requires the Task Force to submit a final report on its findings and recommendations to the Governor and the General Assembly.

Should you have questions or need additional information, please contact Susan Spinnato, Director of Instructional Programs, at (410) 767-0349 or via email at susan.spinnato@maryland.gov.

Sincerely,

Jack R. Smith, Ph.D.
Interim State Superintendent of Schools

Attachment

Report of the Task Force to Study Sports Injuries in High School Female Athletes

Submitted to the Governor and Maryland General Assembly
December 2015

Task Force to Study Sports Injuries in High School Female Athletes

Membership

Tracy Layton, Chair

Rebecca Bethea

Frank P. Dawson IV

Cheryl De Pinto

Kathleen Dumais

Kayla Harris

Donna Hill-Staton

David Klossner

Dominick Lanzo

Andrew Lincoln

DeToiya McAliley

Christina Morganti

Davia Procida

Megan Rich

David M. Scrivener

Maria Trent

The Maryland State Department of Education provided staff for the Task Force.

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Background

The Task Force to Study Sports Injuries in High School Female Athletes was established during the 2014 Maryland General Assembly session (House Bill 1332-Appendix B).
From May to October 2014, Governor Martin O'Malley appointed members of the Task Force as specified in the H.B. 1332.

The Task Force consists of the following:

One member of the Senate of Maryland, appointed by the President of the Senate:

Vacant

One member of the House of Delegates, appointed by the Speaker of the House:

The Honorable Kathleen M. Dumais

One representative of the State Board of Education with experience related to high school sports programs, appointed by the chair of the State Board:

Donna Hill-Staton, Ph.D. (through January 2015)

One representative of the Department of Health and Mental Hygiene with experience related to sports injuries or adolescent health, appointed by the Secretary of Health and mental Hygiene:

Cheryl De Pinto, M.D., MPH

And the following members, appointed by the Governor:

One athletic trainer employed by a high school who is a member of the National Athletic Trainers Association:

Tracy Layton, LAT/ATC

One orthopedic physician with experience in adolescent female anterior cruciate ligament (ACL) injuries:

Dr. Dominick Lanzo

One orthopedic physician with expertise in adolescent female orthopedic ankle or shoulder injuries:

Dr. Christina Morganti

One physician with expertise in adolescent female concussion injuries:

Dr. *Frank P. Dawson IV*

One physician with expertise in adolescent female health:

Dr. Maria Trent

One epidemiologist with expertise in adolescent female sports injuries:

Dr. Andrew Lincoln

One physical therapist with expertise in treating ligamentous knee or orthopedic ankle injuries in adolescent female athletes:

Megan Rich

One female varsity member of a high school soccer, lacrosse, or basketball team who incurred an ACL injury while participating in a team sport:

Kayla Harris

One high school athletic director with experience coaching high school female athletes:

David Scrivener

One individual employed by an intercollegiate athletic department at an institution of higher education in the State:

David Klossner, Ph.D.

One coach of a high school girls' lacrosse team:

Davia Procida

One coach of a high school girls' soccer team:

Rebecca Bethea

One coach of a high school girls' basketball team:

DeToiya McAliley

The first meeting of the Task Force was held on November 20, 2014. The Task Force was divided into three committees to address the tasks outlined in the bill: Data, Rules, and Injury Prevention, (Appendix C).

The Task Force met on the following dates:

November 20, 2014

January 29, 2015

March 12, 2015

April 23, 2015

May 28, 2015

July 9, 2015 (committee chairs)

August 20, 2015

September 17, 2015 (committee chairs)

October 5, 2015

Meeting agendas and minutes are available at:
http://www.marylandpublicschools.org/fsitf/index.html

Task Force Charge

House Bill 1332 from the 2014 General Assembly Legislative session (codified in Chapter 653, Acts of 2014) outlined the Task Force membership and duties as stated below.

The Task Force shall:

(1) review recent medical research regarding the nature and risks of sports injuries incurred by high school female athletes, including concussions, ACL injuries, shoulder injuries, and orthopedic ankle injuries;

(2) report on the rate of sports injuries incurred by high school female athletes compared to high school male athletes in the State;

(3) study effective methods of reducing sports injuries incurred by high school female athletes, including implementation of preventive measures such as conditioning exercises and the use of protective equipment;

(4) establish protocols and standards for clearing a female athlete to return to play following an injury, including treatment plans for such athletes;

(5) review statutes and regulations from other states regarding high school programs designed to prevent the higher rate of injury of female athletes compared to male athletes;

(6) study whether the State Department of Education should develop statutory or regulatory requirements for high school female athletic programs for the prevention of injuries; and

(7) make recommendations regarding injury prevention, including whether high schools in the State should adopt policies that:

(i) limit the frequency and duration of practice;

(ii) restrict athletic maneuvers that endanger adolescent females, such as heading a soccer ball;

(iii) promote a warm–up program consisting of specific neuromuscular and proprioceptive training techniques, such as the Prevent Injury and Enhance Performance Program (PEP); and

(iv) require the use of additional protective equipment for female athletes.

On or before December 31, 2014, the Task Force shall submit an interim report on its findings and recommendations to the Governor and, in accordance with § 2–1246 of the State Government Article, the General Assembly.

On or before December 1, 2015, the Task Force shall submit a final report on its findings and recommendations to the Governor and, in accordance with § 10 2–1246 of the State Government Article, the General Assembly.

Executive Summary

House Bill 1332 from the 2014 General Assembly Legislative session (codified in Chapter 653, Acts of 2014) created the Task Force to Study Sports Injuries in High School Female Athletes. The bill required the Task Force to review medical research regarding the nature and risks of sports injuries incurred by high school female athletes, including concussions, Anterior Cruciate Ligament (ACL) injuries, shoulder injuries, and orthopedic ankle injuries. While a review of the Female Athlete Triad, (characterized by low energy availability, menstrual dysfunction, and low bone mineral density) was not a requirement of the bill, the task force deemed it necessary to include due to its impact on the risk of injury among female athletes.

The Committee Chair divided the Task Force, and members self-selected into three committees: Data, Rules, and Injury Prevention (Appendix C). Committees shared information with the Task Force at each meeting. This report is evidence-based recommendations regarding injury prevention for the high school female athlete based on the work of each committee.

Data

The Data Committee reviewed published data on female athlete injury incidence and concluded that female high school athletes sustain Anterior Cruciate Ligament (ACL) tears and concussions at a higher rate than males in comparable sports. Developmental, hormonal, neuromuscular and anatomical gender differences play a role in why injuries are sustained at a higher rate among females compared to males. Data specific to high school athletes in Maryland is very limited due to the lack of a statewide high school sports injury surveillance system. Currently, few Maryland high schools participate in the annual National High School

Sports-Related Injury Surveillance Study (RIO Summary Report); therefore, most of the findings of the Data Committee are based on a national sample, rather than data specific to Maryland.

Rules

The Rules Committee reviewed information related to several factors that may contribute to the risk of injury among female athletes. The Committee reported on requirements for a Maryland Public Secondary Schools Athletic Association coach in accordance with the Code of Maryland Regulations (COMAR) 13A.06.03.04.B. The committee concluded that currently there is no requirement for recertification after completing the one-credit Care and Prevention Course (Appendix E) mandated in the first year of coaching.

The Rules Committee looked at other factors that may affect the risk of injury, including the maximum number of practice hours and competitions per week. The Maryland State Board of Education sets rules for the maximum number of competitions per week and total competitions per season (COMAR 13A.06.03.03.B); however, maximum number of practice hours per day beyond the heat acclimatization period is determined by each local school system. The Committee also explored whether any other states required warm-up programs for ACL injury prevention and found no states have such requirements. Currently, various versions of these programs are being used on a voluntary basis by schools and coaches throughout the United States.

The Rules Committee also identified the benefits of having athletic trainers in middle and high schools, including a reduced risk of injury, reduced academic time lost for medical visits, and education of coaches and players on methods of injury prevention.

Protocols and standards for clearing female athletes to return to play were also reviewed. Other than requirements specific to concussions, there are currently no protocols or standards regarding an athlete's return to or removal from play after sustaining an injury. Return to play decisions are made on a case-by-case basis by the athlete's health care provider, which results in a variation of return to play standards. The Task Force feels that further research is needed to create more standardized protocols when it comes to injuries sustained by athletes.

Injury Prevention

The Injury Prevention Committee examined common injuries sustained by the female athlete: ACL injuries, concussions, and ankle and shoulder injuries as well as the health concern of the Female Athlete Triad. The Committee looked at the requirements for the initial physical exam of the female athlete, intrinsic and extrinsic risk factors, mechanisms of injury, methods for reduction of injury, and the strength evidence that warm-up programs or protective equipment effectively reduce such injuries.

The Injury Prevention Committee found the pre-participation exam should include a thorough history, emphasizing review of previous injuries and treatment, a Female Athlete Triad risk assessment questionnaire, and a more in-depth physical exam using specific tests as well as a functional assessment. The female high school athlete encounters multiple intrinsic risk factors as referred to in the data section. Extrinsic factors including field conditions, equipment, nutrition, adequacy of sleep, pre-season conditioning, and in-season coaching were reviewed. When optimized, these factors allow an athlete to arrive prepared for competition and training with lower injury risk.

Particular to the female high school athlete, wellness environments of schools, including adequate supports for physical education, access to healthy foods during the school day through the Maryland State Department of Education's School and Community Nutrition Programs, and a structured collection of health and injury surveillance data in female athletes is problematic given disproportionate development of eating disorders in female athletes. There is a paucity of data regarding how school wellness programs and the nutritional environment affect female athlete development for the prevention of injury and should be further studied.

After a review of injury mechanisms, the Task Force did not find sufficient evidence to warrant restrictions of any specific athletic maneuver, such as heading a soccer ball; however, most ACL injuries are non-contact injuries that may benefit from pre- and in-season multifaceted neuromuscular and proprioceptive training programs. The most effective programs involve balance, strength, and plyometric training under the guidance of a trained instructor, starting during the preseason and continuing at a lower level throughout the season.

The Committee also looked at the use of additional protective equipment for female athletes beyond that required by the National Federation of High Schools (NFHS) or the sports' governing bodies. There was strong evidence that in athletes with previous ankle injuries, taping or bracing is protective; however, at this time, there is insufficient evidence to require the use of additional protective equipment. The use of any sport-specific, protective equipment should be based on certified industry standards developed by such organizations as the National Operating Committee on Standards for Athletic Equipment (NOCSAE) or the American Society for Testing and Materials (ASTM) and in conjunction with an individual's physician.

In order to prevent injuries, strategies incorporating a multifaceted approach with attention to technique, training load, development of specific training techniques, equipment, nutrition, sleep, and psychosocial issues is necessary to address effectively the issue of injury prevention of female athletes. It is also necessary to incorporate education for the athlete, parent, and coach, and provide access to qualified coaches and athletic trainers.

Summary of Recommendations

The Task Force addressed the tasks required in House Bill 1332 (Appendix B) through research and discussion. Below are the recommendations of the Task Force regarding development of statutory or regulatory requirements for female high school athletes.

The Maryland State Department of Education should consider various methods, including regulations, to implement the recommendations contained in this report to promote high school female athletic programs for the prevention of injuries.

The Task Force recommends:

1. Review and provide educational materials for the female athlete, parents, and coaches dedicated to the female athlete through multiple formats and venues, including online resources. It is necessary to increase awareness and knowledge of injuries specific to the female high school athlete, including but not limited to, ACL injuries, concussions, Female Athlete Triad, ankle and shoulder injuries, as well as overuse injuries and the risks of sports specialization. The Maryland Public School Secondary Athletic Association-Sports Medicine Advisory Committee (MPSSAA-SMAC) should review and provide these materials.

2. Require coaches to take a periodic standardized renewal of the *Care and Prevention of Athletic Injuries* course to be determined by the MPSSAA in order to enhance coaches' education on health and safety. It is also recommended that the current required one-credit course be revised in order to highlight and enhance prevention of injury methods in all aspects of the course.
3. Provide access to a certified athletic trainer on site in every high school in Maryland. This would require a plan to phase in the employment of athletic trainers in all secondary schools with athletic programs.

Due to the lack of sufficient evidence, the Task Force is unable to make recommendations regarding the following:

1. High schools adopting policies that limit the frequency and duration of practices for the purpose of reducing injury.
    - The Task Force would encourage such limitations if and when the literature and best practices are more conclusive.
2. High schools adopting policies that restrict any athletic maneuvers that endanger adolescent females, such as heading a soccer ball.
    - The Task Force would encourage such restrictions if and when the literature and best practices are more conclusive.
3. High schools adopting policies that promote a warm-up program consisting of specific neuromuscular and proprioceptive training techniques, such as the Prevent Injury and Enhance Performance Program (PEP).

- However, the Task Force encourages the use of evidence-based sport-specific, warm-up programs consisting of neuromuscular, balance, plyometric and proprioceptive training techniques.

4. High schools adopting policies that require the use of additional protective equipment for female athletes.
    - The use of any sport-specific protective equipment should be based on published scientific evidence in conjunction with certified industry standards developed by such organizations as NOCSAE or ASTM and in cooperation with an individual's physician.

The Task Force recommends:

1. Further study regarding the establishment of protocols and standards for return to play after an injury, particularly for those who do not seek medical attention from a licensed healthcare provider.
2. Further study regarding the creation of a data collection/ injury surveillance system for high school interscholastic sports.
3. Further study regarding the review of the overall wellness environments of schools, and their impact on the high school female athlete, including adequate supports for physical education, access to healthy foods during the school day through Maryland State Department of Education's School and Community Nutrition Programs.

Introduction

House Bill 1332 of the 2014 Maryland Legislative Session (Chapter 653) created The Task Force to Study Sports Injuries in High School Female Athletes. The Task Force represents expertise in medicine, orthopedics, epidemiology, athletics, coaching, treatment of athletic injuries, state policy development, and legislation.

Physical activity is associated with increases in self-esteem and academic success; it improves bone health, and decreases the rate of diabetes, obesity, depression, and teen pregnancy. Decreasing female athletic injuries allows continued participation in physical activity. Unfortunately, injuries occur while playing sports.

According to the National Federation of State High School Associations (NFHS), high school athletic participation has increased yearly for the past 25 years. Almost 7.8 million high school students participate in athletics. This increase also applies to female participation, with over 3 million participants as of 2012-13. During the 2014-15 school year, 50,638 females participated in Maryland High School athletics (Dunn, 2015). But with sports participation there is an increased risk of injury.

Epidemiologic data indicates that female athletes have a higher risk of multiple injuries related to sports participation, including ACL injuries, concussions, and overuse injuries (related to the Female Athlete Triad) when compared to male athletes in gender comparable sports. This discrepancy is due to gender developmental and hormonal differences and the training techniques used.

Many habitual neuromuscular patterns and attitudes toward exercise develop prior to high school. During prior years, high school female athletes may have either little exposure to competition because of lack of interests or resources, or have had first exposures through recreation and club sports. Both extremes coupled with lack of education among athletes, parents, and coaches can expose the female athlete to unnecessary risk for injury and burnout. Finding ways to prevent injuries to female high school athletes can help eliminate the higher-risk of long-term health consequences.

Unfortunately, while exploring the research, rules, and data, the Task Force quickly learned there is a lack of data relevant to all high school sports injuries in Maryland. There is no standard method of collecting data regarding injuries sustained by athletes participating in Maryland public school interscholastic sports. In addition, while there are injury prevention programs available for coaches to implement during their teams' training, there are no rules requiring the use of such programs. In addition, the pre-participation exam (Appendix F) has very few specific questions relevant to the female athlete in order to screen for females who are at increased risk of injury.

To prevent injuries sustained by the high school female athlete, a comprehensive program should be implemented. This program would include education of the female athlete coach and the female athlete, as well as provide access to an athletic trainer in every secondary school.

Methodology

In November 2014, the Task Force met for the first time and the group was tasked with reviewing recent medical research and methods to reduce sports injuries sustained by the high school female athlete. The Task Force met approximately every six weeks and concluded its meetings on October 5, 2015.

HB 1332 required the Task Force to address seven tasks. The tasks ranged from reviewing research and finding data to creating recommendations related to injury prevention of the high school female athlete. In order to complete the tasks required of HB 1332, the Task Force was broken down into three committees: Data, Injury Prevention, and Rules. Each committee took responsibility for reviewing recent literature and sharing knowledge of the methods to reduce injuries sustained by high school female athletes.

The goal of this Task Force is to study injuries commonly sustained by the high school female athlete and methods to reduce the risk of ACL injuries, ankle and shoulder injuries, concussions, and overuse injuries related to the Female Athlete Triad. The Task Force also took into consideration the data and the current rules in Maryland athletics and surrounding states regarding how such injuries can be reduced and prevented. This report contains recommendations based upon HB 1332 and the findings from each committee with conclusive information with respect to the high school female athlete injuries (ACL injuries, concussions, ankle and shoulder injuries, and the Female Athlete Triad).

Findings

Data Committee: Chair- Dr. Andrew Lincoln

The Risk of Injury in Relation to Practice Time and Frequency of Practice

Based on the 2013-14 school year National Sample of High School Sports-Related Injuries (RIO Study) with at least 1 day of time lost, there are more injuries that occur during competition [n=790,966, 4.22 injuries per 1000 athlete-exposures, 55.4%] than during practice [n=636,349, 1.39 injuries per 1000 athlete-exposures, 44.6%] (Comstock et al., 2014).

The proportion of injuries is higher in the second hour of practice [57.5%] than the first hour [31.6%] (Comstock et al., 2014); however, this may reflect more intense physical activities (e.g., scrimmaging) and exposures for injury during the second hour than the first hour's activities (e.g., warm-up, conditioning). At this time, there is no published study with evidence to suggest that limiting the frequency and duration of practice would be an effective approach to preventing injury. A recent study, however, suggests that limiting contact in practices is an important strategy for controlling the risk of concussion to football players (Dompier et al., 2015). This approach of limiting contact in practice may also be effective to reduce the risk of concussion with other contact sports. In August 2013, the Maryland State Department of Education (MSDE) made recommendations to strengthen concussion safety by creating recommendations for practice limitations (Appendix G).

Table 1- Source: Comstock et al., 2014

Practice-Related Variables, High School Sports-Related Injury Surveillance Study, US, 2013-14 School Year*

	n	%
Time in Practice		
First ½ hour	62,417	11.1%
Second ½ hour	115,146	20.5%
1-2 hours into practice	323,234	57.5%
>2 hours into practice	61,820	11.0%
Total	**562,617**	**100%**

* Totals and n's are not always equal due to slight rounding of the weighted number of injuries and missing responses. Due to a low level of non-response, these totals are always similar but are not always equal to the total number of injuries.

Rate of Injury of the High School Female Athlete vs. the High School Male Athlete

The Task Force found a lack of Maryland-specific high school athletic injury data available for analysis. The National High School Sports-Related Injury Surveillance Study (Comstock et al., 2014) is the standard for injury surveillance among high school athletes and bases its research on high school athletic trainers reporting injury rates. The researchers gather information through Reporting Information Online software in which athletic trainers enter injury information from their high schools. In order to participate in the study, the high school is required to have a certified athletic trainer entering the data. Only 11 high schools participated in the 2013-2014 RIO study for high school injury surveillance in Maryland. Due to confidentiality, it is unknown which 11 schools participated in the study and if they are from public or private high school settings. Therefore, gathering Maryland specific data regarding injury rates was a challenge. Some high schools and local school systems collect data; however, data is not collected in a systematic manner that allows analysis to determine specific trends within the State.

National scientific studies of high school athletic injuries over the last 10 years suggest that female athletes sustain more injuries than males, especially in gender-comparable sports. In gender comparable sports, girls had a higher concussion rate [1.7 injuries per 10,000 athletic-exposures] than boys [1.0] (Marar et al., 2012). The incidence of anterior cruciate ligament (ACL) injury in young athletes is highest in cutting sports, such as soccer, basketball, and football (Joseph et al., 2013). Other studies have shown a significantly higher incidence of ACL tears in women compared to age- and sport-matched men, with a ratio of approximately 3:1 (Arendt et al., 1999). Ligamentous laxity of the ankle joint has been shown to be greater in women; talar tilt stress radiography results revealed that talar tilt in 58 athletes averaged 1.07 degrees in men and 3.20 degrees in women (Wilkerson & Mason, 2000). Researchers have noted that women sustain ankle sprains nearly twice as often as men: 13.6 sprains compared with 6.94 sprains, respectively (Doherty et al., 2014). Other studies show that girls and women have higher rates of chronic ankle instability in both high school and collegiate settings (Tanen et al., 2014). Data from a national high school epidemiologic study of athletic injuries noted gender differences in baseball/softball, basketball and soccer in 2013-14 (Comstock et al., 2015). These are consistent with earlier studies.

Table 2- Summary of female to male injury rates in high school sports.

Injury type	Authors	Female rate	Male rate	Rate ratio (95% CI)[a]	Comment
ACL injury	Joseph et al., Journal of Athletic Training. 2013	7.2 8.9[a]	6.2 2.6[a]	3.4 (2.64, 4.47)	• From 2007-2012 academic years, certified athletic trainers reported 617 ACL injuries in 9,452,180 athlete exposures [AEs] across 9 sports in 100 participating US high schools.

					• Rates calculated per 100,000 AEs • Rate ratio: higher rate in females than in males for gender-comparable sports
Concussion	Marar et al., AJSM. 2012	3.1 1.7[a]	1.6 1.0[a]	1.7 (1.4-2.0)	• From 2008-2010 academic years certified athletic trainers reported 1,936 concussions in 7,780,064 AEs across 20 sports in participating US high schools. • Rates calculated per 10,000 AEs • Rate ratio: higher rate in females than in males for gender-comparable sports
Ankle sprain	Swenson et al., Clin J Sport Med. 2013	3.14	3.11	1.25 (1.17-1.34)	• From 2005–2011 academic years, certified athletic trainers reported 5,373 ankle sprains in 17,172,376 AEs across 20 sports in participating US high schools. • Rates calculated per 10,000 AEs • Rate ratio: higher rate in females than in males for gender-comparable sports
Shoulder sprain/injury	Robinson et al., Pediatrics. 2013	0.67	2.9	NA	• From 2005-2012 academic years, certified athletic trainers reported 2,798 shoulder injuries in 13,002,321 AEs across 9 sports in participating US high schools • Rates calculated per 10,000 AEs
Overuse injuries	Schroeder et al., J Pedatr 2015	1.88	1.26	1.50 (1.39-1.61)	• From 2006-2012 academic years, certified athletic trainers reported 2,834 overuse injuries in 18,889,141 AEs across 9 sports in participating US high schools • Rates calculated per 10,000 AEs • Rate ratio: higher rate in females than in males

[a] gender-comparable sports

Table 3- Source: Comstock et al., 2014

Comparison of Boys' and Girls' Soccer Injury Rates, High School Sports-Related Injury Surveillance Study, US, 2013-14 School Year

	Boys' soccer	Girls' soccer*	RR (95% CI)†
Total	1.62	**2.47**	**1.53 (1.31, 1.78)**
Competition	3.40	**5.72**	**1.68 (1.40, 2.03)**
Practice	0.82	**1.04**	1.27 (0.97, 1.66)

Table 4- Source: Comstock et al., 2014

Comparison of Boys' and Girls' Basketball Injury Rates, High School Sports-Related Injury Surveillance Study, US, 2013-14 School Year

	Boys' basketball	Girls' basketball	RR (95% CI)*
Total	1.45	**1.88**	**1.30 (1.11, 1.51)**
Competition	2.40	**3.66**	**1.52 (1.24, 1.87)**
Practice	1.02	**1.08**	1.05 (0.83, 1.33)

Table 5- Source: Comstock et al., 2014

Comparison of Baseball and Softball Injury Rates, High School Sports-Related Injury Surveillance Study, US, 2013-14 School Year

	Baseball	Softball	RR (95% CI)
Total	**1.01**	0.99	1.02 (0.82, 1.27)
Competition	**1.68**	1.09	**1.54 (1.11, 2.16)**
Practice	0.63	**0.93**	**1.48 (1.08, 2.02)**

Why do Female Athletes Sustain More injuries than Male Athletes?

Why the High Rate of ACL Tears Among Female Athletes?

Epidemiologic studies of athletic injuries suggest that female athletes sustain more injuries than male athletes especially in gender comparable sports. In the research literature, several explanations for this increased risk were proposed. According to Kiani et al., (2010) several risk categories commonly cited individually or in combination include: (1) neuromuscular; (2) anatomic; (3) hormonal; and (4) biomechanical. Additional factors include a combination of biological findings as part of the Female Athlete Triad (i.e., low energy availability, menstrual dysfunction, and low bone mineral density) as well as statistical interpretation of data were cited among researchers.

Neuromuscular: An increased risk for anterior cruciate ligament (ACL) tears may be explained by several neuromuscular factors. Female athletes tend to activate the knee stabilizing muscles more intensely than male athletes do causing a muscle imbalance. There are also differences in the angles of the knees when the knee is moved away from the body. During jumping movements, female athletes tend to bend the knee more quickly during landing. Together, these neuromuscular differences increase the risk of ACL tears (Wolf et al., 2015).

Anatomic: The anatomy of the female knee also increases injury risk. The slope of the tibial head, the angle between the hip and the knee (Figure 1), and narrow notch between the femur and the tibia also contribute to a greater risk of ACL tears (Wolf et al., 2015).

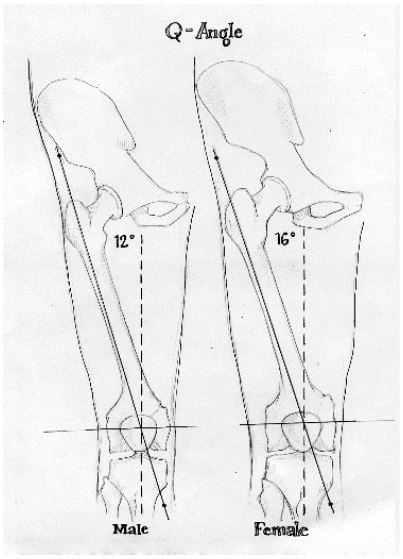

Figure 1- Anatomical Q-Angle, Male vs. Female

Hormonal: During certain phases in the female hormonal cycle, chemicals are released that increase joint laxity, or looseness, that increase the risk of both ACL injury and sprains or chronic ankle instability (Wolf et. al., 2015).

Biomechanical & Developmental: LaBella et al. (2014) suggest that during the adolescent growth spurt, the increased weight, height, and bone length contributes to an increased risk for ACL tears. Differences in the characteristics between the male and female growth spurt increase the risk of ACL tears among females. As stated by LaBella, girls do not have the same degree of growth in muscular power, strength, and coordination. This results in both neuromuscular differences and biomechanical differences in the knee. Girls have reduced neuromuscular control resulting in differences in muscle activation in the calf and thigh muscles (hamstring and quadriceps) resulting in an increased risk of ACL tears. The authors suggest that prevention using neuromuscular training prior to the growth spurt (e.g., early puberty) may reduce this risk.

The Female Athlete Triad: The Female Athlete Triad is characterized by low energy availability (with or without an eating disorder), menstrual dysfunction (typically few or absent menstrual cycles), and low bone mineral density. A study by Rauh et al. (2014) found that menstrual dysfunction (oligo/amenorrhea) and low bone mineral density were most associated with the increased risk for injury among runners. Shin and calf injuries, especially stress fractures, were most common, followed by knee, hip and foot injuries. Both bone and non-bone injuries were associated with menstrual abnormalities. Diet may play a factor in the increased risk. In addition, low bone mineral density was associated with a five to six fold increase in injury risk.

Statistical Interpretation: Joseph, et al., (2013) suggest the study designs and the specifics of the research questions may play a role in the findings of increased prevalence of sports injuries among female athletes. While females have an increased biologic risk when statistics are aggregated across all sports, females have a lower risk than male athletes. It is only when injury rates are compared between male and female athletes in gender comparable sports that excess female injuries are noted. No studies reviewed for this report suggested rules or other aspects of play decrease the risk of injury for female athletes.

Rules Committee: Chair- Dave Scrivener

The Maryland Public Secondary Schools Athletic Association has set the rules for public school athletics to which all schools must adhere within their school's athletic program. In addition to the State rules, each county athletic program may create its own additional rules. During this section of the report, the current rules pertaining to public school interscholastic athletics in Maryland will be discussed, focusing on policies and guidelines that may have an impact on injuries involving female high school athletes.

Current Education Requirements for Coaching

Currently coaches are categorized as either an MPSSAA/MSDE Certified Coach or an Emergency Coach. To be a Certified Coach, the coach must be a certified teacher in the State of Maryland and have completed a one-credit (15 hours) course called Care and Prevention of Athletic Injuries. If a Certified Coach is unavailable, an outside Emergency Coach may be hired. The Emergency Coach must also complete the Care and Prevention of Athletic Injuries course. For an emergency coach to become a MPSSAA/MSDE certified coach, he/she must complete the NFHS Level 1 Coaching Certification or MSDE approved in-service coaching education program prior to the start of his/her fourth year as an Emergency Coach (COMAR 13A.06.03.04.B). It is the responsibility of each local school system to determine if coaches complete the coaching requirements and complete the Care and Prevention course. In addition, each local school system can approach the presentation of the Care and Prevention of Athletic Injuries course according to their local process based on the outline (Appendix E) (MPSSAA Handbook 2015-16, pp. 32-33), therefore specific content may vary. It should be noted that

local school systems are allowed to create additional rules for coaches to maintain their coaching certifications.

The current Care and Prevention of Athletic Injuries outline dedicates 1 hour 30 minutes to the prevention of injuries. According to the outline, this section includes conditioning concepts, alternate training concepts, nutrition, and performance enhancing issues. Other sections of the course outline may cover injury prevention but there is no emphasis on prevention in the other sections of the course outline. There is no stated requirement on who teaches the course; however, in some local systems, this course is taught by athletic trainers. In addition, hired coaches must also be certified and be current in CPR and complete National Federation of High Schools online Concussion Awareness & Heat Acclimation courses every two years.

By MPSSAA rules, coaches are not currently required to take additional "refresher" courses after completing the Care and Prevention course. In addition, hired coaches are not required to be certified in the specific sport they are coaching. The NFHS offers many continuing education classes that are available to coaches. The courses include First Aid, Nutrition, and Strength and Conditioning courses, as well as sports specific online educational courses. In many states, for coaches to maintain a coaching certificate, they must periodically complete refresher courses in first aid, injury prevention methods, and other related topics. Renewal periods differ among states ranging from renewing every two years (Pennsylvania-effective July 1, 2016; Missouri) to every six years (Arizona), and other states require concussion awareness and/or first aid on a yearly basis. Completing these refresher courses is

essential for coaches to be current on injury prevention methods and basic treatment of injuries.

Practices and Games: Number and Frequency

There are no regulations that specify the maximum length of practice time or the number of practices. Local school systems create their policies regarding length of practice time by considering health and academic factors. Requirements for a heat acclimation period that restricts the number and length of practices are guided by the requirements set forth in Annotated Code of Maryland, Education Article Section 7-434. Each local school system is able to determine and create guidelines regarding the maximum length of practice; however, there is a rule referencing when games may begin. According to the Code of Maryland Regulations 13A.06.03 .03 A(5), "Required Practice: A member MPSSAA school may not participate in a regularly scheduled game until at least 20 calendar days have elapsed after and including the first day of practice…." Scrimmages can occur prior to this start date.

Preparedness for sports activity and participation is essential to the prevention of injuries. Although there is no practice time limit during in-season play, MPSSAA has guidelines limiting the number of out-of-season practices for all interscholastic sports (MPSSAA Handbook p. 33) and the maximum number of contests to be played per season in each sport (MPSSAA Handbook pp. 18-20).

<u>Basketball</u>:

20 regular season games or 22 with designated optional tournament

- may elect to play in a two or three-game tournament
- if they play in a three-game tournament- 19 maximum regular season games
- may play maximum of 4 games during the week of the tournament

2 games maximum per a week

- 3 games in 1 week may be scheduled twice during the season

Lacrosse:

12 regular season games or 14 with designated optional tournament

- may elect to play in a two-game tournament

2 games maximum per a week

- 3 games in 1 week may be scheduled twice during the season

Soccer:

12 regular season games or 14 with designated optional tournament

- may elect to play in a two or three-game tournament
- if they play in a three-game tournament- 11 maximum regular season games

2 games maximum per a week

- 3 games in 1 week may be scheduled twice during the season

Additional guidelines can be found on pages 18-21 of the MPSSAA handbook. It should be noted that guidelines are not separated by gender.

Policies in Other States

Based on the Committee's knowledge and research, no state has created rules or statutes specifically designed to prevent orthopedic injuries for females participating in interscholastic sports when it comes to ACL prevention, removing heading from soccer, or requiring the use of protective equipment. There are no set requirements to use injury prevention programs with high school female athletes, including but not limited to the Santa Monica Prevent injury Enhance Performance Program (PEP Program) (Appendix H) or The "11+" Program created by Fédération Internationale de Football Association (FIFA) and its Medical Assessment and Research Center (F-MARC) (Appendix I). Individual schools and coaches throughout the United States choose to integrate such programs. While there are no required ACL prevention programs, some states, including Maryland, do have laws in place regarding

concussions, heat-related injuries, and sudden cardiac death awareness. Requirements include the Concussion Awareness and Return to Play Protocol and the Heat Acclimation Protocol, which are now mandatory in the state of Maryland. Maryland also was one of the first states to create recommendations to strengthen concussion safety by setting guidelines to reduce contact during practices (Appendix G).

The Committee did find that other states require coaches to maintain a current coaching certificate or credentials through continuing education. Each state sets its own guidelines regarding coaching requirements to coach interscholastic sports. The Committee reviewed several other state school systems and athletic association requirements. The requirements of coaching vary, as well as the requirements for renewal of the coaching certificate. Effective July 1, 2016, Pennsylvania Athletic Association is requiring coaches to renew their certificate through continuing education coursework every two years, whereas coaches in other states can complete renewal by completing a Sports First Aid Course (Missouri every 2 years, Maine every 5 years). Other states have additional requirements for renewal, such as Arizona (60 clock hours of professional development and first aid every 6 years) and Iowa (5 renewal activities from an approved list every 5 years).

High School Athletic Trainer Mandates

Athletic trainers (ATs) are highly knowledgeable and trained professionals in the area of sports-related injuries. They are recognized as licensed health care providers by the Maryland Board of Physicians and practice under the supervision of a licensed physician. Athletic trainers follow the Evaluation & Treatment Protocol and must obtain their licenses and certifications every two years by completing a minimum of 50 continuing education units (hours). The

American Medical Association recognizes athletic trainers as health care providers who should be part of Athletic Medicine Unit in secondary schools, and according to the *Appropriate Medical Care for Secondary School-Age Athletes Consensus Statement* (1998), athletic trainers are included as part of the Athletic Health Care Team (Lyznicki et al., 1998). Currently there are no laws or regulations in Maryland requiring schools to employ athletic trainers in the secondary school setting.

Athletic trainers are certified allied healthcare professionals who are specifically trained to work with the physically active population, and their knowledge and skill set is based upon the BOC Role Delineation/Practice Analysis (RD/PA6). (Appendix J)

Services that ATs provide include:

- Injury/Illness Prevention and Wellness Protection: Educating participants and managing risk for safe performance and function.
- Clinical Evaluation and Diagnosis: Implementing standard evaluation techniques and formulating a clinical impression for the determination of a course of action.
- Immediate and Emergency Care: Employing standard care procedures and communicating outcomes for efficient and appropriate care of the injured.
- Treatment and Rehabilitation: Reconditioning participants for optimal performance and function.
- Organizational and Professional Health and Well-being: Understanding and adhering to approved organizational and professional practices and guidelines to ensure individual and organizational well-being.

Surprisingly, despite various lobbies and petitions, not a single state has issued a legislative mandate for high schools to employ certified athletic trainers for sporting games and practices. Approximately 70% of high schools nationwide provide their athletes with some type of access to an athletic trainer, although only 37% employ a full time AT (Pryor et al., 2015). Hawaii and Washington D.C. have full-time coverage for all high schools, despite not being mandated. Nearby states that have 90% coverage include Delaware, Virginia, and Pennsylvania (Westerman, 2014). In Maryland, only 60% of its high school athletes have access to an AT (Figure 2). According to Maryland Athletic Trainers Association data, most school systems have athletic trainers who are contracted with the school systems and employed by a clinic working part-time in both settings, while a few of the athletic trainers are full time school system teachers and work as part-time athletic trainers beyond their teaching positions.

An alarming fact is that out of the 24 systems in Maryland, some of the largest school systems (Baltimore City and Prince George's County) are the ones lacking athletic training coverage at all. Baltimore County only has athletic trainers at approximately half of the schools. Two smaller school systems (Kent and Calvert County) are also without athletic trainers.

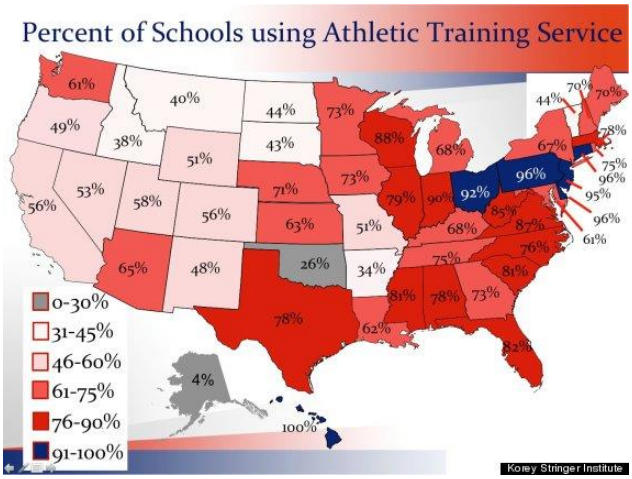

Figure 2- Source: Svokos, 2014

Professional health care authorities (Almquist et al., 2004) (Appendix K) have long recommended the employment of high school athletic trainers, and concerned parents have petitioned for them in various states (DeLench, 2014). However, every legislative motion to mandate institutions to employ them thus far has been unsuccessful. North Carolina, Arkansas and Oklahoma are the states leading the race in this advocacy (DeLench, 2014). After five sports related deaths in one school year, North Carolina athletic authorities began intensive advocacy for athletic trainer mandates for all state high schools. While they still have not obtained this mandate, in April 2015, the North Carolina State Board of Education adopted a policy that requires an athletic trainer or first responder be present at every football game and practice. Each institution is required to designate its own personnel, and will be fined for failure to comply. The goal is for high schools to employ adequate staff to provide athletes with daily medical attention and for this mandate to be extended to all sports. Cost has been the primary basis for resistance to AT mandates. There are several different models under which a school or school system can employ athletic trainers. The *Inter-Association Consensus Statement on Best Practices for Sports Medicine Management for Secondary Schools and Colleges* (Courson et al., 2014) shares several models to include employment of athletic trainers in secondary schools. In addition, the National Athletic Trainers Association (NATA) has provided documents supporting the use of athletic trainers in the secondary school setting through Secondary School Value Model (http://www.nata.org/secondary-school-value-model).

Injury Prevention Committee: Chair- Megan Rich

Anterior Cruciate Ligament Sprain/Rupture

The anterior cruciate ligament (ACL) connects the tibia to the femur within the knee joint. It prevents anterior displacement of the tibia on the femur. If the ACL is torn, the stability within the knee is compromised often causing inability to perform physical activity. Adolescent ACL injuries have increased because of an increase in single sport focus, less free play, and year round training (Frank, 2013). Female athletes have been reported to sustain non-contact ACL injuries at a rate two to eight fold greater than their male counterparts (Arendt & Dick, 1995). Female athletes are more likely to have surgery for an ACL injury and are less likely to return to the sport (Musinski, 2014). Female athletes rehabilitating from an ACL injury or post-surgical repair will be unable to participate in physical activity for an extended period. The long term effects of ACL injuries in adults aged 20-40 include an increased risk of degenerative joint disease, pain, and functional limitations from osteoarthritis (Simon et al, 2015). ACL injuries could have far reaching implications regarding the effect on a woman's overall well being.

Etiology & Intrinsic Risk Factors

Most ACL injuries (75%) are non-contact in origin (Boden et al., 2000). The following intrinsic risk factors for ACL injury include increased weight and body mass index, ligament laxity, subtalar joint pronation, previous ACL injury, and being female. Several theories and risk factors have been proposed to explain the mechanism of a non-contact ACL injury, including poor hamstring flexibility, impingement on the intercondylar notch (Uhorchak et al., 2003), quadriceps-hamstring force balance (Renstrom et al., 2008) and, more recently, axial

compressive forces on the lateral aspect of the joint (Sturnick et al., 2015; Meyer et al., 2008; Boden et al., 2000). Many explanations for the increased risk of injury to female athletes have been proposed such as significantly greater use of tensor fascia lata and rectus femoris (Wolf et al., 2015), increased knee valgus or abduction moments, increased Q-angle, a narrow intercondylar notch (Sturnick, 2015; Souryal & Freeman, 1993), increased quadriceps angle and tibial slope, generalized joint laxity (Uhorchak et al., 2003), knee recurvatum (Boden et al., 2000; Loudon et al., 1996), ACL size (Chappell et al., 2007), quadriceps strength inequality (Myer et al., 2013), less core strength and stability (Myer et al., 2013), the hormonal effects of estrogen on the ACL (Park et al., 2009 ; Chappell et al., 2007), and excessive pronation (Loudon, 1996). Anderson et al., (2001) describe quadricep strength in women being less than a man after adjustment for weight. It is significantly smaller possibly making the female's ACL more vulnerable to injury. Ultimately, it is the increased anterior shear force at the proximal end of the tibia that causes anterior translation and a potential ACL strain/rupture (Dai et al., 2014). Most of these factors cannot be altered; however, methods of assessing, increasing awareness, and managing the risk factors may help to reduce the risk of ACL injury.

Furthermore, high levels of neuromuscular control are necessary to create dynamic knee stability (Besier et al., 2001; Li et al., 1999). Neuromuscular control is defined as the unconscious efferent response to an afferent signal (feedforward or feedback) regarding dynamic joint stability. Female athletes may demonstrate one or more neuromuscular imbalances that increase lower extremity joint loads during sports activities and may increase the risk of injury to their ACL (Hewett et al., 2001; Hewett et al., 1996). These injuries occur under conditions of high dynamic loading of the knee joint and when active muscular restraints

do not adequately compensate and dampen joint loads (Beynnon & Flemming, 1998). The provocative position of initial ground contact in or close to a flatfooted position, i.e. reduced ankle plantar flexion, and increased hip flexion predispose the knee to ACL disruption by reducing the dampening capabilities of the leg and by placing the lateral tibial compartment closer to the subluxed position. Knee valgus stress may also play an important role, especially in female athletes, by potentially reducing the compression force threshold needed to produce a non-contact ACL injury (Boden et al., 2010).

Accordingly, female athletes may demonstrate one or more neuromuscular imbalances of ligament dominance, quadriceps dominance, and leg dominance. If an athlete demonstrates quadriceps dominance, he or she will have an imbalance between knee extensor and knee flexor strength, muscle recruitment, and coordination (Renstrom et al., 2008; Hewett et al., 1996). Leg dominance involves an imbalance between strength and coordination of the two lower extremities (Myer et al., 2013; Hewett et al., 2005; Hewett et al., 2001) and is an inability to control dynamic knee valgus when landing and cutting. The leg dominance occurs secondary to unbalanced neuromuscular and ligamentous control of the joint (Hewett et al., 2005). Ultimately, decreased neuromuscular control of the joint may stress the passive ligament structures, exceeding the failure strength of the ligament causing an ACL partial or full thickness tear (Li et al., 1999; Markolf et al., 1978).

Although there are many identifiable risk factors and mechanisms of injury, no conclusive evidence indicates any one single risk factor either environmental, anatomical, or hormonal directly correlates with an increase in ACL injury in the female athlete population (Griffin, 2000).

Functional Screening Tools

Functional screening tools to assess athletes and identify improper running form, poor jump mechanics, and foot pronation are necessary to increase athlete self-awareness, compliance, and effectiveness of prevention programs. There are no universally used functional screening tools to serve this purpose. The Functional Movement Screen and the Y Balance Test are functional screening tools that assess clinical impairments; however, they identify more impairments than what correlates to a greater risk of injury. Therefore, they are poor choices for identifying an athlete's functional ability (Mayer, 2015). Currently the pre-participation exam (Appendix F) is the only screening required prior to an athlete's participation in competitive school sports. During the brief screen, a physician manually assesses strength and joint range of motion; no other functional measures of risk factors are assessed. Note that the performing artist, in particular dancers, with the same risk of ACL injuries are not required to have a pre-participation physical. Objective, standardized jump-landing risk assessments can be administered quickly and easily by clinicians and should be encouraged for preseason screening of female athletes and dancers. Although significant strides have been made, continued advancements in sports injury-risk screening, including the incorporation of high-risk sports movements and maturational assessment into the screening tests, are necessary.

Extrinsic Risk Factors

Extrinsic risk factors which include weather, playing surface, and type of footwear may also put an athlete at increased risk for an ACL sprain/rupture. Scranton et al. (1997) showed higher ACL injury rates in football players in dry weather conditions. Statistics show more ACL injuries on grass and AstroTurf in hot and dry weather (Scranton et al., 1997). This could be due

to increases in the torsional resistance of cleats on AstroTurf in hot and dry weather (Torg et al., 1996). In contrast, the relative risk for ACL injury is lower with rye grass than other types of grass because rye grass has less lateral growth and lower shoe surface traction than others e.g. Bermuda, Kentucky bluegrass. Higher traffic on grass is also beneficial because grass roots and lateral growth are cut which lowers shoe-surface traction and contributes to risk of spraining or rupturing the ACL (Orchard, 2008). Planting a 'safer' grass and practicing at cooler times of the day could help reduce risks of ACL injury. Footwear is also a factor. A shoe with irregular cleats along the edge increase the risk of ACL injury (Torg, 1996). Future research is necessary to understand the real contribution of the playing surface as a risk factor as well as which cleats and shoe types are best for a particular playing surface.

Return to Play Following Injury

Once an injury is sustained, the athlete and his/her physician must decide the method of recovery. Often the surgical procedure to repair the damaged ligament is chosen. According to Eitzen et al. (2010), short-term progressive exercise therapy programs are well tolerated and should be incorporated in early-stage ACL rehabilitation, either to improve knee function before ACL reconstruction or as a first step in further non-operative management. The American Association of Orthopedic Surgery states that 98% of surgeons recommend surgery for return to play post ACL tear and 79% think ACL deficient knees are unable to return to all recreational sport. Return to sport protocols post ACL sprain/rupture depend on whether the athlete is able to rehabilitate conservatively without surgery or has surgical intervention to repair the ACL. Various surgical methods are used for ACL reconstruction, but graft choice does not have an effect on the ability to return to the sport (Brophy et al., 2012). If the athlete is

skeletally immature, methods of sparing the physeal plate (growth plate) are recommended for the surgical procedure (Frank, 2013). Although ACL reconstruction may return a female athlete to sport, the long term outcome of surgery does not prevent the increase risk of osteoarthritis from altered suboptimal kinematics (Simon et al., 2015).

Each orthopedic surgeon, in conjunction with the physical therapist or athletic trainer, recommends a specific ACL rehabilitation protocol for a reconstructed or conservatively managed ACL sprain or rupture. Successful outcome criteria include no re-injury or recurrent giveway, no joint effusion, quadriceps strength symmetry, restored activity to level and function, and return to pre-injury sports. Dunn (2015) found most patients post ACL reconstruction, show significant improvement in physical function after two years and continue to do so for at least six years.

Careful attention to return to play guidelines and physician recommendations can help decrease the chance for a second injury. Protocols incorporate a variety of neuromuscular re-education, strength, balance, and plyometric exercises as well as drills and skill training specific to the sport. Risberg et al. (2007) found neuromuscular training worked better than strength training post ACL reconstruction. The athlete is responsible for compliance with this protocol, guiding the athlete's return play within six months to one year depending on their progress and the sport. The Multicenter Orthopedic Outcome Network, (MOON) Group suggests that best rehabilitation post ACL practice includes early motion and limited open chain exercise in the first six weeks post reconstruction followed by neuromuscular reeducation and open chain exercise slowly progressed thereafter (Wright, 2015).

Physicians use a variety of measures and questionnaires to determine if an athlete is ready to return to partial, modified, full practice or competition. Measures include range of motion, strength, balance, and manual ligament tests. The International Knee Document Committee Form is a reliable means of evaluating outcome of ACL reconstruction. (Noyes & Westin, 2012) (Appendix L) Patients who returned to sport obtained significantly better scores with the Marx scale (Appendix M) and the Psychovitality Questionnaire return-to-participation questions, than those who did not (Gobbi & Francisco, 2006). Ultimately, the treating physician signs the form for an athlete to return to sport after subjective and objective assessment of the athlete. Communication with parents, coaches, and athletic trainers contributes to the decision- making process.

If the primary reason for surgery is to return to play, female patients should be made aware of the following:

- Female soccer players are less likely to return to play and are more likely to have future ACL surgery.
- Only 12% of female soccer players were still playing after 7 years.
- Other studies have shown less than 50% return from 2-7 years after surgery (Ardern et al., 2012).
- Patients who do not return to pre-injury level of sport after primary ACL reconstruction are influenced by fear, shifts in priorities, and individual personalities (Tjong et al., 2014).

- Although patients may have no knee function impairments after reconstruction, psychological factors and lifestyle changes need to be considered when discussing return to sport (Ardern et al., 2011).

Brace-wearing

There are several styles of knee braces to address the various knee injuries and instabilities sustained by the active mover. These include the prophylactic knee braces, functional knee braces and patellofemoral braces. The purpose of prophylactic bracing is used to prevent injuries such as medial collateral sprains- most commonly worn by American football lineman. The braces are not intended for daily use.

More common are the functional bracing to help stabilize the knee during rotational and anterior/posterior movements. These braces are often used by those who sustained an ACL tear and are either post-operative ACL repair, wearing the brace when returning to activity in conjunction to rehabilitation, or those who elected not to have surgery but want to continue to be active. The research on this topic is conflicting; and the ideas of requiring an athlete to wear a functional knee brace is often left to the physician and patient. Studies show that the knee brace can prevent injuries caused by low force loads (Cluett, 2015), but very little research has been done to study the effects of functional brace wearing during high impact physical activity. In conclusion, literature shows conflicting evidence supporting the use of a functional knee brace post-operative ACL repair to prevent recurring knee injuries (Logerstedt et al., 2010).

ACL Injury Prevention Programs & Neuromuscular Training Programs

Future ACL injury prevention programs could target decreasing risk factors. Multiple studies support methods of decreasing ACL sprains and ruptures by altering risk factors. The findings include improving balance (Renstrom et al., 2008), increasing reaction times (Sasaki et al., 2008), using proper toe landing, (narrowing cuts and low knee valgus during sidestep cutting (Kristianslund et al., 2012)), and preventing pronation of the foot (Canavan, 1996).

It is not feasible to eliminate any maneuvers to decrease the risk of ACL sprain/rupture as it would prevent involvement in sport. Dynamic neuromuscular analysis training provides a method to address and correct the neuromuscular imbalances that contribute to ACL injuries. Correction of neuromuscular imbalances is important for both optimal biomechanics and performance of athletic movements and reduction in female athlete ACL injuries (Myer et al, 2004).

A meta-analysis of fourteen studies reviewing the effects of participation in the neuromuscular training revealed significantly lower ACL injuries in mid-teens compared with late teens and early adults. The conclusion was that *integrative neuromuscular training programs should be optimally implemented in early adolescence* (Myer et al., 2013). A systematic review revealed that *Sportsmetrics* (www.sportsmetrics.org) and *Santa Monica Sports Medicine Foundation Prevent injury and Enhance Performance* (PEP) ACL intervention training programs (Appendix H) had a positive influence on injury reduction and athletic performance tests (Noyes & Westin, 2012). In contrast, another systematic review of the literature revealed no overall statistically significant evidence supporting neuromuscular training programs for the reduction of ACL injuries in female athletes (Stevenson et al., 2014).

The authors did not believe the current data could substantiate widespread use. However, there is moderate evidence that *multifaceted* neuromuscular programs involving preseason conditioning, including plyometrics, may reduce the risk of ACL injuries in female athletes. Based upon research, there is moderate evidence regarding the use of programs only during in season conditioning, or only used proprioception or plyometrics does not reduce the risk of injury (Stevenson et al., 2014; Pfeiffer et al., 2006). Level 1 (considered the most reliable) evidence demonstrated neuromuscular training reduced ACL injuries in female soccer and basketball participants. The program included combined progressive strengthening, plyometric, balance, and agility exercises (LaBella et al., 2011). Using verbal feedback cues to ensure proper form enhanced program effectiveness (Hewett et al., 2006), and maintaining the alignment using the cue 'knee over the toe' decreased knee valgus stress (Ebstrup & Boysen-Moller, 2000; Olsen et al., 2004). Feedback driven modification encouraging landing quietly and softly help improve technique (Hewett et al., 2006). Improving awareness and knee and ankle control during landing and pivoting movements in high school athletes can decrease knee and ankle non-contact injuries by 50% (Olsen et al., 2005).

Use of Specific Warm-Up Programs

Particular warm-up exercises have been shown to be useful in preventing ACL sprain/rupture. Female athletes must (1) learn to co-contract hamstring and quadriceps instead of being quadriceps dominant, (2) demonstrate equal leg strength, (3) land on 2 feet equally instead of with their weight to one side, (4) increase core strength and stability, (5) maintain their center of gravity over their base of support, and (6) train muscles to control range of motion, joint position, and absorb landing forces instead of relying on bones and ligaments to

stop motion (Dharamsi & LaBella, 2013). Injury prevention programs were not widely used in high schools based on 66 coaches from 15 Oregon high schools. According to Norcross et al. (2015), 21% use an injury prevention program but less than 10% were using the program as it was designed; 65% use no formal injury prevention program, but included activities similar to the program activities. Female sport coaches are more aware of programs existing compared to male sport coaches.

The *FIFA 11+* (Appendix I) program may not be any different from other warm-ups for decreasing lower extremity injury rates especially if athletes are not compliant (Steffen et al., 2008); however, a level 3 evidence study incorporating a countywide campaign to prevent soccer injuries proved the FIFA 11+ effective in reducing soccer injuries in amateur players (Junge, 2010). Adherence to the "11" does not appear to depend on injury knowledge or beliefs of coaches or players. Interestingly, coaches and players did not believe warm-up could prevent knee and ankle injury (McKay et al., 2014).

The *PEP Program* (Appendix H) showed an 88% reduction in the incidence of severe ACL injuries in a season among the female population (Mandelbaum et al., 2005). Noyes and Westin (2012) found the PEP program reduced ACL injury rate with statistical significance. Exercises included education and basic warm-up activities, stretching and strengthening techniques, plyometric activities, and soccer-specific agility drills. Another study found a non-significant trend to risk reduction in ACL injury using the PEP program particularly for those with a history of ACL injury (Gilchrest et al., 2008). The FIFA 11+ and PEP programs were designed for protecting knees for soccer and may not be functional for other sports. ACL injury prevention programs are not limited to the FIFA 11+ or PEP programs; additional programs are

continuously being developed to address neuromuscular training and warm-up programs to help reduce the risk of ACL injuries. It is important to note, programs may be more effective in the second season, suggesting that a minimum time to benefit is necessary with the program; this has been suggested as at least 4-6 weeks (Renstrom et al., 2008).

The PEP program is a lower cost method to administer injury prevention strategies with positive success as reported in the literature. In practice, successful implementation relies on coaches' training and support, and success is increased with athletic trainer involvement in promotion of the program. Balance training is also an effective treatment method, which has been associated with decreased ankle injury in Swedish national soccer players (Tropp et al., 1985). Although impaired balance and sway are associated with ankle injury, the causative relationship is not established (Arnold et al., 2009; Beynnon et al., 2002; McGuine et al., 2000).

There is a lack of strong evidence demonstrating isolated proprioception or *balance training* as effective in preventing ACL injuries particularly using a balance board (Thacker et al., 2003; Carrafa et al., 1996; Soderman et al., 2000). A trend in decreasing incidence of ACL injuries exists and balance training may be beneficial for other reasons (Owen, 2006). A systematic review and meta-analysis concluded the effectiveness of programs will improve if balance training is de-emphasized and static stretching in emphasized (Taylor et al., 2013). Although foot mechanics are part of the kinetic chain that influences lower leg alignment and function there were few programs reviewing the effect of neuromuscular training of the foot to reduce ACL injuries. The *Frapier Acceleration,* a 7 week program comprising 2 times a week of treadmill running with a 40% incline and 1 time a week of progressive plyometrics was unable to show a reduction in ACL injuries but did show a statistically lower number of lower extremity

injuries (Heidt et al., 2000). Compliance to the program may have affected outcomes. Female handball players performed various balance exercises focusing on neuromuscular control and planting/landing skills. A reduction trend in ACL injuries occurred but was not statistically significant; compliance again seemed to be an issue (Myklebust et al., 2003). Coach-led programs versus independent training had the highest compliance both pre and in season.

Evidence does support a program with multiple neuromuscular training components including plyometric training, technique training, and a biomechanics analysis (Hewett et al., 2006). Educating female athletes, parents, and coaches about the risk factors associated with ACL tears along with preventative exercise to improve motor skills, body control, and muscle activation help reduce the incidence of non-contact knee injury in female soccer players up to 90% (Kiani et al., 2010). The emphasis on education may have contributed to the high compliance rate resulting in the large decrease in incidence.

Conclusion

Continued debate is needed regarding best practice assessment, management, prevention, and research direction (Weller, 2015). Although multifaceted neuromuscular training programs trend toward reducing ACL injuries, the specific dimensions of these programs have not been identified. Educating athletes, educating those most closely involved in their training and increased compliance to training are critical in significantly lowering injury risk. Coach-led prevention programs and positive attitudes toward injury prevention correlated with high compliance and lower injury risk (Soligard et al., 2010). Research is warranted to determine the most effective timing for interventional training in young female athletes, with the goals of maximizing efficiency and precluding them from high-risk competitive seasons

(Myer et al., 2004). Improved injury surveillance systems, data collection methods, and further study on the effects of neuromuscular retraining on biomechanical performance and knee-injury incidence will help advance the ability to understand ACL injury in Maryland's female athletes.

Ankle Injuries- Lateral Ankle Sprain

Based on the current literature, the following comments are appropriate for high school female athletes and ankle injury prevention:

Mechanism & Risk of Injury

Ankle sprains are the most common injuries in sports, and comprise a greater proportion of sports injuries in female high school athletes compared to male athletes (Nelson et al., 2007). Ankle sprains account for 12-18% of all injuries (Sharpe et al., 1997). Lateral ankle sprains occur when the ankle is placed in excessive plantar flexion and inversion placing stress on the lateral ankle ligaments ultimately compromising the stability of the ankle joint and causing missed participation time in physical activity. Sports requiring rapid change of direction and close proximity to other players subject players to the highest risk of ankle injury. In general, females have a lower direct contact mechanism than males. In recreation basketball for young adults, almost half of the ankle sprains were related to the jump-landing mechanism (Nelson et al., 2007; McKay et al., 2001). Females have a 25% increased risk of a low-grade ankle sprain than males at the high school level. The risk doubles as they advance to the intercollegiate level (Hosea et al., 2000). Previous studies have not supported gender difference in overall ankle injury numbers (Beachy et. al., 1997; RIO; Nelson et al., 2007). The most

consistent predictive factor of an ankle sprain is an athlete's history of previous ankle injury (Beynnon et al., 2002; Hosea et al., 2000; Beachy et al., 1997; Tropp et al., 1985; McKay et al., 2001).

There is evidence for muscle strength differences in injured versus non-injured athletes, with greater plantar flexion and inversion strength in injured athletes. (Baumhauer et al., 1997). There is no association of increased injury rate in athletes based on general joint laxity, height, weight, or joint range of motion.

Treatment & Prevention

Ankle sprains are most common among sports requiring sudden stopping and cutting maneuvers such as soccer, basketball and lacrosse. The most common sprain, the lateral ankle sprain, is often treated with rehabilitation exercises: range of motion, stretching, strengthening, and proprioceptive exercises along with taping or bracing when able to return to activity. Research shows taping and bracing are effective in preventing ankle sprains in athletes who have suffered a previous ankle injury (McKay et al., 2001; Tropp et al., 1985; Beynnon et al., 2002). Sharpe et al. (1997) study using college female soccer players has found bracing to be more beneficial than ankle taping in prevention of ankle sprains; however, there was no significant difference between using a combination of taping and bracing versus using one method or the other. Statistics show that an athlete who sprains his/her ankle is likely to re-injure it; however, bracing and taping can prevent this from occurring. In a 2004 study, Olmsted et al. found the cost of using ankle braces is three-times less than the cost of taping daily Using lace-up ankle braces can reduce the number of incidences of ankle sprains but not the severity

of acute ankle injuries (McGuine et. al., 2000). Little research and evidence has shown bracing to prevent initial ankle sprains all together.

In conclusion, brace wearing to prevent ankle sprains on individuals who have previous history of ankle sprains is valuable when looking at injury prevention. These studies do not take in to consideration an athlete's performance and psychological factors when being braced or taped.

Cleat wearing, shoe types, and field surfaces also play a factor in the risk of ankle injury and prevention. Smaller cleat length is associated with lower risk of ankle injury in football players, but evidence is not conclusive for surface type (turf vs. grass) or shoe type (low tops vs. high tops) for prevention of ankle injury. Heel air cells in basketball shoes are associated with a four times greater increased risk of ankle injury, and high top sneakers were not found to be protective for basketball players. There is some suggestion that turf may be associated with lower ankle injury rate for high school or collegiate athletes, but a higher level for professional athletes (Beynnon et al., 2002, Taylor et al., 2013).

Conclusion

Based on the task force review of the literature and the strength of the evidence, the task force makes the following conclusions:

1. Given the high rate of ankle injury in male and female athletes, and the even higher risk in athletes with history of prior ankle injury, attention should be focused on athletes who have previous ankle sprains.

2. Bracing or taping could be beneficial for athletes with a history of ankle injury. Since the risk of injury is higher during competition compared to practice, taping or bracing could be recommended for competition in particular.
3. Balance training should be used for athletes with a history of ankle injury. This could also be recommended for athletes who have not yet suffered an ankle injury.
4. The literature is not robust enough at this time to make recommendations on footwear or surface type, mechanism specific to female high school athletes, specific return to sport protocol post ankle sprain, of practice duration or frequency, or a specific warm up program.
5. Further research is needed to assess best methods to improve balance and sway and to investigate the cause-effect relationships, assess shoe/surface interaction and injury risk, and to investigate ankle physiology and injury mechanism (in female high school athletes specifically).

Shoulder Injuries

Female high school athlete's shoulder injuries constitute 8.5% of female injuries according to the RIO data for school year 2013-14 (Comstock et al., 2014). This data can be broken down sport by sport with comparisons to the injury rate for male athletes in the same or similar sports. In boys' soccer the injury rate for shoulders is 1.7% compared to 2.4% in females. In basketball the injury rates are 2.8% versus 2.5% respectively. Baseball/softball rates are 12.8% for males and 10.5% for girls. Lacrosse shoulder injury incident rate ratios are 2.38 times higher for males than females (Hinton et al., 2005).

The mechanism of injury varies greatly sport by sport. The highest shoulder injury rate for females was in softball at 10.5% (Comstock et al., 2014). This was due most often to overuse syndromes (32.6% rate), and from throwing (6.8% rate) more often than pitching (3.8% rate). This was observed to occur in practice more than competition. Overuse was also the leading mechanism of injury in swimming and diving at 63.9% of the shoulder injury rate for this sport (Roos et al., 2015). Overall diagnoses for shoulder injuries include sprain or strain (39.6%), dislocation/separation (23.7%), contusion (11.5%) and fracture (6.6%). Mechanism of injury overall included player to player contact in 57.6%, contact with playing surface 22.8%, no contact 10% and chronic overuse 4.6%. Most injuries (72%) occurred in playing season while 24.6% occurred in preseason. Athletes were three times more likely to injure a shoulder in competition than in a practice (Bonza et al., 2009).

Prevention and Treatment

According to the current literature, there are a few methods of decreasing shoulder injuries by altering risk factors. Improving range of motion deficits in internal rotation and horizontal adduction may decrease shoulder injuries in throwers (Shanley et al., 2011). Decreasing pitch counts has been shown to decrease shoulder injuries in throwers (Olsen et al., 2006).

Although multifaceted, neuromuscular training programs incorporating alignment, stabilization of the spine, pelvis, and scapula, and rotator cuff strengthening have been utilized in an attempt to decrease shoulder injuries in throwers, the supporting evidence of an ideal program is lacking in the literature.

When individuals seek medical attention from a physician, each physician has a rehabilitation protocol to guide the athlete to return to sport. The physician will determine when the athlete is ready for practice and ultimately for competition after a shoulder injury. Return to play criteria should be individualized (Park et al., 2004). If the player was asymptomatic with all rehabilitative exercises, demonstrated symmetric and full strength, was able to perform sport-specific exercises, and had no pain or limitations, he or she would be cleared for full participation (Dickens et al., 2014).

There is no specific treatment protocol or plan for managing shoulder injuries conservatively or surgically. The treating physician will make the decisions regarding immobilization, bracing, rest, exercise, range of motion, or an accelerated rehabilitation protocol. At this time, no protective gear has been shown to be effective at reducing or preventing shoulder injuries, however, functional bracing may help prevent recurrence of anterior instability after an initial injury (Dickens et al., 2014).

Conclusion

There is no definitive answer regarding a recommended frequency of practice to decrease the risk of injury. There are established pitch limits for 15-18 year old baseball players that may be applicable to female fast pitch softball players; 90 pitches per game and only 2 games per week (Position statement for youth baseball pitchers, American Sports Medicine Institute, http://www.asmi.org/research.php?page=research&section=positionStatement, Last accessed 11/24/15). The literature does not support a specific recommended duration of practice that would decrease the risk of shoulder injuries, nor does the literature recommend limitation of specific maneuvers to decrease the risk of injury. According to the research (Olsen

et al., 2006), a particular warm up has not been shown to be useful in preventing shoulder injuries.

Head Injuries/ Concussions

According to the Center for Disease Control and Prevention a concussion is defined as "a type of traumatic brain injury—or TBI—caused by a bump, blow, or jolt to the head or by a hit to the body that causes the head and brain to move rapidly back and forth. This sudden movement can cause the brain to bounce around or twist in the skull, stretching and damaging the brain cells and creating chemical changes in the brain" (What is a concussion? Center for Disease Control website http://www.cdc.gov/headsup/basics/concussion_whatis.html). The common mechanism of injury among high school female athletes is contact to the head, and rapid change of head direction.

The Annotated Code of Maryland, Education Article, Section 7-433 requires the Maryland State Department of Education (MSDE) to develop policies and implement a program to provide concussion awareness to coaches, school personnel, students, and parents in collaboration with the Department of Health and Mental Hygiene (DHMH), local boards of education, and other experts and stakeholders. In July 2012, the Maryland State Department of convened a Traumatic Brain Injury/Sports-Related Concussion Task Force to research best practices, treatment, and prevention of concussions in school athletics.

Prevention

Researchers have attempted to find ways to decrease the risk of concussion from altering external risk factors such as looking at the use of headbands in soccer and other sports,

soft and hard helmets in female lacrosse, and decreasing or limiting the amount of heading allowed in soccer. No methods currently have strong enough evidence to require implementation of such equipment or rules (Koutores & Gregory, 2010). No protective gear has been shown effective in reducing or preventing concussions; however, this type of equipment (headbands, helmets), has been shown to reduce soft tissue injury (Benson et al., 2009).

Extrinsically, there is no evidence that reducing frequency or duration of practices would decrease the risk of concussion. Currently there are no limiting maneuvers, such as decreasing heading the ball, which would decrease the risk of concussions among the high school athlete. MSDE recommends practice limitations and emphases on proper heading techniques in soccer, positioning and checking in girls lacrosse, and body-to-body contact in basketball.

Weak cervical muscles are a possible intrinsic risk factor of sustaining a concussion in sports. By increasing the cervical muscle strength, the risk of concussions decreased (Barnes et al., 1998; Mansell et al., 2005). There is no universally accepted method to prevent concussions.

Treatment

While there is very little evidence at this time to prevent head injuries, policies and procedures have been put in place through Maryland State Laws when an athlete sustains a concussion. Current laws require athletes who sustained a susceptible concussion to be evaluated by a health care provider in order to receive diagnosis. Athletes are not allowed to return to physical activity until being seen by the appropriate health care provider. An individual who sustained a concussion should rest until asymptomatic and then begin a gradual return to play (RTP) plan (Harmon et al., 2013). After an athlete is cleared to return to activity,

she/he must follow a six step gradual return to play progression with at least 24 hours between each step and without experiencing any signs or symptoms of a concussion. The stages are as follows:

1. *No Activity, Recovery* - physical and cognitive rest
2. *Light Aerobic Exercise, Increase Heart Rate (HR)* - walk, swim, stationary bike, max 70% MHR, no resistance
3. *Sport Specific Exercise, Add Movement* - skate and run drills, no head impact
4. *Non-Contact Training Drills, Exercise, Coordination and Cognitive* L*oad* - progressive complexity, begin resistance
5. *Full Contact Practice, Restore Confidence, Assess Functional Skills* by coach staff - medical clearance for normal training activities
6. *Return to Play* - normal game play

Conclusion

In summary, concussions are caused by an acceleration-deceleration mechanism caused by head contact or rapid change in head direction. Stabilizing the head via strengthening neck muscles may be an intrinsic way to reduce the frequency of concussions. Athletes diagnosed with a concussion must be treated with physical rest until asymptomatic and only then starting a gradual return to play plan. Protective gear has not been shown to reduce injury frequency, and there have not been any changes in duration or warm up techniques that have been shown to reduce concussion frequency. The best method to decrease concussion frequency is the accurate diagnosis and prevention of returning to play before an athlete is ready.

Female Athlete Triad

Etiology

Female Athlete Triad is a medical condition experienced by physically active female athletes. Early signs of the disorder include: (Nattiv et al., 2007)

1) Low energy availability (with or without disordered eating),

2) Menstrual dysfunction, and
3) Low bone mineral density

Athletes may present with any of these symptoms and/or all three components of the disorder. Early recognition of the signs of the disorder is critical for prevention of more significant outcomes such as the development of frank eating disorders, amenorrhea, and osteoporosis.

In 2014, the Female Athlete Triad Coalition published a consensus statement on treatment and return to play of the female athlete triad in the *British Journal of Sports Medicine* that resulted from a set of recommendations developed at national and international meetings. The document is designed to provide clinical guidance for treatment by clinicians, athletic trainers, and other health care professionals and to outline a strategy for return to play. The statement recognizes the treatment and recovery process for the core components of female athlete triad occur over time with recovery of energy status being a critical aspect of short-term management productive outcomes that leads to improved menstrual function and ultimate longer-term recovery of bone mineral density. It also recognizes the comprehensive nature of the impact of the Triad on body systems including endocrine, gastrointestinal, renal, and neuropsychiatric issues. The consensus statement provides a detailed algorithm for management of primary and secondary amenorrhea, the use and interpretation of DXA scan results, and non-pharmacological, and pharmacological treatments. Furthermore, the consensus statement acknowledges the value in creating interdisciplinary treatments that include primary care/sports medicine clinicians, mental health providers, and sports dieticians and the potential consultative role of orthopedic surgeons, certified athletic trainers, family

members, and coaches to facilitate recovery in the context of an athlete-centered approach ([1]De Souza, et al., 2014).

The International Olympic Committee (IOC) has recently adopted the term Relative Energy Deficiency in Sport (RED-S). This is considered an update to the 2014 Consensus statement on the Female Athlete Triad as it has further been established that the etiology of the Triad is energy deficiency relative to energy intake and the energy expenditure required to support and maintain health including the activities of daily living and sporting activities. There was also concern that the clinical findings present on a spectrum rather than a purely defined syndrome that affects a variety of physiological functions including metabolic rate, cardiovascular function, reproductive (menstrual) function, immune function, protein synthesis, and bone health. While the Female Athlete Triad Coalition Consensus statement includes the notion of a spectrum of illness and recognizes the comprehensive impact on the athlete's body, the Triad identifies the three most significant attributes of the disorder and asserts that the interdisciplinary IOC misunderstands their approach ([2]De Souza et al., 2014). The IOC, however, concluded that the new terminology, Relative Energy Deficiency in Sport (RED-S), instead of Female Athlete Triad, might be more appropriate as it allows for inclusion of men and recreational exercisers who may also suffer the consequences of relative energy deficiency. RED-S is more comprehensive in describing symptomatology, *FAT* is an unfortunate acronym to describe the disorder, and the Triad model fails to address sufficiently the interrelatedness of all of the factors and to capture adequately individuals who do not meet all three components of the Triad (Mountjoy et al., 2015). The IOC further supports adoption of the RED-S Clinical Assessment Tool (RED-S CAT) (Figure 3) for use in evaluating athletes potentially affected by

RED-S, though there is limited data on use ([2]Mountjoy et al., 2015). Despite the ongoing debate in the medical literature, the National Collegiate Athletic Association (NCAA) has adopted the Female Athlete Triad Consensus Statement and has user-friendly materials for the public that link to the document on their website:

Part 1
http://www.ncaa.org/health-and-safety/nutrition-and-performance/2014-female-athlete-triad-consensus-statement-guidelines

Part 2
http://www.ncaa.org/health-and-safety/nutrition-and-performance/female-athlete-triad-health-consequences-low-energy

Parts 3 and 4
These parts have not yet been released on the site, but Part 3 includes the return to play guidance references in the Consensus statement.

The Triad may result in declining physical performance, competitiveness, and/or being sidelined, particularly for athletes experiencing stress fractures and/or other significant clinical morbidity, which has the potential to undermine their performance and/or safety on the field. For girls who love sport, early identification and treatment also may result in healthy, active continued play.

Treatment and Return to Play

The protocol or plan to treat FAT recommends sports medicine professionals and general health care providers should recognize, diagnose, treat, and/or refer women with any one component of the triad. The Female Athlete Triad Consensus Guidelines can be used to guide treatment ([1]De Souza, et al., 2014). The enclosed charts (Figure 3-7) are documents health providers may use to determine an athlete's return to physical activity.

Recognition & Prevention

Though calculating energy availability and expenditure can be assessed using online calculators or dietitian assessment (Energy Expenditure calculators, Female Athlete Triad Coalition Website, http://www.femaleathletetriad.org/calculators/ , Last accessed 8/20/15), relationship with food and mental health status can play a role in decreasing FAT risk intrinsically.

Extrinsically altering an athlete's training and general food environment as well as parent and coach influence can play a role in helping females who experience or are at risk of Female Athlete Triad.

The Pre-Participation Examination (PPE) form most commonly used in Maryland (Appendix F) lacks several screening questions to assess possible risk of FAT. Screening questions are needed to recognize female athletes at risk for Female Athlete Triad. A random sample of menstrual screening questions from the PPE requires further study to determine the adequacy of the form for screening and assessment for FAT. There may be a need to integrate additional screeners such as those outlined below (Table 6).

Table 6- Potential Questions Needed on Pre-Participation Physicals

Recommendations for Pre-Participation Examination Form	**Triad Consensus Panel Screening Questionnaire for PPE** ([1]De Souza et al., 2014)
1. Do you worry about your weight or body composition? Yes No 2. Do you limit or carefully control the foods that you eat? Yes No 3. Do you try to lose weight to meet weight or image/appearance requirements in your sport? Yes No 4. Does your weight affect the way you feel	1. Have you ever had a menstrual period? 2. How old were you when you had your first menstrual period? 3. When was your most recent menstrual period? 4. Are you presently taking any female hormones (estrogen, progesterone, birth control pills)?

about yourself? Yes No 5. Do you worry that you have lost control over how much you eat? Yes No 6. Do you make yourself vomit, use diuretics or laxatives after you eat? Yes No 7. Do you currently or have you ever suffered from an eating disorder? Yes No 8. Do you ever eat in secret? Yes No 9. What age was your first menstrual period? ____ 10.Do you have monthly menstrual cycles? Yes No 11.How many menstrual cycles have you had in the last year? Yes No 12.Have you ever had a stress fracture? Yes No	5. Do you worry about your weight? 6. Are you trying to or has anyone recommended that you gain/lose weight? 7. Are you on a special diet or do you avoid certain types of foods or food groups? 8. Have you ever had an eating disorder? 9. Have you ever had a stress fracture? 10. Have you ever been told you have low bone mineral density (osteopenia or osteoporosis)?

The duration of practice may be limited to improve energy balance and prevent further injury for individuals who have evidence of low bone mineral density and/or have returned to play after stress fractures.

There is no warm-up exercise to prevent Female Athlete Triad; however, the use of warm-ups to prevent general injuries is warranted.

All individuals working with girls/women, parents, and sports medicine professionals, should be educated about recognizing the symptoms and risks of Female Athlete Triad (or Relative Energy Deficiency Syndrome). Practical guidelines and resources for athletes, parents, and coaches are found on the Female Athlete Triad Coalition website:

http://www.femaleathletetriad.org

Conclusion

In order to reduce the risks related to the Female Athlete Triad, the following should be addressed:

1. The role of wellness plans and adequate food environments on high school campuses and at home to ensure prevention of adequate energy availability for female athletes.
2. Emphasize the role of coaches, parents, and health providers to promote wellness and adequate energy intake of female athletes.
    a. Coaches should refer athletes suspected of menstrual dysfunction, disordered eating, and/or low bone mineral density to a health provider for evaluation
    b. Health providers should screen for disordered eating, assess clinical status including BMI, reproductive function, and order appropriate laboratory assessments as indicated using national management standards.
    c. Parents require education and support for athletes diagnosed with the Triad to facilitate recovery and return to play using a healthy approach.
3. Female athletes in sports not defined in the document [e.g. cross-country, track/field, ballet/dance] may be particularly vulnerable to sports injuries due to low energy availability.
4. An impact assessment with a random sample of menstrual screening questions from the PPE form Maryland uses needs to be studied to determine the adequacy of the current form for screening and assess the potential need for integration of other screens outlined above.
5. Adoption of a universal strategy to facilitate return to play for female athletes with injuries (e.g. stress fractures) resulting from low energy availability (Female Athlete Triad) is necessary.

Recommendations & Rationale

The Task Force was charged with studying whether the State Department of Education should develop statutory or regulatory requirements for high school female athletic programs. Based on the findings of the Task Force, the Task Force recommends the following:

1. **Review and provide educational materials for the female athlete, parents and coaches dedicated to the female athlete through multiple formats and venues, including online resources. This will increase awareness and knowledge of injuries specific to the female high school athlete including, but not limited to, ACL injuries, concussions, Female Athlete Triad, ankle and shoulder injuries, as well as overuse injuries and risks of sports specialization. The Maryland Public Secondary School Athletic Association (MPSSAA), in collaboration with the Sports Medicine Advisory Committee should review and provide these materials.**

   Rationale:

   Gender differences between the female and male athletes can place the female at higher risk of certain injuries when competing in high school athletics. Many young female athletes, their parents, and coaches are unaware of the risks. Differences include anatomical, neuromuscular, hormonal, and developmental differences in comparison to their male counterparts. An athlete's understanding of his or her body is essential to the prevention of injury. Having an understanding of proper nutrition, social well-being, fundamental care, rest, sleep, and body awareness is paramount

information for an athlete. Proper form and training methods play a role in reducing an athlete's risk of injury and the ability to recover after sustaining an injury.

Although there are no conclusive studies on the proper "dose" of exercise, educating the female athlete about her body, times of increased vulnerability to injury, such as during "growth spurts" or at fatigue, is beneficial. Both volume and intensity of exercise should be explained and taken into consideration when educating the female athlete, as well as the risks of overtraining and focusing participation on a single sport outside of school in addition to the high school team. Participating in pre-season conditioning can reduce the risk of injury, particularly ACL tears among female athletes (*American Academy of Orthopedics, 2015)*. Knowledge of the importance of pre-season training and what exercises to include in a multi-facet neuromuscular training program can help prevent injury. It is important the information shared with the female athletes be from creditable, reliable resources. The information should also include the importance of obtaining a yearly pre-participation physical examination, preferably from their primary physician- who maintains an athlete's medical records over time to detect potential risks for injuries or illnesses such as the Female Athlete Triad. Theses physicals should be done prior to participating in a training program.

In addition, the Task Force discussed the need to provide educational opportunities for female participants in other extracurricular programs not affiliated with school athletics such as performing arts and Junior Reserve Officer Training Corps (JROTC) who may also present a risk of injury.

2. **Require coaches to take a periodic standardized renewal of the *Care and Prevention of Athletic Injuries* course to be determined by the MPSSAA in order to enhance coaches' education on health and safety. It is also recommended that the current required one-credit course be revised in order to highlight and enhance prevention of injury methods in all aspects of the course.**

   Rationale:

   Coaches work with female athletes on a daily basis. The Task Force believes in order for injuries to be prevented, a quality educational program for the coaches is essential along with the need for coaches to be educated on sports injuries. The current MPSSAA coaching requirements are very limited with no emphasis or requirements for renewing certification. If coaches are unaware of current trends and the most updated information about injury treatment and prevention, they are potentially placing the female athlete at an increased risk of injury. Not requiring coaches to be current with the latest consensus statements, first aid treatment, and training techniques can potentially place schools at risk for liability litigation.

   It is currently a local school system decision whether coaches should complete additional coursework during their coaching tenure, and most of the material is limited to the NFHS concussion awareness, CPR, and heat acclimatization courses. Many other state high school athletic associations have requirements regarding maintaining coaching certificates and requiring continuing education classes. Without coaches being current on first aid care, care of injury and training techniques, schools are at risk of liability. Coaches' education and re-certification should be based upon current

information and data and continuously revised to reflect consensus statements and guidelines from established sports medicine organizations. These statements are regularly released, and it is important that coaches are aware of the updated information and new information on common and catastrophic injuries related to sports and first aid treatments. Before creating courses and guidelines, consultation should be made with the MPSSAA Sports Medicine Advisory Committee (SMAC).

The course outline should be revised to include more in-depth preventative methods within the entire course, to include: multi-facet neuromuscular training ideas and pre-season conditioning for ACL prevention, and concussion prevention techniques through emphasis of specific sport-related skills and drills utilizing proper techniques, and knowledge of protective equipment and braces.

3. **Provide access to a certified athletic trainer on site in every high school in Maryland. This would require a plan to phase in the employment of athletic trainers in all secondary schools with athletics programs.**

Rationale:

The AMA (American Medical Association) recognizes certified athletic trainers as healthcare professionals who should be part of the Athletic Medicine Unit established in every school that has a sports program within the Board of Education and the Department of Health (AMA Policy H-470.99S, July 1998). Currently there are no laws in Maryland requiring schools to employ athletic trainers in the secondary school setting. Athletic trainers are healthcare professionals who are specifically trained to work with

physically active population, and their knowledge and skill set is based upon the BOC Role Delineation/Practice Analysis (RD/PA6). (Appendix J) In Maryland, athletic trainers are recognized licensed allied healthcare professionals who are under the supervision of a licensed physician and follow the guidelines of an Evaluation & Treatment Protocol.

Athletic trainers in the secondary school setting possess a unique skill set, which is used to monitor the safety and care of all student athletes. They are present after school hours (during which time school nurses are unavailable to students) while sports teams are practicing and participating in competition. In cases where schools do not have athletic trainers, the initial first aid and treatment of injuries sustained by an athlete is conducted by a coach who has limited knowledge of athletic injuries, treatment, and prevention. Schools that rely on coaches, administrators, and volunteers to provide treatment to the injured athlete put the safety of the student-athlete at risk, as well as the school and employee at risk of litigation.

In an article written by LaBella et al., 2014 and restated in an inter-association consensus statement, "Secondary schools with proper medical teams that include an athletic trainer have seen a lower incidence of injuries both acute and recurring than schools without athletic trainers. These schools also see more diagnosed concussions, demonstrating better identification of athletes with a concussion" (Courson et al., 2014). Athletic trainers are advocates for the student athlete when it comes to injury prevention and treatment and have the ability to be the link between parents and other healthcare providers. Athletic trainers are also trained in the recognition of concussions and can work with the concussed athlete to complete the gradual return to play

protocol. In collaboration with the supervising physician, a school that has an athletic trainer can ensure this process is being followed correctly in accordance with the laws.

It is valuable for high school athletes to have access to athletic trainers on a daily basis. Approximately 60% of Maryland high schools have access to an athletic trainer in their school. Two of the larger school systems-(Prince George's County and Baltimore City) have no athletic trainers in their schools and Baltimore County has athletic trainers in only half of their schools. Athletic trainers can be valuable to the health care of all student athletes, but particularly athletes in areas with socioeconomic barriers to health care. As of 2014 the NFL Foundation, Professional Football Athletic Training Association, and Gatorade has created grants available for schools to place athletic trainers in the high school setting. There are promising examples in surrounding areas that have athletic trainers in all schools. Washington, D.C. Public Schools have athletic trainers in 100% of their schools and Fairfax County in Virginia has had athletic trainers as full-time employees in the school systems for over 25 years.

Currently there is no surveillance system for tracking injuries sustained while playing interscholastic sports in Maryland. Athletic trainers can assist in recording such injuries. This data may inform Maryland policy regarding athletics; athletic trainers can be valuable in future efforts related to data collection on athletic injuries.

Athletic trainers have the ability to educate coaches, athletes, and parents about prevention, recognition, and treatment methods of commonly seen injuries and illnesses. Currently many, but not all, Maryland school systems' Care & Prevention courses are taught by ATs. In addition to treating the athlete, athletic trainers are

trained to work with the physically active population. In the future, participants in other physically active school activities such as performing arts and JROTC should also have access to the same health care services opportunities as female athletes.

The Task Force was charged with making recommendations regarding injury prevention, including whether high schools in the State should adopt the following policies. *Due to the lack of sufficient evidence, the Task Force is unable to make recommendations regarding the following:*

1. **High schools adopting policies that limit the frequency and duration of practices for the purpose of reducing injury.**

   Rationale:

   Although statistics show injury rates increase the second hour of practice and during competition, there is no evidence that reducing the duration of practice time will reduce the rate of injury. In fact, restricting the frequency and duration of practice time may cut down on warm-up time and other injury prevention strategies.

   Currently Maryland has a heat acclimatization policy limiting the length and number of practices daily as well as the equipment permitted to be worn during the practices for fall season athletes. This policy is also taken into consideration during the winter and spring season.

2. **High schools adopting policies that restrict any athletic maneuvers that endanger adolescent females, such as heading a soccer ball**

Rationale:

Rather than restrict athletic maneuvers, the Task Force agreed that additional education of coaches is more critical. Coaches need to have a knowledgeable understanding of how injuries can occur and how to implement techniques and methods that lower the risk of injury.

At this time, there is insufficient information and evidence to recommend policy-restricting athletic maneuvers thought to endanger the adolescent high school female. According to Comstock, et al., 2015 there are more effective methods to prevent concussions than banning heading from the sport of soccer. In August 2013, Maryland released information regarding recommendations to strengthen concussion safety by limiting the number of contact practices in collision sports (Appendix G). Soccer, basketball, field hockey, and girls' lacrosse are classified as contact sports where contact is incidental and cannot be totally avoided while playing. Coaches should be teaching specific sports-related skills to help reduce the risk of contact.

3. **High schools adopting policies that promote a warm-up program consisting of *specific* neuromuscular and proprioceptive training techniques, such as the Prevent Injury and enhance Performance Program (PEP)**

Rationale:

There is no evidence stating one specific ACL injury prevention program (such as the Santa Monica Performance Enhancement Program or FIFA 11+) (Appendix H, Appendix I) is better than another. In order for programs to be effective, coaches need

to be taught proper body form and what to look for if they are using these programs with their athletes. The Task Force reviewed research supporting the incorporation of a validated *multi-facet neuromuscular program* that considers the athletes' age, sport and gender (American Academy of Orthopedics, 2015). Often, if coaches are taught such programs, they will utilize them in their practices; it should be advised that it is important that athletes receive feedback on their performance. Therefore, the Task Force supports the implementation of multi-facet neuromuscular training programs in order to reduce the risk of injury, but does not support a specific program to be used.

4. **High schools adopting policies that require the use of additional protective equipment for female athletes.**

Rationale:

MPSSAA allows protective equipment permitted by the NFHS or the sport's governing body, and the individual athlete and his/her health care provider

Protective Equipment for the Head-

Based on current research and the lack of effectiveness of protective head equipment among female athletes to reduce the risk of concussions, MSDE should not require the use of protective equipment such as helmets in girls lacrosse or headbands in soccer. This equipment can help protect the external surface but there is no strong evidence stating the reduction in the risk of head injury. According to the NFHS SMAC Position Statement (Appendix O) on *Soft or Padded Headgear in Non-Helmeted Sports,*

"The NFHS does not consider soft or padded headgear products as effective equipment in preventing a concussion in non-helmeted sports."

The use of such equipment should be optional and determined by the individual athlete and his or her health care provider. Individuals who choose to wear such protective equipment shall be permitted to do so after consulting with their physician and with no penalty during competition.

Ankle Braces-

Evidence shows ankle braces can help reduce the risk of re-injury after sustaining the initial lateral ankle sprain. The female athlete who has sustained previous ankle injuries should be encouraged to wear an ankle brace or be taped to limit the risk of re-injury; however, there should be no requirement for athletes to wear ankle braces or have their ankles taped. As stated above, this requirement should be left to the individual athlete and her health care provider.

Knee Braces-

Research regarding the use of functional knee braces to prevent ACL injury or re-injury is conflicting. Some studies show benefit during low-force loads. The Task Force was unable to identify research assessing the benefit of wearing braces to prevent injury during high impact physical activity. Once again, wearing a knee brace should be left to the individual athlete and her licensed health care provider.

The Task Force recommends further study is needed:

1. **Regarding the establishment of protocols and standards for return to play after an injury, particularly for those who do not seek medical attention.**

Rationale:

There is no current triage system in place to determine an athlete's playing status, especially in schools without athletic trainers. If an athlete seeks care from a physician, a protocol to return to play is established by the attending physician. While athletes who lack a source of care may seek community services through already established school health services' referral processes, access and equity were concerns of the Task Force. Furthermore, there are no standards on when athletes must seek medical attention after being injured in high school athletics. Schools or coaches may set their own guidelines, but they are often unclear among the coaches as well as the athletes. In schools where athletic training services are provided to student athletes; the athletic trainer will assess and determine the athlete's playing status or refer him/her to a physician for additional assessments and treatment. In situations where an athletic trainer is not present, it is often the responsibility of the coach, athlete, and parent to determine if an athlete is able to continue to play or should seek additional medical attention. This may result in an athletes return to play too soon or continue playing while injured and not receive proper care.

Policy regarding removing athletes from play and permitting return to play after a concussion is in accordance with the Annotated Code of Maryland, Education Article, Section 7-433. The Maryland State Department of Education (MSDE), in collaboration

with a group of experts and the Maryland Public Secondary School Athletic Association developed policies and recommendations regarding concussion management. The Maryland Concussion Task Force has set policy through the Code of Maryland Regulation (COMAR) 13A.08.06, which requires coaches and athletes to be educated on concussion awareness as well as for athletes who sustain potential injury to be assessed by proper health care providers trained in concussion assessment and management. Upon being cleared by a health care provider, athletes must complete a gradual return to play protocol before participating in competition. No other protocols or standards have been set for clearing a female athlete to return to play following injury.

2. **Regarding the creation of a data collection/ injury surveillance system for high school interscholastic sports in order to collect data on sports injuries sustained during high school sports.**

   Rationale:

   The Task Force was given the task of reporting the rate of sports injuries incurred by high school female athletes compared to male athletes in the State. The Task Force was unable to report data specific to Maryland athletics due to the lack of injury surveillance and no uniform data collection within the state. Local school systems may collect their own data, however no local data was strong enough to make conclusions to compare male vs. female high school athlete injury rates.

   The Data Committee used data from the National High School Sports-Related Injury Surveillance Study (RIO Summary). The RIO Summary is an accurate injury

reporting method, in which athletic trainers in high schools enter data about injuries sustained by athletes who attend the school where the athletic trainer works. Dawn Comstock, Ph.D, Associate Professor, University of Colorado, leads the RIO Summary project. According to Dr. Comstock, (email communication, Thursday December 04, 2014), only 11 Maryland High Schools participated in the 2013-2014 study. She was unable to state whether the schools were public or private. Participation in the National High School Sports-Related Injury Surveillance Study by more Maryland athletic trainers participating or Maryland creating a statewide injury surveillance/ data collection system, may yield more accurate data relevant to Maryland high school athletic injuries.

3. **To review the overall wellness environments of schools, and its impact on the high school female athlete, including adequate supports for physical education, access to healthy foods during the school day through Maryland school nutrition programs, and a structured collection of health and injury surveillance data on female athletes.**

Rationale:

Disorders of relative energy deficiency (e.g. female athlete triad) are disproportionately seen in adolescent girls and emerging adult women. The irregular menstrual cycles, reduced bone density, and the disordered eating observed in affected female athletes are symptoms to be recognized given the association with observed adverse health outcomes (e.g. stress fractures). There is data that suggests that the general wellness and nutritional environments through which female athletes develop may influence athletic performance, risk for injury, and return to play after an

injury. Since youth are often not in control of their food resources and many rely on the Maryland school nutrition program for up to two meals per school day, additional research on food environments in the context of female athlete health are warranted. Further study is also needed to evaluate the impact of wellness promotion programs and behaviors by school-based athletic professionals (e.g. coaches, athletic trainers, and physical education teachers) for prevention of disorders of relative energy deficiency and associated sequelae in association with athletic participation.

While this report directly responds to the issues raised by the legislature, there were several issues for which the task force was unable to provide recommendations due to a paucity of available data. In order to develop evidence-based recommendations for health promotion, prevention of injury, and successful return to play after injury for female high school athletes in the state of Maryland, structured collection of general health, injury, and outcomes surveillance data is warranted.

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Appendix

Appendix A

Report Glossary

Appendix A: Glossary

Accelerated rehabilitation protocol: typically refers to recovery from ACL surgery in which the rehabilitation encourages earlier motion and strengthening than in traditional protocols. Results from ACL surgery were felt to have improved after initiating accelerated rehab.

ACL: abbreviation for anterior cruciate ligament

Adduction moments: this refers to forces on the knee that tend to valgus deforming forces

Afferent signal: the message that the sensory nerve sends to the brain that triggers the brain to send and efferent response.

Amenorrhea: cessation of menstruation in premenopausal females

Anorexia: an eating disorder characterized by obsessive desire to lose weight and refusal to eat.

Anterior: nearer to the front of the body

Anterior translation of the tibia: when the tibia moves forward relative to the thigh. This is prevented by the ACL if it is intact.

Anterior cruciate ligament: one of two ligaments in the center of the knee that cross, responsible for preventing excess forward movement of the tibia on the femur.

Athlete: an individual participating in inter-scholastic sports

Body mass index: a ratio calculated related to height and weight, also known as BMI

Chronic ankle instability: instability that persists after an acute ankle injury has healed; this could manifest as recurrent ankle sprains, pain, or swelling and lead to permanent irreversible damage.

Concussion: a head injury with temporary loss of brain function, with or without loss of consciousness, which can cause cognitive, physical, and emotional symptoms.

Efferent response: the signal that the nerve sends to the muscle to make it fire.

Dynamic knee valgus: the knee valgus angle when moving, separate from the anatomic knee valgus angle measured at rest.

Female athlete triad: a syndrome described in female athletes consisting of some combination of disordered eating (such as anorexia), amenorrhea or oligomenorrhea, and osteoporosis.

Femur: thigh bone

Functional knee bracing: this generally refers to a brace used in ACL or PCL injured patients that helps prevent rotational forces that stress the ACL or PCL, while allowing the knee to move through a functional range of motion.

Higher Valgus Angle: more "knock-knee'd". Higher valgus angles are felt to be correlated to more chance of knee injury.

Intercondylar notch: the opening in the end of the femur that houses the ACL and PCL. A narrow intercondylar notch has been called a gothic type notch and is thought to predispose to inadequate space for the ACL and possible increased chance of rupture. A wider notch has been referred to as a roman type arch.

Knee recurvatum: knee angle that is relatively hyper extended

Leg dominance: when one leg is stronger or is used preferentially or habitually over the other. This is felt to perhaps risk injury to the weaker leg.

Ligament: structure made up of collagen that connects two bones

Low bone mineral density: lower than normal score on a bone density test (DEXA). In high school athletes, this would be a low "Z score".

Low energy availability: In the context of female athletes, this is the state of imbalance of energy related to either inadequate intake of food or increased energy expenditure related to increased exercise, or some combination of the two. This has been suggested as a more accurate term to describe the syndrome of the Female athlete triad.

Lower flexion angle: this refers to an athlete landing after jumping with stiffer, straighter knees, which could indicate higher chance of injury

Manual ligament tests: hand on testing of joints done by health care providers to assess ligament integrity.

Menstrual dysfunction: In this context , this refers to either oligomenorrhea or amenorrhea in pre menopausal females.

MPSSAA: Maryland public secondary school athletic association

Multi-faceted neuromuscular training programs: a term to describe conditioning programs that include strength, power, balance, coordination and technique training.

Neuromuscular patterns: the coordination of muscle group activation for activities. Often referred to in regards to training proper landing techniques after jumping in ACL prevention strategies or in throwing mechanics, for example.

NFHS: National federation of state high school associations

Noncontact injury: this often refers to ACL tears that are sustained without collided with another player. Often this occurs with a particular position of the foot related to the knee

Notch: the intercondylar notch.

Plyometric exercises: exercises that emphasize training power and neuromuscular coordination, for example jumping and bounding exercises.

Prophylactic bracing: using a joint brace in a healthy athlete who has not yet been injured in an attempt to prevent an injury.

Oligomenorrhea: decreased amount or frequency of menstruation in premenopausal females

Overuse injury: any injury thought to be caused by excessive volume and/or intensity of training for any particular injury at their current level of fitness.

Patellofemoral braces: braces that stabilize the patella

Pre –participation physical: a history and physical exam by a medical professional that is typically required in high school athletes prior to starting an athletic season.

Plyometric exercises: generally jumping exercises that train power for muscles

Q angle: the angle that the front of the thigh makes with the direction of the patella tendon. This is different from the valgus angle, but they are often both increased in female athletes.

Quadriceps dominance: when the quadriceps fires stronger, earlier, or longer than the hamstrings or gluteal muscles. This is thought to potentially displace the tibia anteriorly and stress the ACL.

Quadriceps muscle: the muscle in the front of the thigh responsible for extending the knee.

Rectus femoris: one of the four muscles that makes up the quadriceps muscle.

Sprain: injury to a ligament. Lowest grade sprains could indicate microscopic injury, high grade sprains could indicate complete tear, and intermediate grade sprains could indicate partial tear or stretch

Strain: injury to a muscle or tendon

Subluxed position: partially dislocated

Talar tilt angle: the angle that he talus makes with the end of the tibia in the ankle joint. Higher talar tilt angles could indicate laxity in the lateral side of the ankle and increased susceptibility to sprain.

Talar tilt stress radiography: a radiograph (xray) taken with pressure applied to the lateral side of ankle. More laxity in the lateral side of the ankle would show up as increased talar tilt angle.

Tensor fascia lata: the muscle on the side of the hip

Tibia: leg bone

Valgus of the knee: this refers to the knee position "knocked knee"

Appendix B

Maryland

House Bill 1332

Appendix B: House Bill 1332

Chapter 653

(House Bill 1332)

AN ACT concerning

Task Force to Study Sports Injuries in High School Female Athletes

FOR the purpose of establishing the Task Force to Study Sports Injuries in High School Female Athletes; providing for the composition, chair, and staffing of the Task Force; prohibiting a member of the Task Force from receiving certain compensation, but authorizing the reimbursement of certain expenses; requiring the Task Force to study and make recommendations regarding certain matters; requiring the Task Force to submit certain reports on its findings and recommendations to the Governor and the General Assembly on or before certain dates; providing for the termination of this Act; and generally relating to the Task Force to Study Sports Injuries in High School Female Athletes.

SECTION 1. BE IT ENACTED BY THE GENERAL ASSEMBLY OF MARYLAND, That:

(a) There is a Task Force to Study Sports Injuries in High School Female Athletes.

(b) The Task Force consists of the following members:

(1) one member of the Senate of Maryland, appointed by the President of the Senate;

(2) one member of the House of Delegates, appointed by the Speaker of the House;

(3) one representative of the State Board of Education with experience related to high school sports programs, appointed by the chair of the State Board;

(4) one representative of the Department of Health and Mental Hygiene with experience related to sports injuries or adolescent health, appointed by the Secretary of Health and Mental Hygiene; and

(5) the following members, appointed by the Governor:

(i) one athletic trainer employed by a high school who is a member of the National Athletic Trainers Association;

(ii) one orthopedic physician with experience in adolescent female anterior cruciate ligament (ACL) injuries;

(iii) one orthopedic physician with expertise in adolescent female orthopedic ankle or shoulder injuries;

(iv) one physician with expertise in adolescent female concussion injuries;

(v) one pediatrician with expertise in adolescent female health;

(vi) one epidemiologist with expertise in adolescent female sports injuries;

~~(vi)~~ (vii) one physical therapist with expertise in treating ligamentous knee and orthopedic ankle injuries in adolescent female athletes;

~~(vii)~~ (viii) one female varsity member of a high school soccer, lacrosse, or basketball team who incurred an ACL injury while participating in a team sport;

~~(viii)~~ (ix) one high school athletic director with experience coaching high school female athletes;

(x) one individual employed by an intercollegiate athletic department at an institution of higher education in the State;

~~(ix)~~ (xi) one coach of a high school girls' lacrosse team;

~~(x)~~ (xii) one coach of a high school girls' soccer team; and

~~(xi)~~ (xiii) one coach of a high school girls' basketball team.

(c) The Governor shall designate the chair of the Task Force.

(d) The State Department of Education shall provide staff for the Task Force.

(e) A member of the Task Force:

(1) may not receive compensation as a member of the Task Force; but

(2) is entitled to reimbursement for expenses under the Standard State Travel Regulations, as provided in the State budget.

(f) The Task Force shall:

(1) review recent medical research regarding the nature and risks of sports injuries incurred by high school female athletes, including concussions, ACL injuries, shoulder injuries, and orthopedic ankle injuries;

(2) report on the rate of sports injuries incurred by high school female athletes compared to high school male athletes in the State;

(3) study effective methods of reducing sports injuries incurred by high school female athletes, including implementation of preventive measures such as conditioning exercises and the use of protective equipment;

(4) establish protocols and standards for clearing a female athlete to return to play following an injury, including treatment plans for such athletes;

(5) review statutes and regulations from other states regarding high school programs designed to prevent the higher rate of injury of female athletes compared to male athletes;

(6) study whether the State Department of Education should develop statutory or regulatory requirements for high school female athletic programs for the prevention of injuries; and

(7) make recommendations regarding injury prevention, including whether high schools in the State should adopt policies that:

(i) limit the frequency and duration of practice;

(ii) restrict athletic maneuvers that endanger adolescent females, such as heading a soccer ball;

(iii) promote a warm–up program consisting of specific neuromuscular and proprioceptive training techniques, such as the Prevent Injury and Enhance Performance Program (PEP); and

(iv) require the use of additional protective equipment for female athletes.

(g) (1) On or before December 31, 2014, the Task Force shall submit an interim report on its findings and recommendations to the Governor and, in accordance with § 2–1246 of the State Government Article, the General Assembly.

(2) On or before December 1, 2015, the Task Force shall submit a final report on its findings and recommendations to the Governor and, in accordance with § 2–1246 of the State Government Article, the General Assembly.

SECTION 2. AND BE IT FURTHER ENACTED, That this Act shall take effect July 1, 2014. It shall remain effective for a period of 1 year and 6 months and, at the end of December 31, 2015, with no further action required by the General Assembly, this Act shall be abrogated and of no further force and effect.

Approved by the Governor, May 15, 2014.

Appendix C

Committee Lists

Appendix C: Committee List

Task Force Chair

Tracy Layton MS, LAT, ATC, CES

Data Committee

Dr. Andrew Lincoln, Committee Chair

Dr. Cheryl De Pinto

David Klossner, Ph.D

Rules Committee

David M. Scrivener, Committee Chair

Rebecca Bethea

The Honorable Kathleen M. Dumais

Donna Hill-Staton, Ph.D

Injury Prevention

Megan Rich, Committee Chair

Dr. Frank P. Dawson IV

Kayla Harris

Dr. Dominick Lanzo

DeToiya McAliley

Dr. Christina Morganti

Davia Procida

Dr. Maria Trent

Appendix D

Preliminary Report

MARYLAND STATE DEPARTMENT OF EDUCATION
PREPARING WORLD CLASS STUDENTS

Lillian M. Lowery, Ed.D.
State Superintendent of Schools

200 West Baltimore Street • Baltimore, MD 21201 • 410-767-0100 • 410-333-6442 TTY/TDD • MarylandPublicSchools.org

December 22, 2014

The Honorable Martin O'Malley
State House
100 State Circle
Annapolis, Maryland 21401

The Honorable Thomas V. Mike Miller
H-107 State House
100 State Circle
Annapolis, Maryland 21401

The Honorable Michael Busch
H-101 Lowe House Office Building
100 State Circle
Annapolis, Maryland 21401

Re: Task Force to Study Sports Injuries in High School Female Athletes (MSAR #10030)

Dear Governor O'Malley, President Miller, and Speaker Busch:

Pursuant to HB1332, I am submitting the preliminary report of the Task Force to Study Sports Injuries in High School Female Athletes. The committee had one meeting on November 20, 2014 with 17 members and observers in attendance. We are awaiting the name of one additional member of the Task Force; we will then have the full membership as required by HB 1332 Section 1(a).

The Task Force had open discussion on medical research and data that is available, what other states are doing in regards to injury prevention, and what additional areas the Task Force would consider that the legislation does not address. There were several suggestions/topics that may merit additional discussion as we move forward.

The Task Force will have three committees – Data and Information, Injury Reduction, and Rules. Members selected which committee they would be interested in working with, and committee chairs were selected by the group. Dr. Andrew Lincoln will chair the Data and Information Committee, Ms. Megan Rich will chair the Injury Reduction Committee, and Mr. David Scrivener will chair the Rules Committee. The committees will meet prior to the next full Task Force meeting. The next meetings of the committees are as follows: Data and Information – conference call on December 4, 2015, at 1:00 p.m.; Injury Reduction – virtual meeting on January 8, 2015, at 5:00 p.m.; and Rules – will be scheduled the week of January 10, 2015.

The next full committee meeting will be held on January 29, 2015 from 5:30 - 7:30 p.m. At the January 29, 2015 meeting, each committee chairperson will report to the entire Task Force. On or before December 31, 2015, the Task Force will submit a final report as required in the legislation. The working committees will use the time to study the results of the research and data gathered and thoughtfully make recommendations for consideration by the full committee for inclusion in the report to the General Assembly.

Based on our first meeting, there are intriguing ideas which we will consider during future meetings, ranging from the need for better pre-participation exams and medical care for the female athletes to education for coaches, athletes, parents and staff. Should you have questions or need additional information, please contact me at (443) 326-2871 or by email at tlayton@bcps.org.

Sincerely,

Tracy Layton
Chairperson

Attachment

Appendix E

Maryland Public School State Athletic Association

Care and Prevention of Athletic Injuries

Course Outline

4. Emergency coaches must have completed a Care and Prevention course in the first year of his/her employment.

5. Local supervisors will certify that coaches have complete the course.

6. **COMAR 13A.05.05.09 states one certified person in CPR shall be available on site at all school-sponsored athletic events.** It is strongly recommended that all coaches complete a course in CPR/AED.

Following is a suggested outline formulated by the MPSSAA Medical Advisory Board (revised April 22, 1998; September 8, 2010; April 17, 2014):

CARE AND PREVENTION OF ATHLETIC INJURIES COURSE OUTLINE

I. Legal Issues Suggested time allocation: 45 min.

- Emergency Plan
- Knowledge of proper skills, techniques, and protective equipment
- **Laws and MSDE recommended procedures for Heat Acclimatization and Concussions**
- Medical records and documentation
- Safety

II. Introduction to Injury Suggested time allocation: 1 hr. 30 min.

- Mechanisms of injury
- Tissue response to injury (mild/moderate/severe)
- Stages of healing
- Psychology of injury
- Psychology of sport

III. Prevention of Injuries Suggested time allocation: 1 hr. 30 min.

- Conditioning concepts
- Alternate training concepts
- Nutrition
- Performance enhancing issues

IV. First Aid/On Field Management of Injuries
Suggested time allocation: 3 hr.

- Concussion Awareness
  - o Signs and Symptoms
  - o Initial Intervention
  - o Evaluation
  - o Return to play decision making
- Primary/Secondary survey
- Cuts, blisters, bruises, **skin issues**
- Hyperventilation
- Care of eye, mouth, nose injuries
- Thermal injuries
- Choking
- Hygiene and sanitation (facilities, equipment, supplies)
- Hot and Cold Treatment (RICE/ICER treatment)
- Ambulatory assistance
- Bloodborne pathogens, use of personal protection equipment
- First Aid kit
- Principles of taping

V. Life Threatening Injuries **Suggested time allocation: 1 hr.**

- Cardiac
- Head/Brain
- Spinal
- Respiratory
- Circulatory
- Thoracic/Internal injuries
- **EpiPen**
- **Seizure**

VI. Ankle Injuries **Suggested time allocation: 2 hr.**

- Anatomy and mechanics of the joint
- Physical examination
- Common injuries and causes
- Rehabilitation — specific exercises and techniques
- Taping techniques

VII. Knee Injuries **Suggested time allocation: 1 hr. 15 min.**

- Anatomy and mechanics of the joint
- Physical examination
- Common injuries and causes
- Rehabilitation — specific exercises and techniques

VIII. Neck, Spine, Pelvis Injuries **Suggested time allocation: 1 hr.**

- Anatomy and mechanics of the joint
- Physical examination
- Common injuries and causes
- Rehabilitation — specific exercises and techniques

IX. Shoulder Injuries **Suggested time allocation: 1 hr. 15 min.**

- Anatomy and mechanics of the joint
- Physical examination
- Common injuries and causes
- Rehabilitation — specific exercises and techniques

X. Arm, Elbow, Hand Injuries **Suggested time allocation: 1 hr. 15 min.**

- Anatomy and mechanics of the joint
- Common injuries and causes
- Rehabilitation — specific exercises and techniques
- Taping techniques

XI. Exit Exam **Suggested time allocation: 30 min.**

TOTAL TIME: 15 Hr = 1 credit

OUT-OF-SEASON PRACTICE

.04E(1) "Member MPSSAA schools and coaches of member schools shall confine school practices to the seasonal limitations as defined in Regulation .03 of this chapter."

Interpretation: Any school group or team gathering consisting of three or more players that has assembled for the purpose of drilling or instruction would constitute a violation. School coaching staffs may work with a maximum of two players per day.

.04E(2) "A coach may not coach a team representing the coach's school beyond the sports season as defined in Regulation .03 of this chapter."

Interpretation: Any paid or volunteer coach at a member school may coach a non-school team provided the team has no direct affiliation with the school. When coaching non-school teams, including returning school players on non-school teams, the following criteria shall be observed:

a. The non-school team may not use a name directly connected with the school;

b. The non-school team may not use school uniforms, equipment or funds;

c. The non-school team may not use school facilities except as allowed by local school system guidelines;

d. The non-school team must meet local school system standards of a non-school team; and

e. The number of returning school players on the non-school team is limited according to the following timeframe.

Appendix F

Pre-Participation Physical Exam

PREPARTICIPATION PHYSICAL EVALUATION
HISTORY FORM

(Note: This form is to be filled out by the patient and parent prior to seeing the physician. The physician should keep this form in the chart.)

Date of Exam _____

Name _____ Date of birth _____

Sex _____ Age _____ Grade _____ School _____ Sport(s) _____

Medicines and Allergies: Please list all of the prescription and over-the-counter medicines and supplements (herbal and nutritional) that you are currently taking

_____

_____

_____

Do you have any allergies? ☐ Yes ☐ No If yes, please identify specific allergy below.
☐ Medicines ☐ Pollens ☐ Food ☐ Stinging Insects

Explain "Yes" answers below. Circle questions you don't know the answers to.

GENERAL QUESTIONS	Yes	No
1. Has a doctor ever denied or restricted your participation in sports for any reason?		
2. Do you have any ongoing medical conditions? If so, please identify below: ☐ Asthma ☐ Anemia ☐ Diabetes ☐ Infections Other: _____		
3. Have you ever spent the night in the hospital?		
4. Have you ever had surgery?		
HEART HEALTH QUESTIONS ABOUT YOU	**Yes**	**No**
5. Have you ever passed out or nearly passed out DURING or AFTER exercise?		
6. Have you ever had discomfort, pain, tightness, or pressure in your chest during exercise?		
7. Does your heart ever race or skip beats (irregular beats) during exercise?		
8. Has a doctor ever told you that you have any heart problems? If so, check all that apply: ☐ High blood pressure ☐ A heart murmur ☐ High cholesterol ☐ A heart infection ☐ Kawasaki disease Other: _____		
9. Has a doctor ever ordered a test for your heart? (For example, ECG/EKG, echocardiogram)		
10. Do you get lightheaded or feel more short of breath than expected during exercise?		
11. Have you ever had an unexplained seizure?		
12. Do you get more tired or short of breath more quickly than your friends during exercise?		
HEART HEALTH QUESTIONS ABOUT YOUR FAMILY	**Yes**	**No**
13. Has any family member or relative died of heart problems or had an unexpected or unexplained sudden death before age 50 (including drowning, unexplained car accident, or sudden infant death syndrome)?		
14. Does anyone in your family have hypertrophic cardiomyopathy, Marfan syndrome, arrhythmogenic right ventricular cardiomyopathy, long QT syndrome, short QT syndrome, Brugada syndrome, or catecholaminergic polymorphic ventricular tachycardia?		
15. Does anyone in your family have a heart problem, pacemaker, or implanted defibrillator?		
16. Has anyone in your family had unexplained fainting, unexplained seizures, or near drowning?		
BONE AND JOINT QUESTIONS	**Yes**	**No**
17. Have you ever had an injury to a bone, muscle, ligament, or tendon that caused you to miss a practice or a game?		
18. Have you ever had any broken or fractured bones or dislocated joints?		
19. Have you ever had an injury that required x-rays, MRI, CT scan, injections, therapy, a brace, a cast, or crutches?		
20. Have you ever had a stress fracture?		
21. Have you ever been told that you have or have you had an x-ray for neck instability or atlantoaxial instability? (Down syndrome or dwarfism)		
22. Do you regularly use a brace, orthotics, or other assistive device?		
23. Do you have a bone, muscle, or joint injury that bothers you?		
24. Do any of your joints become painful, swollen, feel warm, or look red?		
25. Do you have any history of juvenile arthritis or connective tissue disease?		

MEDICAL QUESTIONS	Yes	No
26. Do you cough, wheeze, or have difficulty breathing during or after exercise?		
27. Have you ever used an inhaler or taken asthma medicine?		
28. Is there anyone in your family who has asthma?		
29. Were you born without or are you missing a kidney, an eye, a testicle (males), your spleen, or any other organ?		
30. Do you have groin pain or a painful bulge or hernia in the groin area?		
31. Have you had infectious mononucleosis (mono) within the last month?		
32. Do you have any rashes, pressure sores, or other skin problems?		
33. Have you had a herpes or MRSA skin infection?		
34. Have you ever had a head injury or concussion?		
35. Have you ever had a hit or blow to the head that caused confusion, prolonged headache, or memory problems?		
36. Do you have a history of seizure disorder?		
37. Do you have headaches with exercise?		
38. Have you ever had numbness, tingling, or weakness in your arms or legs after being hit or falling?		
39. Have you ever been unable to move your arms or legs after being hit or falling?		
40. Have you ever become ill while exercising in the heat?		
41. Do you get frequent muscle cramps when exercising?		
42. Do you or someone in your family have sickle cell trait or disease?		
43. Have you had any problems with your eyes or vision?		
44. Have you had any eye injuries?		
45. Do you wear glasses or contact lenses?		
46. Do you wear protective eyewear, such as goggles or a face shield?		
47. Do you worry about your weight?		
48. Are you trying to or has anyone recommended that you gain or lose weight?		
49. Are you on a special diet or do you avoid certain types of foods?		
50. Have you ever had an eating disorder?		
51. Do you have any concerns that you would like to discuss with a doctor?		
FEMALES ONLY		
52. Have you ever had a menstrual period?		
53. How old were you when you had your first menstrual period?		
54. How many periods have you had in the last 12 months?		

Explain "yes" answers here

_____

_____

_____

_____

_____

_____

_____

_____

I hereby state that, to the best of my knowledge, my answers to the above questions are complete and correct.

Signature of athlete _____ Signature of parent/guardian _____ Date _____

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Preparticipation Physical Evaluation

THE ATHLETE WITH SPECIAL NEEDS: SUPPLEMENTAL HISTORY FORM

Date of Exam _____

Name _____ Date of birth _____

Sex _____ Age _____ Grade _____ School _____ Sport(s) _____

1. Type of disability		
2. Date of disability		
3. Classification (if available)		
4. Cause of disability (birth, disease, accident/trauma, other)		
5. List the sports you are interested in playing		
	Yes	**No**
6. Do you regularly use a brace, assistive device, or prosthetic?		
7. Do you use any special brace or assistive device for sports?		
8. Do you have any rashes, pressure sores, or any other skin problems?		
9. Do you have a hearing loss? Do you use a hearing aid?		
10. Do you have a visual impairment?		
11. Do you use any special devices for bowel or bladder function?		
12. Do you have burning or discomfort when urinating?		
13. Have you had autonomic dysreflexia?		
14. Have you ever been diagnosed with a heat-related (hyperthermia) or cold-related (hypothermia) illness?		
15. Do you have muscle spasticity?		
16. Do you have frequent seizures that cannot be controlled by medication?		

Explain "yes" answers here

Please indicate if you have ever had any of the following.

	Yes	**No**
Atlantoaxial instability		
X-ray evaluation for atlantoaxial instability		
Dislocated joints (more than one)		
Easy bleeding		
Enlarged spleen		
Hepatitis		
Osteopenia or osteoporosis		
Difficulty controlling bowel		
Difficulty controlling bladder		
Numbness or tingling in arms or hands		
Numbness or tingling in legs or feet		
Weakness in arms or hands		
Weakness in legs or feet		
Recent change in coordination		
Recent change in ability to walk		
Spina bifida		
Latex allergy		

Explain "yes" answers here

I hereby state that, to the best of my knowledge, my answers to the above questions are complete and correct.

Signature of athlete _____ Signature of parent/guardian _____ Date _____

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Preparticipation Physical Evaluation
PHYSICAL EXAMINATION FORM

Name _____ Date of birth _____

PHYSICIAN REMINDERS

1. Consider additional questions on more sensitive issues
   - Do you feel stressed out or under a lot of pressure?
   - Do you ever feel sad, hopeless, depressed, or anxious?
   - Do you feel safe at your home or residence?
   - Have you ever tried cigarettes, chewing tobacco, snuff, or dip?
   - During the past 30 days, did you use chewing tobacco, snuff, or dip?
   - Do you drink alcohol or use any other drugs?
   - Have you ever taken anabolic steroids or used any other performance supplement?
   - Have you ever taken any supplements to help you gain or lose weight or improve your performance?
   - Do you wear a seat belt, use a helmet, and use condoms?
2. Consider reviewing questions on cardiovascular symptoms (questions 5–14).

EXAMINATION		
Height Weight ☐ Male ☐ Female		
BP / (/) Pulse Vision R 20/ L 20/ Corrected ☐ Y ☐ N		
MEDICAL	**NORMAL**	**ABNORMAL FINDINGS**
Appearance • Marfan stigmata (kyphoscoliosis, high-arched palate, pectus excavatum, arachnodactyly, arm span > height, hyperlaxity, myopia, MVP, aortic insufficiency)		
Eyes/ears/nose/throat • Pupils equal • Hearing		
Lymph nodes		
Heart[a] • Murmurs (auscultation standing, supine, +/- Valsalva) • Location of point of maximal impulse (PMI)		
Pulses • Simultaneous femoral and radial pulses		
Lungs		
Abdomen		
Genitourinary (males only)[b]		
Skin • HSV, lesions suggestive of MRSA, tinea corporis		
Neurologic[c]		
MUSCULOSKELETAL		
Neck		
Back		
Shoulder/arm		
Elbow/forearm		
Wrist/hand/fingers		
Hip/thigh		
Knee		
Leg/ankle		
Foot/toes		
Functional • Duck-walk, single leg hop		

[a]Consider ECG, echocardiogram, and referral to cardiology for abnormal cardiac history or exam.
[b]Consider GU exam if in private setting. Having third party present is recommended.
[c]Consider cognitive evaluation or baseline neuropsychiatric testing if a history of significant concussion.

☐ Cleared for all sports without restriction

☐ Cleared for all sports without restriction with recommendations for further evaluation or treatment for _____

_____

☐ Not cleared

- ☐ Pending further evaluation
- ☐ For any sports
- ☐ For certain sports _____

Reason _____

Recommendations _____

_____

I have examined the above-named student and completed the preparticipation physical evaluation. The athlete does not present apparent clinical contraindications to practice and participate in the sport(s) as outlined above. A copy of the physical exam is on record in my office and can be made available to the school at the request of the parents. If conditions arise after the athlete has been cleared for participation, the physician may rescind the clearance until the problem is resolved and the potential consequences are completely explained to the athlete (and parents/guardians).

Name of physician (print/type) _____ Date _____

Address _____ Phone _____

Signature of physician _____, MD or DO

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Preparticipation Physical Evaluation
CLEARANCE FORM

Name _____ Sex ☐ M ☐ F Age _____ Date of birth _____

☐ Cleared for all sports without restriction

☐ Cleared for all sports without restriction with recommendations for further evaluation or treatment for _____

_____

☐ Not cleared

- ☐ Pending further evaluation
- ☐ For any sports
- ☐ For certain sports _____

  Reason _____

Recommendations _____

I have examined the above-named student and completed the preparticipation physical evaluation. The athlete does not present apparent clinical contraindications to practice and participate in the sport(s) as outlined above. A copy of the physical exam is on record in my office and can be made available to the school at the request of the parents. If conditions arise after the athlete has been cleared for participation, the physician may rescind the clearance until the problem is resolved and the potential consequences are completely explained to the athlete (and parents/guardians).

Name of physician (print/type) _____ Date _____

Address _____ Phone _____

Signature of physician _____, MD or DO

EMERGENCY INFORMATION

Allergies _____

Other information _____

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Appendix G

Maryland Recommendations to Strengthen Concussion Safety

MARYLAND STATE DEPARTMENT OF EDUCATION
Preparing World-Class Students

Lillian M. Lowery, Ed.D.
State Superintendent of Schools

200 West Baltimore Street • Baltimore, MD 21201 • 410-767-0100 • 410-333-6442 TTY/TDD

FOR IMMEDIATE RELEASE **Contact: William Reinhard, 410-767-0486**

MARYLAND MAKES RECOMMENDATIONS TO STRENGTHEN CONCUSSION SAFETY

RECOMMENDS CERTAIN PRACTICE LIMITATIONS

BALTIMORE, MD (August 13, 2013)— Maryland continues to add protections for student athletes, with a focus on improved concussion safety.

New recommendations from the Maryland State Department of Education, prompted by regulations adopted by the Maryland State Board of Education this spring, limit the number of contact practices in collision sports. MSDE also recommends improved instruction by coaches in contact sports and defines interscholastic sports by types: collision, contact, limited contact, and non-contact.

Football and boy's lacrosse have been defined as collision sports, and the recommendations target those sports in particular. Coaches in both sports should place special emphasis on proper techniques for such activities as tackling or body checking.

In football, no live hitting is allowed until the sixth day of practice. During the season, teams should limit live hitting drills and live game simulations to two practices per week. In lacrosse, after the first play date, schools should be limited to a maximum of one full-contact practice per day. In addition, there would be no live checking the day before a game.

"Student safety is our paramount concern, and our desire is to keep our athletes on the field and in the classroom," said State Superintendent of Schools Lillian M. Lowery. "These recommendations follow those put in place by leading college and university athletic organizations, and we believe they will work well in Maryland schools."

The recommendations were developed by the MSDE Concussion Implementation Advisory Panel, a group of leading medical professionals and athletic officials from systems and organizations across the State. The panel was following up on a directive made by the State Board on May 21.

###

(ATTACHED: RECOMMENDATIONS FROM MSDE'S CONCUSSION IMPLEMENTATION ADVISORY PANEL)

MARYLAND STATE DEPARTMENT OF EDUCATION
Preparing World-Class Students

Lillian M. Lowery, Ed.D.
State Superintendent of Schools

200 West Baltimore Street • Baltimore, MD 21201 • 410-767-0100 • 410-333-6442 TTY/TDD

Identification of Collision, Contact and Non Contact Sports and Recommended Concussion Injury Mitigation and Limitations of Contact Exposure

Sport Classification

Collision	Contact	Limited Contact	Non Contact
Consistent with the purpose of the game athletes hit or collide with each other or inanimate objects including the ground with great force.	*Athletes routinely make contact with each other or inanimate objects but usually with less force than in collision sports.*	*Contact with other athletes or inanimate objects are less frequent or inadvertent.*	*Any contact is inadvertent and not expected.*
Football	Basketball	Baseball	Badminton
Ice Hockey	Field Hockey	Field Events: High Jump Pole Vault	Bowling
Boys' Lacrosse	Girls' Lacrosse	Softball	Field Events: Discus Shot Put Triple Jump Long Jump
	Soccer	Volleyball	Golf
	Wrestling		Swimming
			Track & Cross Country
			Tennis

Recommendations for Concussion Injury Mitigation and Reduction of Contact Exposure for Collision Sports

By definition, those activities designated as Collision Sports may incur a high rate of concussion for participating athletes. Research indicates that in addition to proper instruction and drills a reduction of exposure to live contact should contribute to a lower rate of concussion injury.

Football

Rational:
Research has demonstrated the rate of concussion injury in football is the highest in interscholastic sports. The National High School Sports Related Injury Surveillance Study 2011-12 found that head/face concussions accounted for 23.6 % of total injuries. Furthermore, the data details 95% of these injuries occur while blocking, being blocked, tackling or being tackled. Research data by the Ivy League and the NCAA have reported similar findings in the rate on concussions. Currently numerous national and state organizations, as well as three local school systems in the state of Maryland have implemented reductions to contact exposure during practice sessions.

Recommendation:
1. Coaches should place special emphasis during practice sessions on proper techniques for blocking and tackling.

2. The following football practice restrictions are recommended to strike a balance between teaching proper technique and skills while limiting the number of live contact exposures.

Pre-season:
- No live hitting until day 6 of practice (Heat Acclimatization Rules)

- Live hitting (full speed, go to ground contact) periods limited to full padded practice days.

In-season (Beginning the Monday prior to the first play date):
- A team may conduct full padded practice days, but may only participate in live hitting drills and live game simulations with live hitting no more than two practice days per week.

- Live hitting drills or live game simulations with live hitting shall not be conducted the day prior to a game.

Definition:
- Live Hitting is defined as football drills or live game simulations where full game speed blocking and tackling of players to the ground occurs.

- Full Padded is defined as players dressed and equipped in accordance with NFHS Football Rule 1-5 (equipment guidelines).

Boys' Lacrosse

Rational:
Research has demonstrated the rate of concussion injury in boys' lacrosse is among the highest in interscholastic sports. The National High School Sports Related Injury Surveillance Study 2011-12 found that head/face concussions accounted for 34.3 of reported injuries. NCAA data collected from 1988 to 2003 found the concussion injury rate in men's lacrosse to be 2nd only to football. Research by the Ivy League has reported similar corroborative data.

Recommendation:
1. Coaches should place special emphasis during practice sessions on proper techniques for body checking that avoids contact with or to the head.

2. The following boy's lacrosse practice restrictions are recommended to strike a balance between teaching proper technique and skills while limiting the number of live contact exposures.

- After the 1st play date, schools are limited to a maximum of one full contact practice per day.

- No live body checking (stick checking permissible) allowed in practice the day prior to a game.

Definition:
- Body Checking is defined as contact typically made with a shoulder or chest to an opponent with both hands of the player applying the check remaining in contact with the crosse.

Recommendations for Concussion Injury Mitigation in Contact Sports

While activities classified as Contact Sports are not specifically structured to provide for intentional physical contact between participants like Collision Sports, the incidence of game/sport related contact between players and/or equipment cannot be totally avoided. Providing athletes with proper instruction and drills emphasizing proper techniques should contribute to a lower rate of concussion injury.

Rational:
Research has demonstrated that the rate of concussion in contact sports indicates the need for special emphasis on specific sports related skills. The National High School Sports Related Injury Surveillance Study 2011-12 indicated skill related activities that led to the highest incidents of head/face concussion injury. The instruction and drill of proper techniques in specific sport segments is essential in order to minimize potential for injury.

Sport Recommendations:

Basketball
- Coaches will place special emphasis on proper techniques on play involving body-to-body contact specifically rebounding, picking, screening and shot blockage.

Field Hockey
- Coaches will place special emphasis on proper techniques on dual challenges specifically where the potential for body-to-body or body-to-stick contact can occur.

Girl's Lacrosse
- Coaches will place special emphasis on proper techniques specifically for player positioning and stick checking.

Soccer
- Coaches will place special emphasis during practice sessions specifically on proper individual heading techniques, heading duals and aerial challenges.

Wrestling
- Coaches will place special emphasis specifically on proper takedown techniques and aspects of competitions involving contact to the head.

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Appendix H

The Santa Monica Sports Medicine Research Foundation
The PEP Program: Prevent injury and Enhance Performance

The Santa Monica Sports Medicine Research Foundation

The PEP Program: Prevent injury and Enhance Performance

This prevention program consists of a warm-up, stretching, strengthening, plyometrics, and sport specific agilities to address potential deficits in the strength and coordination of the stabilizing muscles around the knee joint. It is important to use proper technique during all of the exercises. The coaches and trainers need to emphasize correct posture, straight up and down jumps without excessive side-to-side movement, and reinforce soft landings. This program should be completed 3 times a week. If you are using this program with athletes that are twelve or under, please perform the plyometrics over a visual line on the field or a flat 2" cone and land each jump with two feet. Do not perform single leg plyometrics with young individuals until they demonstrate substantial control. (see addendum)
The field should be set up 10 minutes prior to the warm-up. This will allow for a smooth transition between the activities. A sample field set-up has been included in your packet.

This program should take approximately 15 - 20 minutes to complete. However, when you first begin the program, it may take slightly longer due to the fact that you must first become well acquainted with the program and the transitions. Along side each exercise you will notice a box with the approximate amount of time that should be spent on each activity. This will serve as a guideline to you in order to conduct your warm-up in a time efficient manner.

Section I: Warm – up

Warming up and cooling down are a critical part of a training program. The purpose of the warm-up section is to allow the athlete to prepare for activity. By warming up your muscles first, you greatly reduce the risk of injury.

A. Jog line to line (cone to cone): Elapsed Time: 0 - .5 minute
Purpose: Allows the athletes to slowly prepare themselves for the training session while minimizing the risk for injury. Educate athletes on good running technique; keep the hip/knee/ankle in straight alignment without the knee caving in or the feet whipping out to the side.
Instruction: Complete a slow jog from near to far sideline

B. Shuttle Run (side to side) Elapsed Time: .5 to 1 minute
Purpose: engage hip muscles (inner and outer thigh). This exercise will promote increased speed. Discourage inward caving of the knee joint.
Instruction: Start is an athletic stance with a slight bend at the knee. Leading with the right foot, sidestep pushing off with the left foot (back leg). When you drive off with the back leg, be sure the hip/knee/ankle are in a straight line. Switch sides at half field.

C. Backward Running Elapsed Time: 1 – 1.5 minutes

Purpose: continued warm-up; engage hip extensors/hamstrings. Make sure the athlete lands on her toes. Be sure to watch for locking of the knee joint. As the athlete brings her foot back, make sure she maintains a slight bend to the knee.

Instruction: Run backwards from sideline to sideline. Land on your toes without extending the knee. Stay on your toes and keep the knees slightly bent at all times.

Section II: Strengthening

This portion of the program focuses on increasing leg strength. This will lead to increased leg strength and a more stable knee joint. Technique is everything; close attention must be paid to the performance of these exercises in order to avoid injury.

A. Walking Lunges (1 minute) Elapsed Time: 1.5 – 2.5 min

Purpose: Strengthen the thigh (quadriceps) muscle.

Instruction. Lunge forward leading with your right leg. Push off with your right leg and lunge forward with your left leg. Drop the back knee straight down. Make sure that your keep your front knee over your ankle. Control the motion and try to avoid you front knee from caving inward. If you can't see your toes on your leading leg, you are doing the exercise incorrectly.

B. Russian Hamstring (1 minute) Elapsed Time: 2.5 –3.5 min

Purpose: Strengthen hamstrings muscles

Instruction: Kneel on the ground with hands at your side. Have a partner hold firmly at your ankles. With a straight back, lead forward leading with your hips. Your knee, hip and shoulder should be in a straight line as you lean toward the ground. Do not bend at the waist. You should feel the hamstrings in the back of your thigh working. Repeat the exercise for 30 seconds and switch with your partner.

C. Single Toe Raises (1 minute) Elapsed Time: 3.5 – 4.5 min

Purpose: This exercise strengthens the calf muscle and increases balance.

Instruction: Stand up with your arms at your side. Bend the left knee up and maintain your balance. Slowly rise up on your right toes with good balance. You may hold your arms out ahead of you in order to help. Slowly repeat 30 times and switch to the other side. As you get stronger, you may need to add additional repetitions to this exercise to continue the strengthening effect of the exercise.

Section III: Plyometrics

These exercises are explosive and help to build, power, strength and speed. The most important element when considering performance technique is the landing. It must be soft! When you land from a jump, you want to softly accept your weight on the balls of your feet slowly rolling back to the heel with a bent knee and a bent hip. These exercises are basic, however, it is critical to perform them correctly. Please begin these exercise using a flat cone (2 inches) or with a visual line on the field.

A. Lateral Hops over Cone (30 seconds) Elapsed Time: 4.5 – 5min

Purpose: Increase power/strength emphasizing neuromuscular control

Instruction: Stand with a 2" cone to your left. Hop to the left over the cone softly landing on the balls of your feet land bending at the knee. Repeat this exercise hopping to the right. Progress to Single leg hops

B. Forward/Backward Hops over cone (30 sec) Elapsed Time: 5 – 5.5 min

Purpose: Increase power/strength emphasizing neuromuscular control

Instruction: Hop over the cone softly landing on the balls of your feet and bending at the knee. Now, hop backwards over the ball using the same landing technique. Be careful not to snap your knee back to straighten it. You want to maintain a slight bend to the knee.

C. Single Leg hops over cone (30 seconds) Elapsed Time: 5.5 – 6 min

Purpose: Increase power/strength emphasizing neuromuscular control.

Instruction: Hop over the cone landing on the ball of your foot bending at the knee. Now, hop backwards over the ball using the same landing technique. Be careful not to snap your knee back to straighten it. You want to maintain a slight bend to the knee. Now, stand on the left leg and repeat the exercise. Increase the number of repetitions as needed.

D. Vertical Jumps with headers (30 seconds) Elapsed Time: 6 – 6.5 min

Purpose: Increase height of vertical jump.

Instruction: Stand forward with hands at your side. Slightly bend the knees and push off jumping straight up. Remember the proper landing technique; accept the weight on the ball of your foot with a slight bend to the knee.

E. Scissors Jump (30 seconds) Elapsed Time: 6.5 – 7 min

Purpose: Increase power and strength of vertical jump.

Instruction: Lunge forward leading with your right leg. Keep your knee over your ankle. Now, push off with your right foot and propel your left leg forward into a lunge position. Be sure your knee does not cave in or out. It should be stable and directly over the ankle. Remember the proper landing technique; accept the weight on the ball of your foot with a slight bend to the knee. Repeat 20 times.

Section IV: Agilities

A. Forward run with 3 step deceleration Elapsed Time: 7 – 8 min

Purpose: Increase dynamic stability of the ankle/knee/hip complex

Instruction: Starting at the first cone, sprint forward to the second cone. As you approach the cone, use a 3 step quick stop to decelerate. Continue on to cone 2 using the same strategy to deceleration. Do not let your knee extend over your toe. Do not let you knee cave inward. This exercise is used to teach the athlete how to properly accelerate and decelerate while moving forward and the hip, buttock and hamstring musculature.

B. Lateral Diagonal runs (3 passes) Elapsed Time: 8 – 9 min

Purpose: To encourage proper technique/stabilization of the hip and knee. This exercise will also deter a "knock knee" position from occurring – which is a dangerous position for the ACL.

Instruction: Face forward and laterally run to the first cone on the right. Pivot off the right foot and shuttle run to the second cone. Now pivot off the left leg and continue onto the third cone. Make sure that the outside leg does not cave in. Keep a slight bend to the knee and hip and make sure the knee stays over the ankle joint.

C. Bounding run (44 yds) Elapsed Time: 9 – 10 min

Purpose: To increase hip flexion strength/increase power/speed

Instruction: Starting on the near sideline, run to the far side with knees up toward chest. Bring your knees up high. Land on the ball of your foot with a slight bend at the knee and a straight hip. Increase the distance as this exercise gets easier.

Begin your training session with your coach. After the completion of training, resume the PEP program at section V.

Section V: Stretching

It is important to incorporate a short warm-up prior to stretching. Never stretch a "cold muscle". By performing these stretches, you can improve and maintain your range of motion, reduce stiffness in your joints, reduce post-exercise soreness, reduce the risk of injury and improve your overall mobility and performance. Note: this portion of the program may be moved to the end of your training session. Do a warm-up such as brisk walking for five to 10 minutes before stretching. Gently stretch to a point of tension and hold. Hold the stretch for 30 seconds. Concentrate on lengthening the muscles you are stretching. Breathe normally.

A. Calf stretch (30 seconds x 2 reps) Elapsed Time: 10 to 11 minutes

Purpose: stretch the calf muscle of the lower leg

Instruction: Stand leading with your right leg. Bend forward at the waist and place your hands on the ground (V formation). Keep your right knee slightly bent and your left leg straight. Make sure your left foot is flat on the ground. Do not bounce during the stretch. Hold for 30 seconds. Switch sides and repeat.

B. Quadricep stretch (30 seconds x 2 reps) Elapsed Time: 11 to 12 minutes

Purpose: stretch the quadricep muscle of the front of the thigh

Instruction: Place your left hand on your partner's left shoulder. Reach back with your right hand and grab the front of your right ankle. Bring your heel to buttock. Make sure your knee is pointed down toward the ground. Keep your right leg close to your left. Don't allow knee to wing out to the side and do not bend at the waist. Hold for 30 seconds and switch sides

C. Figure Four Hamstring stretch (30 sec x 2 reps) Elapsed Time: 12 – 13 min
Purpose: To stretch the hamstring muscles of the back of the thigh.
Instruction: Sit on the ground with your right leg extended out in front of you. Bend your left knee and rest the bottom of your foot on your right inner thigh. With a straight back, try to bring your chest toward your knee. Do not round your back. If you can, reach down toward your toes and pull them up toward your head. Do not bounce. Hold for 30 seconds and repeat with the other leg.

D. Inner Thigh Stretch (20 sec x 3 reps) Elapsed Time: 13 – 14 min
Purpose: Elongate the muscles of the inner thigh (adductor group)
Instruction: Remain seated on the ground. Spread you legs evenly apart. Slowly lower yourself to the center with a straight back. You want to feel a stretch in the inner thigh. Now reach toward the right with the right arm. Bring your left arm overhead the stretch over to the right. Hold the stretch and repeat on the opposite side.

E. Hip Flexor Stretch – (30 sec x 2 reps) Elapsed Time: 14 - 15 min
Purpose: Elongate the hip flexors of the front of the thigh.
Instruction: Lunge forward leading with your right leg. Drop your left knee down to the ground. Placing your hands on top of your right thigh, lean forward with your hips. The hips should be square with your shoulders. If possible, maintain your balance and lift back for the left ankle and pull your heel to your buttocks. Hold for 30 seconds and repeat on the other side.

Appendix I

The “11+” Manual by F-MARC

THE "11+"

A complete warm-up programme to prevent injuries

MANUAL

F-MARC
FOOTBALL FOR HEALTH
FIFA

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THE "11+" MANUAL

A COMPLETE WARM-UP PROGRAMME TO PREVENT INJURIES

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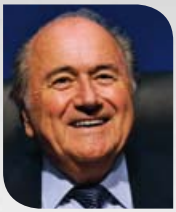
PREFACE



Joseph S. Blatter

Prof. Jiri Dvorak

Physical exercise is the best preventive measure for many diseases – this is a scientifically proven fact. Major scientific studies have shown football to be an ideal sport to improve physical fitness as well as to provide social benefits due to it being a team game. Playing recreational and even competitive football is a safe physical activity if participating players are well prepared by regularly performing the "11+".

In recent decades, football has gained increasing popularity among men and women, to such an extent that there are currently about 300 million registered players, referees and technical staff, approximately 40 million of whom are female football players. There is no doubt that football is the world's most popular sport, and the FIFA World Cup™ is the biggest sporting event on the planet with the beautiful game not only filling stadiums but also pulling in 30 billion TV spectators. FIFA is aware not only of this development but also of its responsibility to care for the health of players. Football injuries can be incurred with and without contact with another player. The Laws of the Game and their appropriate implementation through strict refereeing, fair play and the improvement of technical skills all have a positive effect on the reduction of contact injuries. Non-contact injuries can be best prevented by thorough preparation. With this in mind, FIFA and its Medical Assessment and Research Centre, F-MARC, have developed an injury prevention programme, the "11+". Major clinical research studies have clearly indicated that the consistent implementation of the "11+" can lead to a 30–50% reduction in injuries.

On the basis of these results, FIFA decided to roll this programme out across the world and to use the 2010 FIFA World Cup™ in South Africa to launch the programme within the member associations. Development programmes are used to educate coaches, trainers, referees and technical staff about the background and about how to perform the exercises correctly with their teams. A manual, together with an instructional DVD (www.FIFA.com/medical), are the tools needed to facilitate the implementation all over the world, free of charge, for every football player.

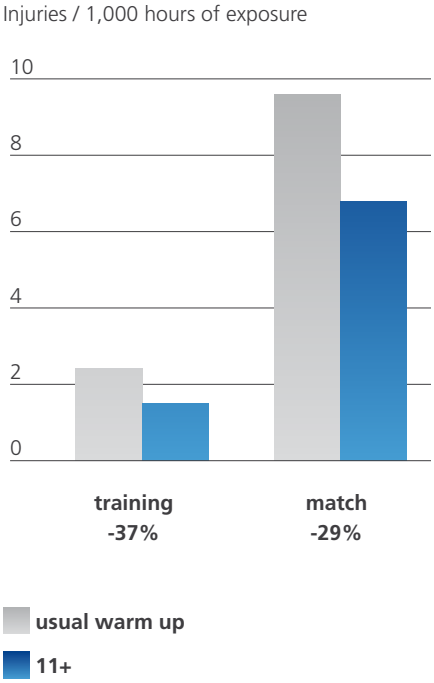
Joseph S. Blatter
FIFA President

Prof. Jiri Dvorak
FIFA Chief Medical Officer, F-MARC chairman

Playing football requires various skills and abilities, including endurance, agility, speed, and a technical and tactical understanding of the game. All of these aspects will be taught and improved during training sessions, but playing football also entails a substantial risk of injury. Thus, an optimal training session should also include exercises to reduce the risk of injury.

The "11+" is an injury prevention programme that was developed by an international group of experts based on their practical experience with different injury prevention programmes for amateur players aged 14 or older. It is a complete warm-up package and should replace the usual warm-up prior to training.

In a scientific study, it was shown that youth football teams using the "11+" as a standard warm-up had a significant lower risk of injury than teams that warmed up as usual.



(Instead of control/intervention: usual warm-up/the "11+")

Teams that performed the "11+" regularly at least twice a week had 37% fewer training injuries and 29% fewer match injuries. Severe injuries were reduced by almost 50%. This study was published in the British Medical Journal in 2008.

The "11+" has three parts with a total of 15 exercises, which should be performed in the specified sequence at the start of each training session.

Part 1: running exercises at a slow speed combined with active stretching and controlled partner contacts;

Part 2: six sets of exercises focusing on core and leg strength, balance and plyometrics/ agility, each with three levels of increasing difficulty; and

Part 3: running exercises at moderate/high speed combined with planting/cutting movements.

A key point in the programme is to use the proper technique during all of the exercises. Pay full attention to correct posture and good body control, including straight leg alignment, knee-over-toe position and soft landings.

⊕ CORRECT

Straight leg alignment

Knee over toe position

⊖ WRONG

The key elements of effective injury prevention programmes for football players are core strength, neuromuscular control and balance, eccentric training of the hamstrings, plyometric and agility.

Core training: The "core" represents a functional unit, which not only includes the muscles of the trunk (abdominals, back extensors) but also of the pelvic-hip region. The preservation of core stability is one of the keys for optimal functioning of the lower extremities (especially the knee joint). Football players must possess sufficient strength and neuromuscular control in their hip and trunk muscles to provide core stability. There is growing scientific evidence that core stability has an important role to play in injury prevention.

Neuromuscular control and balance: Neuromuscular control does not represent a single entity, but rather complex interacting systems integrating different aspects of muscle actions (static, dynamic, reactive), muscle activations (eccentric more than concentric), coordination (multi-joint muscles), stabilisation, body posture, balance and anticipation ability. There is strong empirical and growing scientific evidence that sport-specific neuromuscular training programmes can effectively prevent knee and ankle injuries.

Plyometrics and agility: Plyometrics are defined as exercises that enable a muscle to reach maximum strength in as short a time as possible. Eccentric muscle contractions are rapidly followed by concentric contractions in many sport skills. Consequently, specific functional exercises that emphasise this rapid change in muscle action must be used to prepare athletes for their sport-specific activities. The aim of plyometric training is to decrease the amount of time required between the yielding eccentric muscle contraction and the initiation of the overcoming concentric contraction. Plyometrics provide the ability to train specific movement patterns in a biomechanically correct manner, thereby strengthening the muscle, tendon and ligament more functionally. Plyometrics and agility drills were the important components of the programme that proved to be effective in prevention, especially of ACL injuries, but also of other knee and ankle injuries.

Percentage of injured players	Performed the "11+"	Warmed up as usual	Reduction
All	13.0%	19.8%	-34.3%
Acute injuries	10.6%	15.5%	-31.6%
Overuse injuries	2.6%	5.7%	-54.4%
Knee injuries	3.1%	5.6%	-44.6%
Ankle injuries	4.3%	5.9%	-27.1%
Severe injuries	4.3%	8.6%	-47.7%

The coach should be aware of the importance and efficacy of injury prevention programmes. Not all football injuries can be prevented, but especially knee injuries, ankle sprains and overuse problems can be significantly reduced by regular performance of preventive exercises.

Players are the essential assets of the club and the coach: if (key) players are injured, coaches have fewer options in their squad, and the team usually wins fewer points. Therefore, injury prevention strategies should be part of every training session.

It is crucial that the coach motivates the players to learn the "11+" and perform the exercises regularly and correctly. Research has shown that compliance is the key factor for efficacy. Teams that practised the "11+" more often had fewer injured players than other teams. The easiest way is to perform the "11+" as a standard warm-up at the beginning of every training session, and parts 1 and 3 also as a warm-up before matches.

References:

Soligard T, Myklebust G, Steffen K, Holme I, Silvers H, Bizzini M, Junge A, Dvorak J, Bahr R, Andersen TE (2008) A comprehensive warm-up programme to prevent injuries in female youth football: a cluster randomised controlled trial. BMJ Dec 9; 337:a2469. doi: 10.1136/bmj.a2469

Soligard T, Nilstad A, Steffen K, Myklebust G, Holme I, Dvorak J, et al. Compliance with a comprehensive warm-up programme to prevent injuries in youth football. Br J Sports Med 2010;44(11):787-793.

Start with highlighting the importance of injury prevention: all players should clearly understand this message. Only then, start the explanation and instruction of the exercises.

Start with highlighting the importance of injury prevention: all players should clearly understand this message. Only then should you begin to explain the exercises and give instructions.

The key for efficient teaching is to start at level 1 and focus on how to perform the exercises correctly. Carefully correct all mistakes! Good body positioning is crucial. This allows for better neuromuscular work and a more efficient training session. When the players are able to perform the exercises correctly, the duration and the number of repetitions can be raised to the proposed intensity.

The following steps are helpful in teaching a single exercise:

– explain briefly and demonstrate one exercise

– instruct the players to practise the exercise and give general feedback/corrections

– discuss some of the problems with all of the players, and then demonstrate the exercise again (maybe with one player who performs it well)

– instruct the players to perform the exercise again, and give individual feedbacks/corrections.

This method is particularly recommended for the six exercises in part 2. The running exercises in parts 1 and 3 may need less explanation and consequently less learning time. Usually, it will take a minimum of 2–3 training sessions until the players are able to perform all exercises of the "11+" (level 1) correctly.

Players should begin with level 1. Only when an exercise can be performed without difficulty for the specified duration and number of repetitions should the player progress to the next level of this exercise.

There are three options:

a) Ideally, progression to the next level is determined individually for each player.

b) Alternatively, all players can progress to the next level for some exercises but continue with the current level for other exercises.

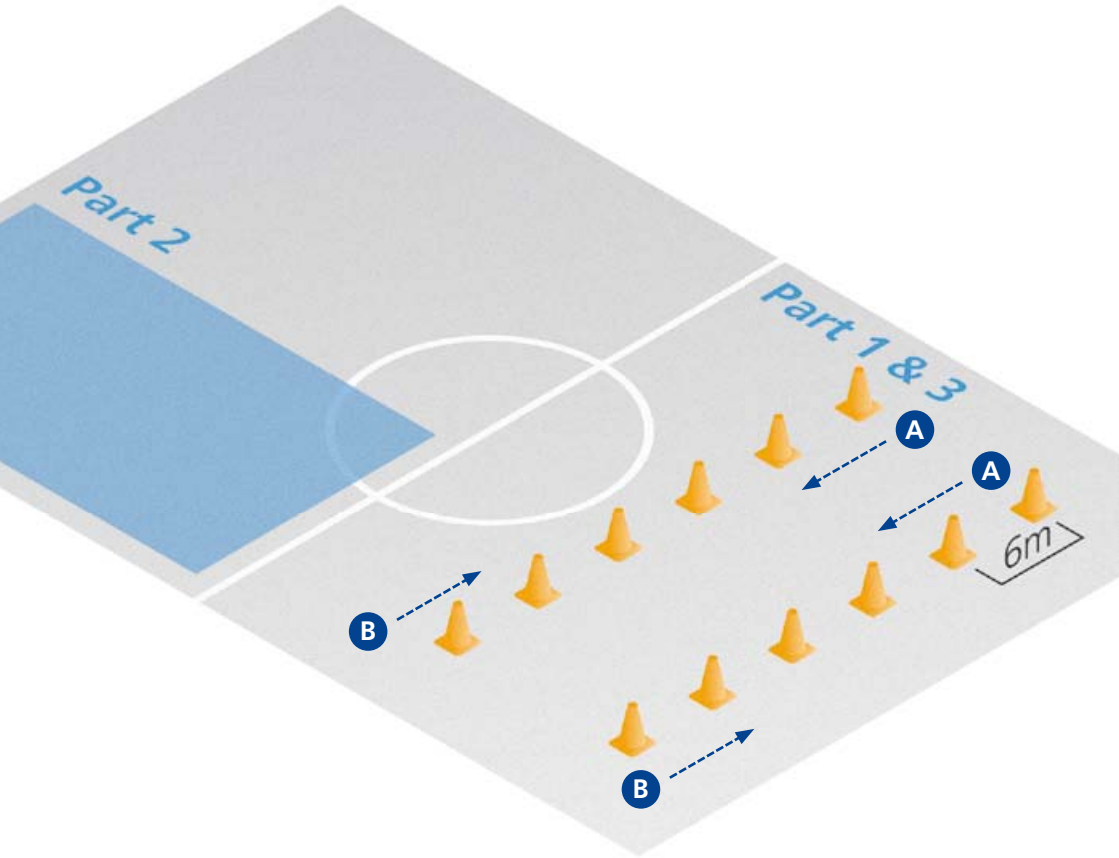
c) For simplicity, all players can progress to the next level of all exercises after three or four weeks.

Important: For all exercises, correct performance is of great importance. Therefore the coach should supervise the programme and correct the players if necessary.

FIELD SET-UP

The course is made up of six pairs of parallel cones, approximately 5–6m apart. Two players start at the same time from the first pair of cones, jog along the inside of the cones and do the various exercises on the way. After the last cone, they run back along the outside. On the way back, speed can be increased progressively as players warm up.

A Excercises
B Way back



NOTES


adidas

PART 1:
RUNNING EXERCISES

1 Straight ahead

2 Hip out

3 Hip in

4 Circling partner

5 Jumping with shoulder contact

6 Quick forwards and backwards sprints

1 RUNNING **STRAIGHT AHEAD**

Jog straight to the last cone. Run slightly more quickly on the way back.

Do the exercise twice.

Important when performing the exercise:

1. Make sure you keep your upper body straight.
2. Your hips, knees and feet should be aligned.

▼ Do **not** let your knees buckle inwards.

1 RUNNING **STRAIGHT AHEAD**

CORRECT

WRONG

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2 RUNNING **HIP OUT**

Jog to the first cone. Stop and lift your knee forwards. Rotate your knee to the side and put your foot down. Jog to the cone and do the exercise on the other leg. When you have finished the course, jog back.

Do the exercise twice.

Important when performing the exercise:

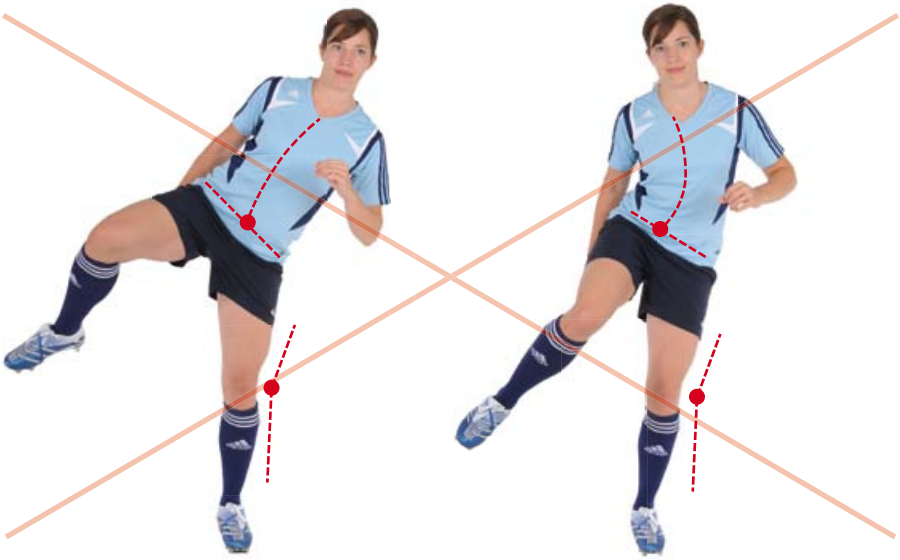
1. Make sure that you keep your pelvis horizontal and your core still.
2. The hip, knee and foot of the supporting leg should be aligned.

▼ Do **not** let the knee of the supporting leg buckle inwards.

2 RUNNING **HIP OUT**

CORRECT

WRONG



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3 RUNNING **HIP IN**

Jog to the first cone. Stop and lift your knee to the side. Rotate your knee forwards and put your foot down. Jog to the next cone and do the exercise on the other leg. When you have finished the course, jog back.

Do the exercise twice.

Important when performing the exercise:

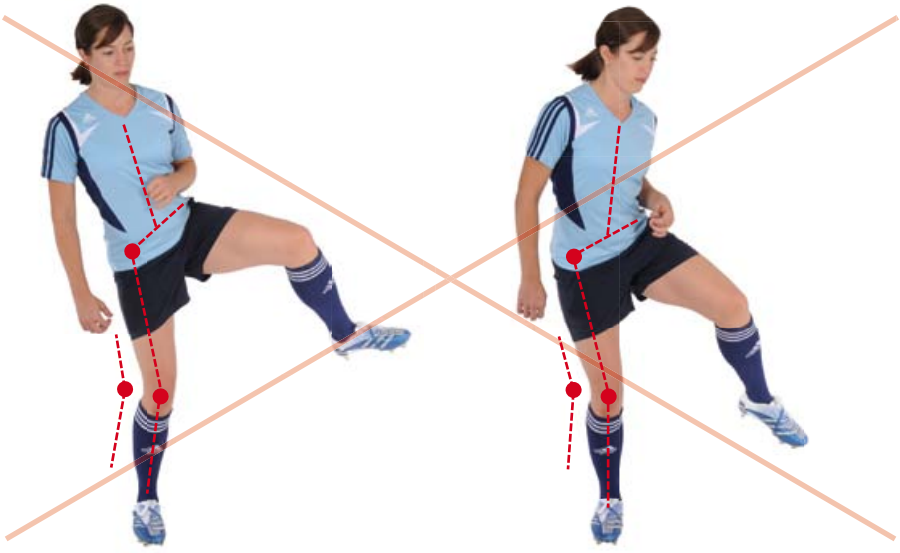
1. Make sure that you keep your pelvis horizontal and your core still.
2. The hip, knee and foot of the supporting leg should be aligned.

▼ Do **not** let the knee of the supporting leg buckle inwards.

3 RUNNING **HIP IN**

CORRECT

WRONG



4 RUNNING **CIRCLING PARTNER**

Jog forwards to the first cone. Shuffle sideways at a 90-degree angle towards your partner, shuffle an entire circle around one other (without changing the direction you are looking in) and back to the first cone. Jog to the next cone and repeat the exercise. When you have finished the course, jog back.

Do the exercise twice.

Important when performing the exercise:

1. Bend your hips and knees slightly and carry your body weight on the balls of your feet.

▼ Do **not** let your knees buckle inwards.

4 RUNNING **CIRCLING PARTNER**

⊕ CORRECT

⊖ WRONG

159

5 RUNNING **JUMPING WITH SHOULDER CONTACT**

Jog to the first cone. Shuffle sideways at a 90-degree angle towards your partner. In the middle, jump sideways towards each other to make shoulder-to-shoulder contact. Shuffle back to the first cone. Then jog to the next cone and repeat the exercise. When you have finished the course, jog back.

Do the exercise twice.

Important when performing the exercise:

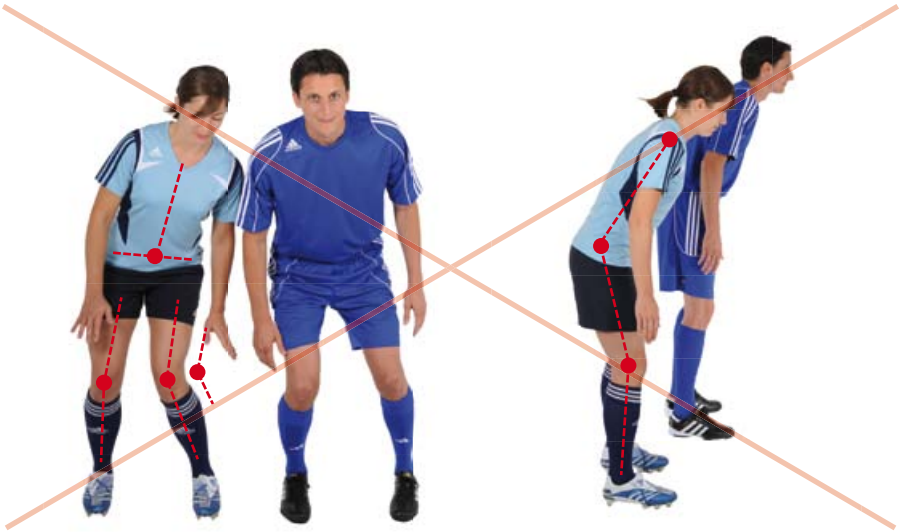
1. Land on both feet with your hips and knees bent.

▼ Do **not** let your knees buckle inwards.

5 RUNNING **JUMPING WITH SHOULDER CONTACT**

CORRECT

WRONG



6 RUNNING **QUICK FORWARDS AND BACKWARDS SPRINTS**

Run quickly to the second cone then run backwards quickly to the first cone, keeping your hips and knees slightly bent. Repeat, running two cones forwards and one cone backwards. When you have finished the course, jog back.

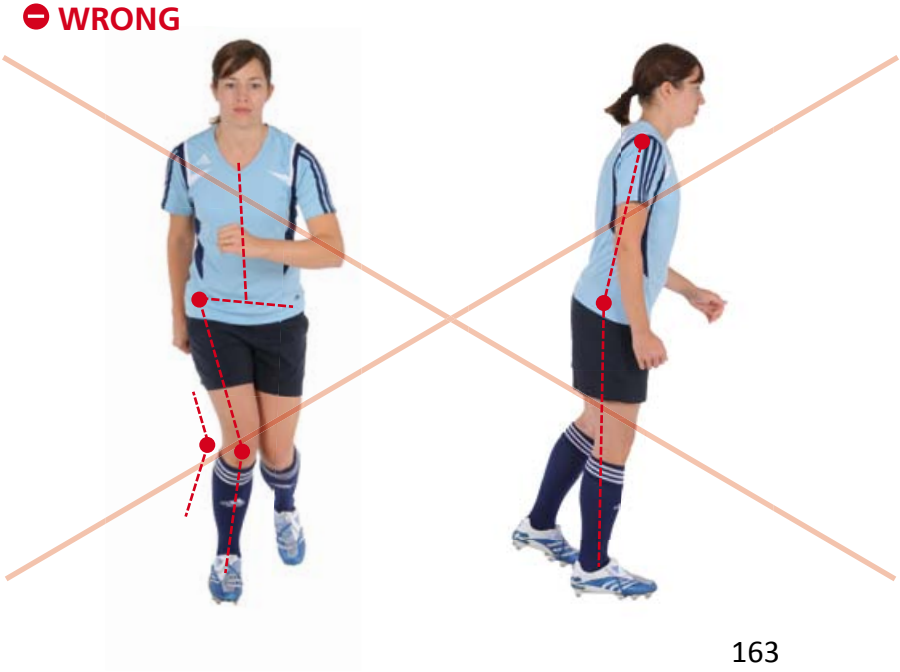
Do the exercise twice.

Important when performing the exercise:

1. Make sure you keep your upper body straight.
2. Your hips, knees and feet should be aligned.

▼ Do **not** let your knees buckle inwards.


CORRECT
1
2
1


WRONG

PART 2:
STRENGTH, PLYOMETRICS AND BALANCE EXERCISES

7.1 THE BENCH **STATIC**

This exercise strengthens your core muscles, which is important to ensure stability of the body in all movements.

Assume the starting position by lying on your front, supporting yourself on your forearms and feet.

During this exercise, lift your upper body, pelvis and legs up until your body is in a straight line from head to foot. Draw your shoulder blades in towards your spine so that they lie flat against your back. Your elbows are directly under your shoulders. Pull in your stomach and gluteal muscles and hold the position for 20–30 seconds. Return to the starting position, take a short break and repeat the exercise.

Repetitions: 3 sets (20–30 sec. each)

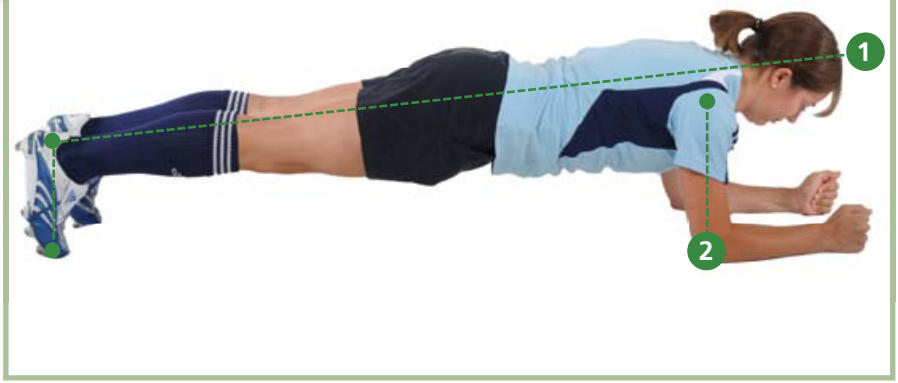
Important when performing the exercise:

1. Your body should be in a straight line from head to feet.
2. Your elbows should be directly under your shoulders.

- Do **not** tilt your head backwards.
- Do **not** sway or arch your back.
- Do **not** raise your buttocks.

7.1 THE BENCH **STATIC**

CORRECT



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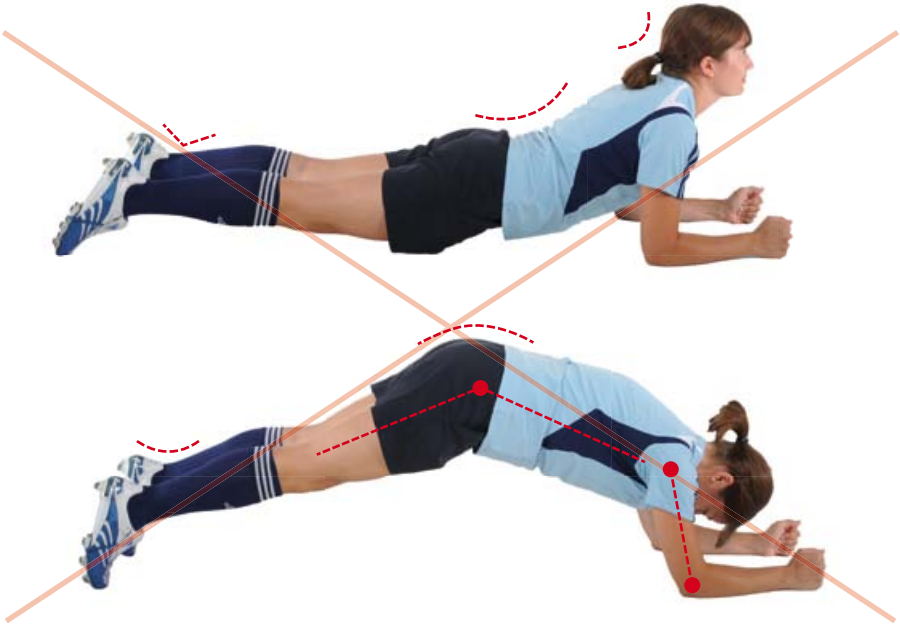


167

7.2 THE BENCH **ALTERNATE LEGS**

This exercise strengthens your core muscles, which is important to ensure stability of the body in all movements.

Assume the starting position by lying on your front, supporting yourself on your forearms and feet.

During this exercise, lift your upper body, pelvis and legs up until your body is in a straight line from head to foot. Draw your shoulder blades in towards your spine so that they lie flat against your back. Your elbows are directly under your shoulders. Pull in your stomach and gluteal muscles. Lift each leg in turn, holding for a count of 2 seconds. Continue for 40–60 seconds. Return to the starting position, take a short break and repeat the exercise.

Repetitions: 3 sets (40–60 sec. each)

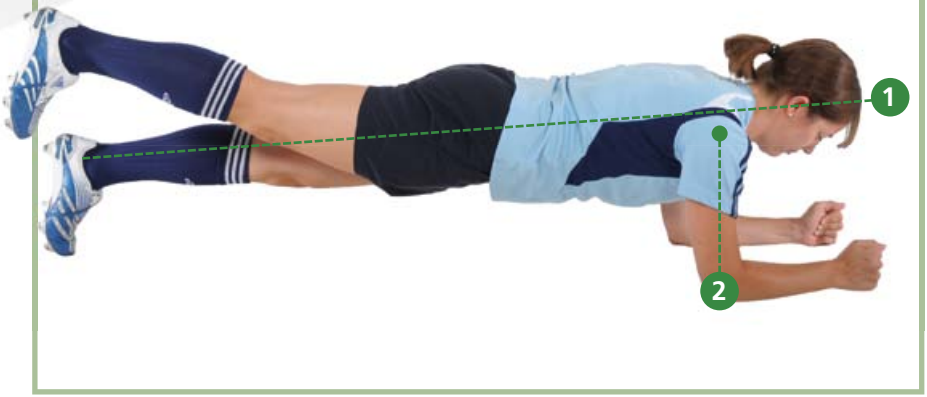
Important when performing the exercise:

1. Your head, shoulders, back and pelvis should be in a straight line.
2. Your elbows should be directly under your shoulders.

- Do **not** tilt your head backwards.
- Do **not** sway or arch your back.
- Do **not** raise your buttocks.
- Keep your pelvis stable and do **not** let it tilt to the side.

7.2 THE BENCH **ALTERNATE LEGS**

CORRECT



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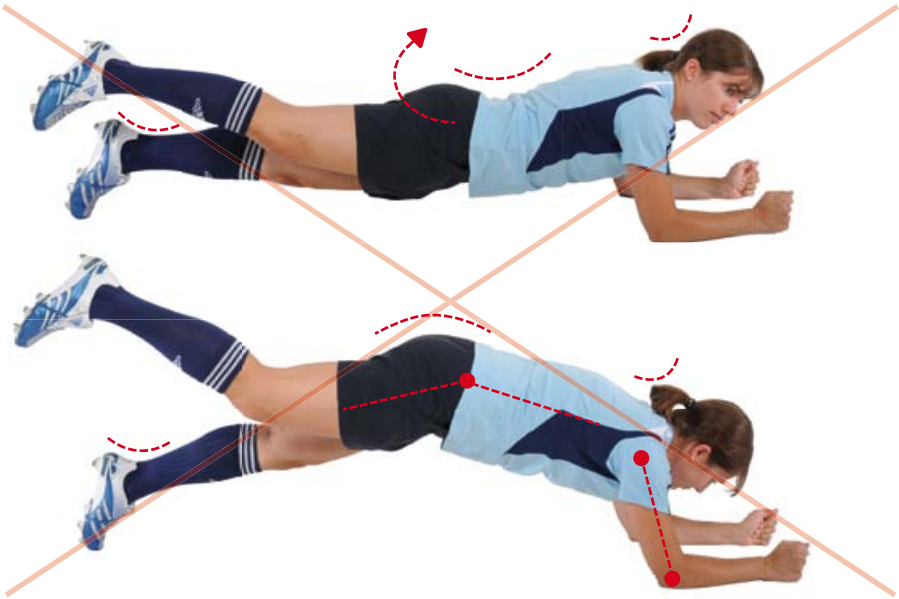


169

7.3 THE BENCH **ONE LEG LIFT AND HOLD**

This exercise strengthens your core muscles, which is important to ensure stability of the body in all movements.

Assume the starting position by lying on your front, supporting yourself on your forearms and feet.

During this exercise, lift your upper body, pelvis and legs up until your body is in a straight line. Draw your shoulder blades in towards your spine so that they lie flat against your back. Your elbows are directly under your shoulders. Pull in your stomach and gluteal muscles. Lift one leg about 10–15 centimetres off the ground and hold the position for 20–30 seconds. Return to the starting position, take a short break and repeat the exercise with the other leg.

Repetitions: 3 sets (20–30 sec. on each side)

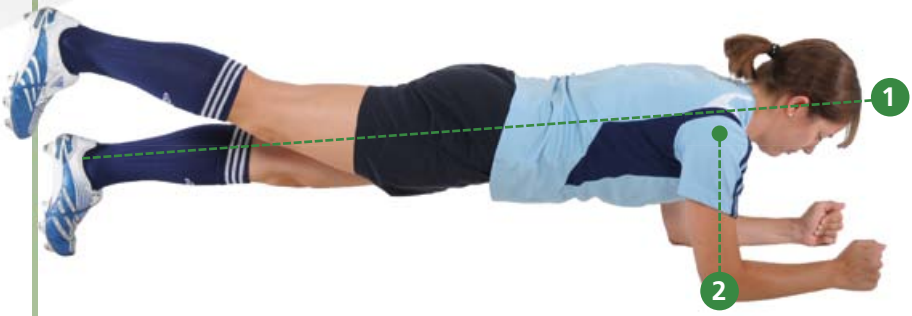
Important when performing the exercise:

1. Your head, shoulders, back and pelvis should be in a straight line.
2. Your elbows should be directly under your shoulders.

- Do **not** tilt your head backwards.
- Do **not** sway or arch your back.
- Do **not** raise your buttocks.
- Keep your pelvis stable and do **not** let it tilt to the side.

7.3 THE BENCH **ONE LEG LIFT AND HOLD**

CORRECT



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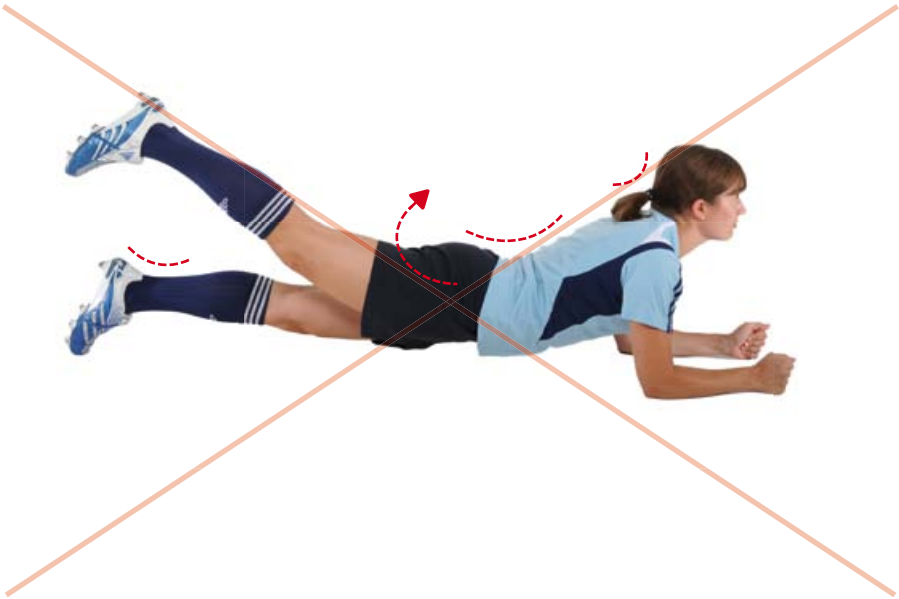


8.1 SIDEWAYS BENCH **STATIC**

This exercise strengthens your lateral core muscles, which is important to ensure stability of the body in all movements.

Assume the starting position, lying on your side with the knee of your lowermost leg bent to 90 degrees and supporting yourself on your forearm and lowermost leg.

During this exercise, lift your pelvis and uppermost leg until they form a straight line with your shoulder and hold the position for 20–30 seconds. The elbow of your supporting arm is directly under your shoulder. Return to the starting position, take a short break and repeat the exercise on the other side.

Repetitions: 3 sets (20–30 sec. on each side)

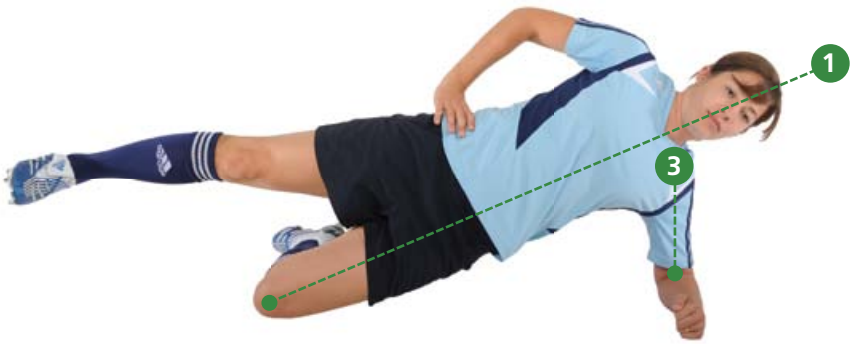
Important when performing the exercise:

1. When viewed from the front, your upper shoulder, hip and upper leg should be in a straight line.
2. When viewed from above, the shoulders, pelvis and both knees should be in a straight line.
3. Your elbow should be directly under your shoulder.

- Do **not** rest your head on your shoulder.
- Keep your pelvis stable and do **not** let it tilt downwards.
- Do **not** tilt your shoulders, pelvis or legs forwards or backwards.

8.1 SIDEWAYS BENCH **STATIC**

CORRECT



WRONG

8.2 SIDEWAYS BENCH **RAISE AND LOWER HIP**

This exercise strengthens your lateral core muscles, which is important to ensure stability of the body in all movements.

Assume the starting position, lying on your side with both legs straight and supporting yourself on your forearm.

During this exercise, raise your pelvis and legs (only the outside of the lowermost foot remains on the floor) until your body forms a straight line from the uppermost shoulder to the uppermost foot. Now lower your hips to the ground and raise them back up again. Repeat for 20–30 seconds. The elbow of your supporting arm is directly under your shoulder. Take a short break, change sides and repeat.

Repetitions: 3 sets (20–30 sec. on each side)

Important when performing the exercise:

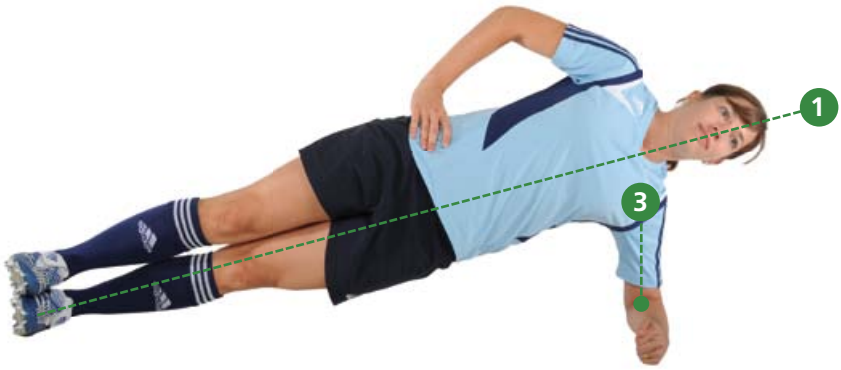
1. When viewed from front, your upper shoulder, hip and upper leg should be in a straight line.
2. When viewed from above, your body should be in a straight line.
3. Your elbow should be directly under your shoulder.

▼ Do **not** rest your head on your shoulder.

▼ Do **not** tilt your shoulders or pelvis forwards or backwards.

8.2 SIDEWAYS BENCH **RAISE AND LOWER HIP**

CORRECT



WRONG

8.3 SIDEWAYS BENCH **WITH LEG LIFT**

This exercise strengthens your lateral core muscles, which is important to ensure stability of the body in all movements.

Assume the starting position, lying on your side with both legs straight and supporting yourself on your forearm and lower leg.

During this exercise, raise your pelvis and legs (only the outside of the lowermost foot remains on the floor) until your body forms a straight line from the uppermost shoulder to the uppermost foot. Now lift your uppermost leg up and slowly lower it down again. Repeat for 20–30 seconds. The elbow of your supporting arm is directly under your shoulder. Take a short break, change sides and repeat.

Repetitions: 3 sets (20–30 sec. on each side)

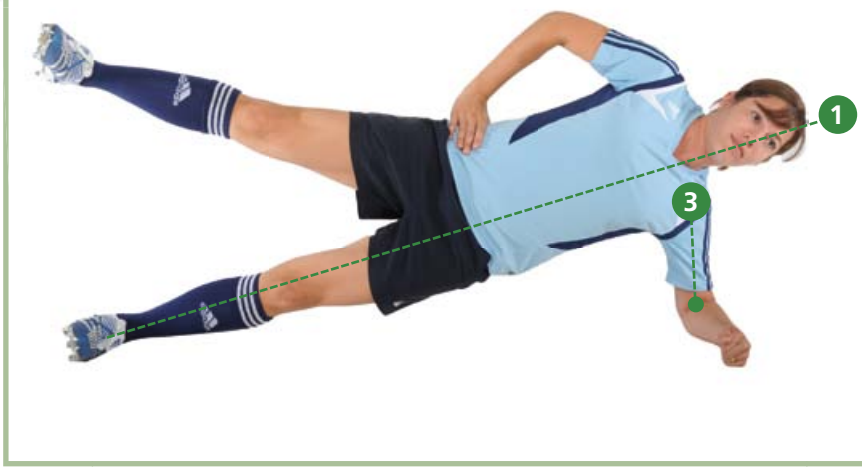
Important when performing the exercise:

1. When viewed from the front, your upper shoulder, hip and upper leg should be in a straight line.
2. When viewed from above, your body should be in a straight line.
3. Your elbow should be directly under your shoulder.

- Do **not** rest your head on your shoulder.
- Keep your pelvis stable and do **not** let it tilt downwards.
- Do **not** tilt your shoulders or pelvis forwards or backwards.

8.3 SIDEWAYS BENCH **WITH LEG LIFT**

⊕ CORRECT



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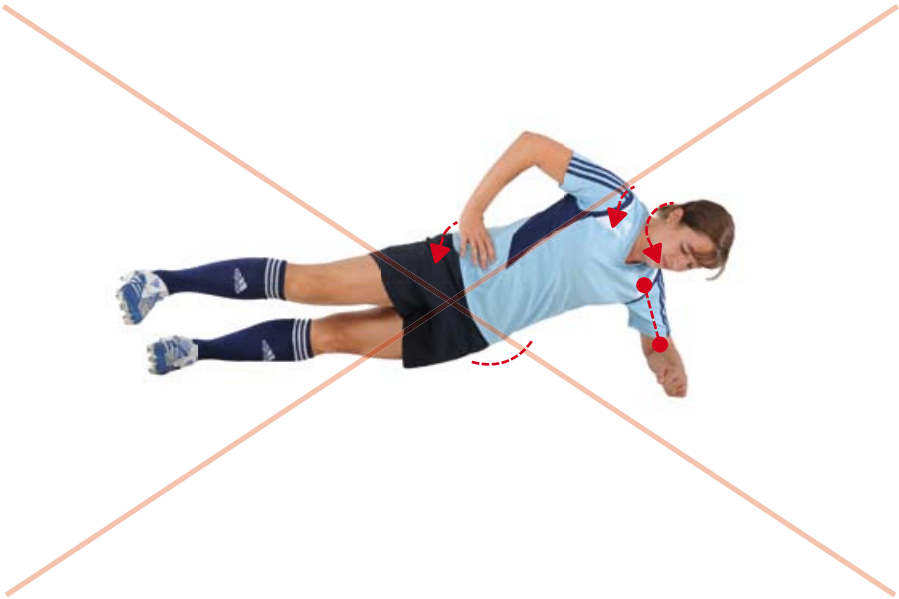


9 HAMSTRINGS **BEGINNER – INTERMEDIATE – ADVANCED**

This exercise strengthens your rear thigh muscles.

Assume the starting position, kneeling on a soft surface with knees hip-width apart and crossing your arms across your chest. Your partner kneels behind you and with both hands grips your lower legs just above the ankles while pushing them with his body weight to the ground.

During this exercise, your body should be completely straight from the head to the knees. Slowly lean forwards, trying to hold the position with your hamstrings. When you can no longer hold the position, gently take your weight on your hands, falling into a press-up position.

9.1 **BEGINNER**
Repetitions: 1 set (3 – 5 repetitions)

9.2 **INTERMEDIATE**
Repetitions: 1 set (7 – 10 repetitions)

9.3 **ADVANCED**
Repetitions: 1 set (minimum 12 – 15 repetitions)

Important when performing the exercise:

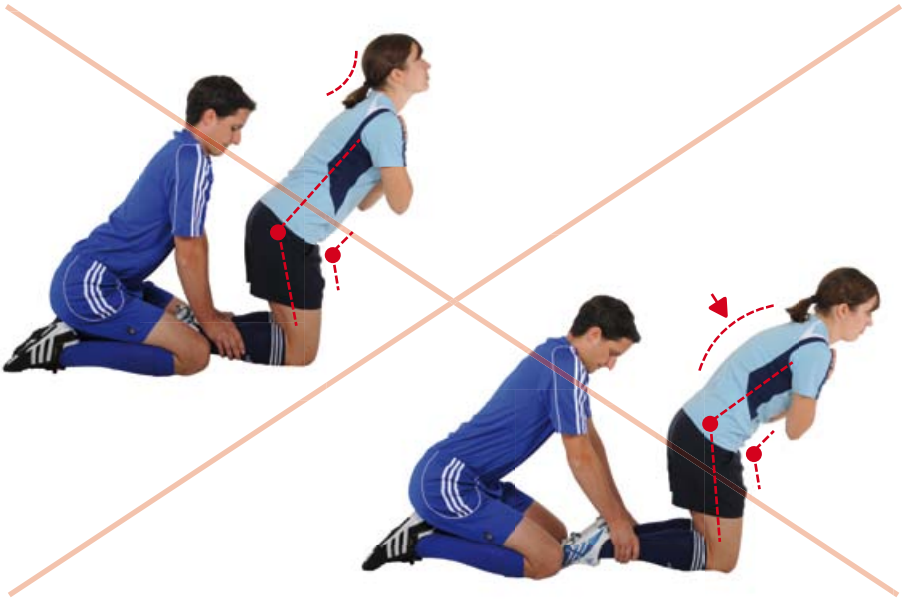
1. Your partner keeps your lower legs firmly on the ground.
2. Your head, upper body, hips and thighs should be in a straight line.
3. The movement is only in the knee joints.
4. Perform this exercise slowly at first, but once you feel more comfortable, speed it up.

▼ Do **not** tilt your head backwards.

▼ Do **not** bend at your hips.

⊕ CORRECT

⊖ WRONG



10.1 SINGLE-LEG STANCE **HOLD THE BALL**

This exercise improves leg muscle coordination and balance.

Assume the starting position, standing on one leg and holding the ball in front of you in both hands. Bend your knee and hip slightly so that your upper body leans forwards slightly. When viewed from the front, the hip, knee and foot of your supporting leg are in a straight line. Hold the raised leg slightly behind the supporting leg.

During this exercise, hold your balance and keep your body weight on the ball of your foot. Hold for 30 seconds, change legs and repeat. The exercise can be made more difficult by lifting the heel from the ground slightly or passing the ball around your waist and/or under your other knee.

Repetitions: 2 sets (30 sec. on each leg)

Important when performing the exercise:

1. When viewed from the front, the hip, knee and foot of your supporting leg should be in a straight line.
2. Always keep the hip and knee of your supporting leg slightly bent.
3. Keep your weight on the ball of your foot.
4. Keep your upper body stable and facing forwards.
5. Keep your pelvis horizontal.

▼ Do **not** let your knee buckle inwards.

▼ Do **not** let your pelvis tilt to the side.

10.1 SINGLE-LEG STANCE **HOLD THE BALL**

CORRECT

WRONG

181

10.2 SINGLE-LEG BALANCE **THROWING BALL WITH PARTNER**

This exercise improves leg muscle coordination and balance.

Assume the starting position, standing 2–3 metres apart from your partner, with each of you standing on one leg. Bend your knee and hip slightly so that your upper body leans forwards slightly. When viewed from the front, the hip, knee and foot of your supporting leg are in a straight line. Hold the raised leg slightly behind the supporting leg.

During this exercise, keep your balance while you throw the ball to one another. Hold in your stomach and keep your weight on the ball of your foot. Continue for 30 seconds, change legs and repeat. This exercise can be made more difficult by lifting the heel from the ground slightly.

Repetitions: 2 sets (30 sec. on each leg)

Important when performing the exercise:

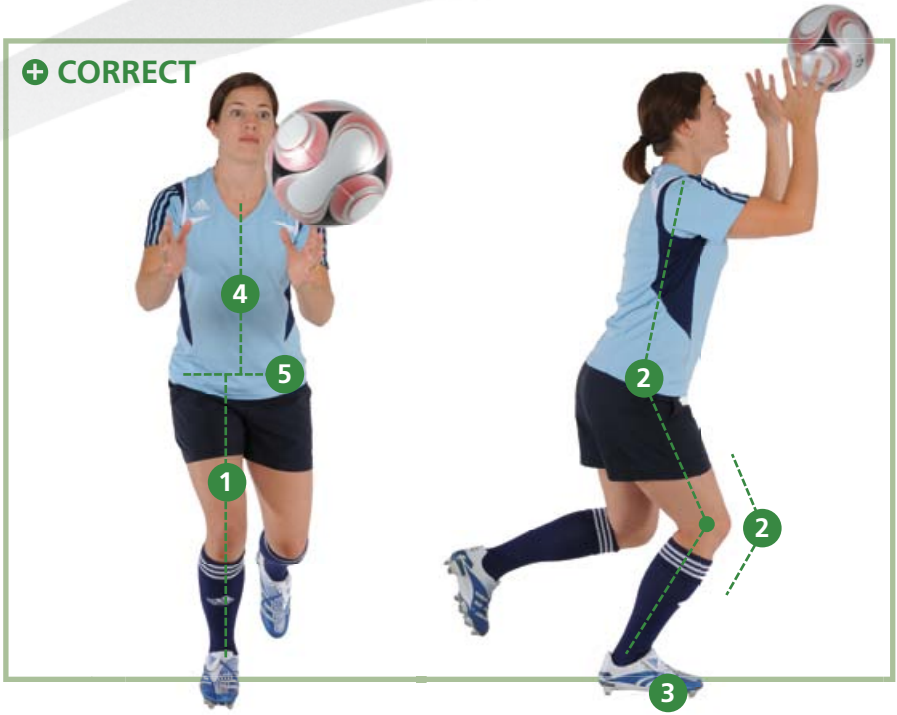
1. When viewed from the front, the hip, knee and foot of your supporting leg should be in a straight line.
2. Always keep the hip and knee of your supporting leg slightly bent.
3. Keep your weight on the ball of your foot.
4. Keep your upper body stable and facing forwards.
5. Keep your pelvis horizontal.

▼ Do **not** let your knee buckle inwards.

▼ Do **not** let your pelvis tilt to the side.

10.2 SINGLE-LEG BALANCE **THROWING BALL WITH PARTNER**

CORRECT



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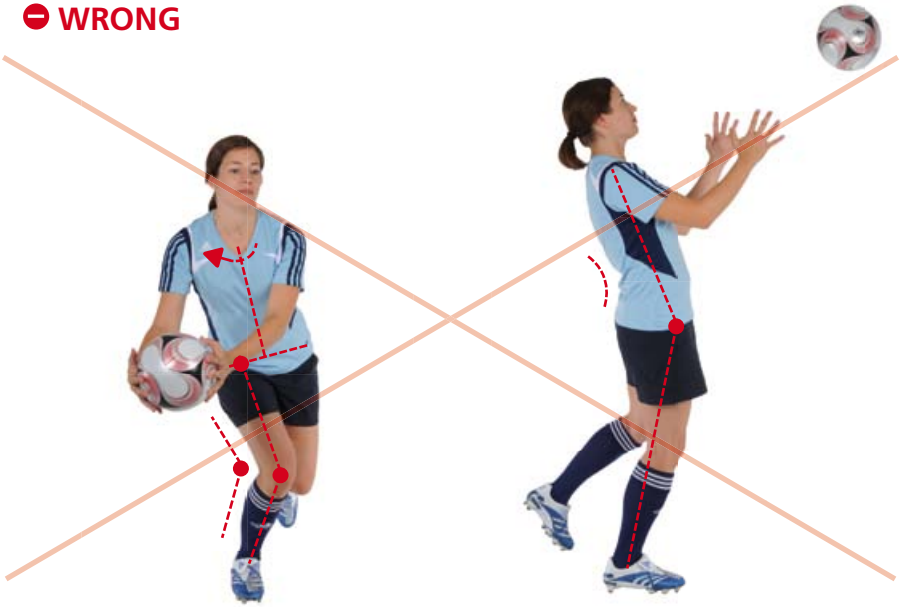

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10.3 SINGLE-LEG BALANCE **TEST YOUR PARTNER**

This exercise improves leg muscle coordination and balance.

Assume the starting position, standing at arm's length from your partner, with each of you standing on one leg. Bend your knee and hip slightly so that your upper body leans forwards slightly. When viewed from the front, the hip, knee and foot of your supporting leg are in a straight line. Hold the raised leg slightly behind the supporting leg.

During this exercise, keep your balance while you and your partner in turn try to push the other off balance in different directions. Keep returning to the starting position. Continue for 30 seconds, change legs and repeat.

Repetitions: 2 sets (30 sec. on each leg)

Important when performing the exercise:

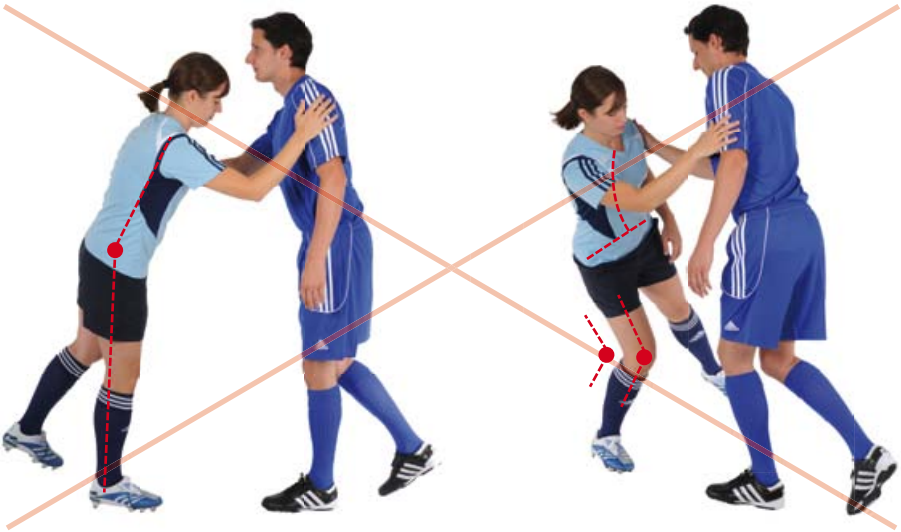
1. When viewed from the front, the hip, knee and foot of your supporting leg should be in a straight line.
2. Always keep the hip and knee of your supporting leg slightly bent.
3. Keep your weight on the ball of your foot.
4. Keep your upper body stable and facing forwards.
5. Keep your pelvis horizontal.

- Do **not** let your knee buckle inwards.
- Do **not** let your pelvis tilt to the side.

10.3 SINGLE-LEG BALANCE **TEST YOUR PARTNER**

CORRECT

WRONG



185

11.1 SQUATS **WITH TOE RAISE**

This exercise strengthens your hamstrings and calf muscles and improves your movement control.

Assume the starting position, standing with your feet hip-width apart and your hands on your hips.

During this exercise, slowly bend your hips, knees and ankles until your knees are flexed to 90 degrees. Lean your upper body forwards. Then straighten your upper body, hips and knees. When your knees are completely straight, stand up on your toes and then slowly lower yourself down again, before straightening up slightly more quickly. Repeat the exercise for 30 seconds.

Repetitions: 2 sets (30 sec. each)

Important when performing the exercise:

1. When viewed from the front, the hip, knee and foot of both legs should be in two straight parallel lines.
2. Bend your hips, knees and ankles at the same time and lean your upper body forwards.
3. When leaning your upper body forwards, keep your back straight.
4. Stand up on your toes when you straighten up.

- Do **not** let your knees buckle inwards.
- Do **not** tilt your head backwards.

11.1 SQUATS **WITH TOE RAISE**

⊕ CORRECT

⊖ WRONG

11.2 SQUATS **WALKING LUNGES**

This exercise strengthens your hamstrings and gluteal muscles and improves your movement control.

Assume the starting position, standing with both feet hip-width apart on the ground and your hands on your hips.

During this exercise, lunge forwards slowly at an even pace. As you lunge, bend your hips and knees slowly until your leading knee is flexed to 90 degrees. The bent knee should not extend beyond the toes. Keep your upper body straight and your pelvis horizontal. Do 10 lunges on each leg.

Repetitions: 2 sets (10 lunges on each side)

Important when performing the exercise:

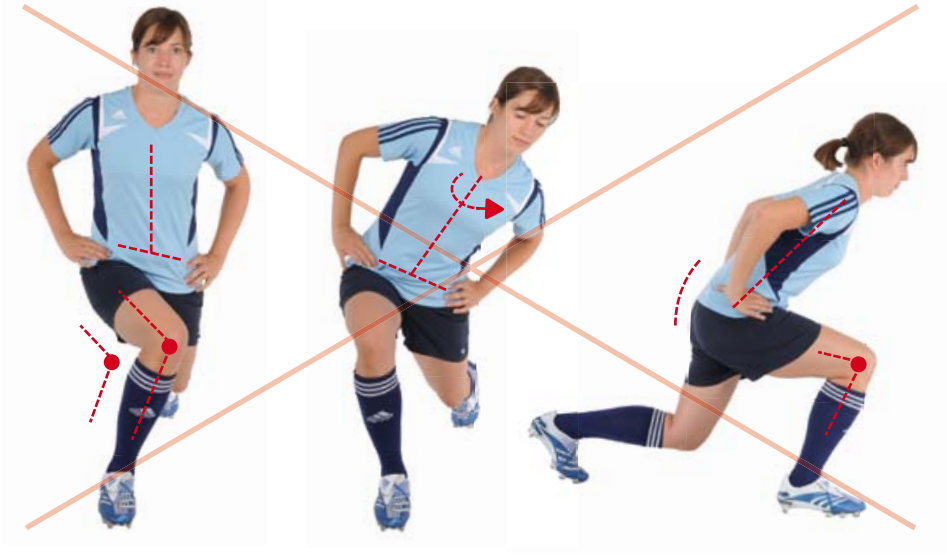
1. Bend your leading knee to 90 degrees.
2. Keep your upper body upright.
3. Keep your pelvis horizontal.

- Your bent knee should **not** extend beyond your toes.
- Do **not** let your leading knee buckle inwards.
- Do **not** bend your upper body forwards.
- Do **not** twist or tilt your pelvis to the side.

11.2 SQUATS **WALKING LUNGES**

CORRECT

WRONG



189

This exercise strengthens your front thigh muscles and improves your movement control.

Assume the starting position, standing on one leg next to a partner so that you can both loosely hold on to each other. Hold the raised leg slightly behind the supporting leg.

During this exercise, bend your knee at the same time as your partner. Slowly bend your knee, if possible until it is flexed to 90 degrees, and straighten up again. Bend your knee slowly then straighten it slightly more quickly. Repeat the exercise on the other side, doing 10 squats on each leg.

Repetitions: 2 sets (10 on each side)

Important when performing the exercise:

1. When viewed from the front, the hip, knee and foot of your supporting leg should be in a straight line.
2. Lean your upper body slightly forwards and keep it stable and facing forwards.
3. Keep your pelvis horizontal.
4. Bend your knee slowly then straighten it slightly more quickly.

- Do **not** let your knee buckle inwards.
- Your bent knee should **not** extend beyond your toes.
- Do **not** twist or tilt your pelvis to the side.

11.3 SQUATS **ONE-LEG SQUATS**

CORRECT

WRONG

191

12.1 JUMPING **VERTICAL JUMPS**

This exercise improves your jumping power and movement control.

Assume the starting position, standing with your feet hip-width apart and your hands on your hips.

During this exercise, slowly bend your hips, knees and ankles until your knees are flexed to 90 degrees. Lean your upper body forwards. Hold this position for 1 second, then jump as high as you can. While you jump, straighten your whole body. Land softly on the balls of your feet and slowly bend your hips, knees and ankles as far as possible. Repeat for 30 seconds.

Repetitions: 2 sets (30 sec.)

Important when performing the exercise:

1. When viewed from the front, the hip, knee and foot of both legs should be in two straight parallel lines.
2. Bend the hips, knees and ankles at the same time and lean your upper body forwards.
3. Jump off both feet and land gently on the balls of your feet.
4. A cushioned landing and a powerful take-off are more important than how high you jump.

- Do **not** let your knees buckle inwards.
- Do **not** land with extended knees or on your heels.

CORRECT

WRONG

This exercise improves your jumping power and movement control on one leg.

Assume the starting position, standing on one leg. Bend your hips, knee and ankle slightly and lean your upper body forwards.

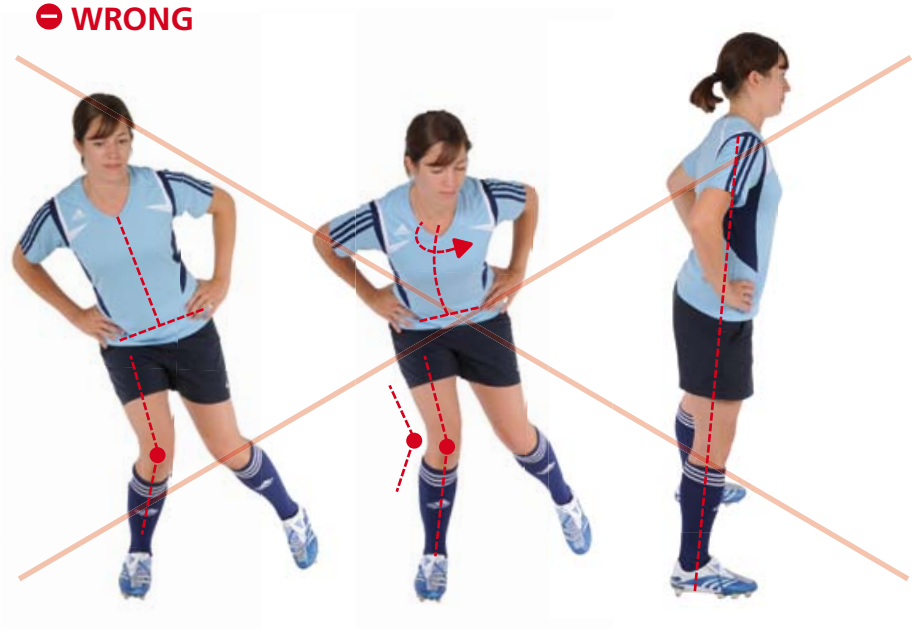
During this exercise, jump approximately one metre to the side from your supporting leg onto your other leg. Land gently on the ball of your foot and bend your hips, knee and ankle. Hold this position for about a second and then jump onto the other leg. Keep your upper body stable and facing forwards and your pelvis horizontal. Repeat for 30 seconds.

Repetitions: 2 sets (30 sec. each)

Important when performing the exercise:

1. When viewed from the front, your hip, knee and foot should be in a straight line.
2. Land gently on the balls of your foot, bend the hip, knee and ankle at the same time and lean your upper body forwards.
3. Keep your upper body stable and facing forwards.
4. Keep your pelvis horizontal.

- Do **not** let your knee buckle inwards.
- Do **not** turn your upper body.
- Do **not** twist or tilt your pelvis to the side.



195

12.3 JUMPING **BOX JUMPS**

This exercise improves body stability through quick movements in different directions.

Assume the starting position, standing with feet hip-width apart and imagine that there is a cross marked on the ground and you are standing in the middle of it.

During this exercise, bend your hips, knees and ankles and from this position alternate between jumping forwards and backwards, from side to side, and diagonally across the cross. Jump as quickly and explosively as possible. Land gently on the balls of your feet and bend your hips, knees and ankles. Lean your upper body forwards slightly throughout the exercise. Repeat the exercise for 30 seconds.

Repetitions: 2 sets (30 sec. each)

Important when performing the exercise:

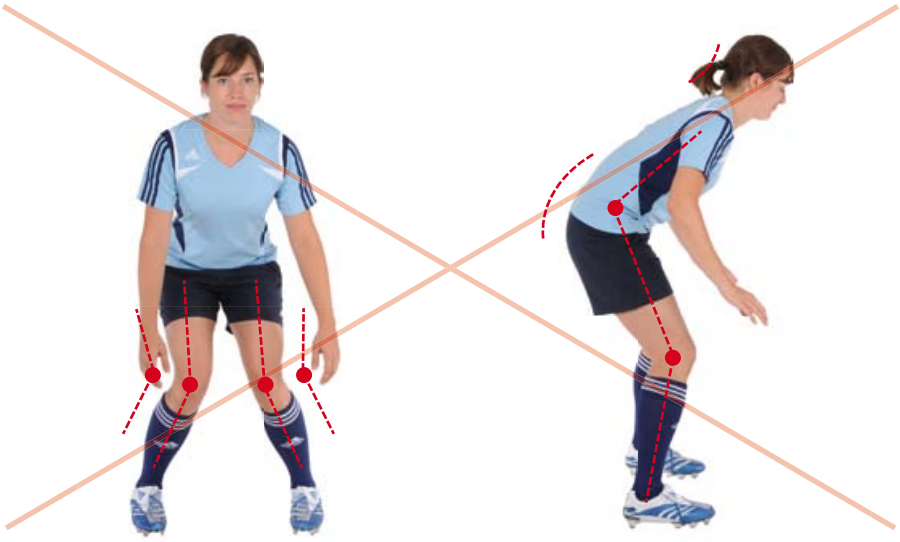
1. When viewed from the front, the hip, knee and foot of both legs should be in two straight parallel lines.
2. Jump off both feet and land on the balls of your feet with feet hip-width apart.
3. Bend your hips, knees and ankles on landing.
4. A cushioned landing and a powerful take-off are more important than how high you jump.

- Never let your knees meet and do **not** let them buckle inwards.
- Do **not** land with extended knees or on your heels.

12.3 JUMPING **BOX JUMPS**

CORRECT

WRONG



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adidas

PART 3:
RUNNING EXERCISES

13 RUNNING **ACROSS THE PITCH**

Run approx. 40 metres across the pitch at 75–80% of maximum pace and then jog the rest of the way. Jog back at an easy pace.

Do the exercise twice.

Important when performing the exercise:

1. Make sure you keep your upper body straight.
2. Your hips, knees and feet should be aligned.

▼ Do **not** let your knees buckle inwards.

13 RUNNING **ACROSS THE PITCH**

CORRECT

WRONG

201

14 RUNNING **BOUNDING**

Take a few warm-up steps then take 6–8 bounding steps with a high knee lift and jog the rest of the way. With each bound, try to lift the knee of the leading leg as high as possible and swing the opposite arm across the body. Jog back at an easy pace to recover.

Do the exercise twice.

Important when performing the exercise:

1. Keep your upper body straight.
2. Land on the ball of the leading foot with the knee bent and spring.

▼ Do **not** let your knee buckle inwards.

14 RUNNING **BOUNDING**

CORRECT

WRONG

203

15 RUNNING **PLANT AND CUT**

Jog four to five steps straight ahead. Then plant on the right leg and cut to change direction to the left and accelerate again. Sprint for 5–7 steps (at 80–90% of maximum pace) before you decelerate and plant on the left foot and cut to change direction to the right. Repeat the exercise until you reach the other side of the pitch, then jog back.

Do the exercise twice.

Important when performing the exercise:

1. Make sure you keep your upper body straight.
2. Your hips, knees and feet should be aligned.

▼ Do **not** let your knees buckle inwards.

15 RUNNING **PLANT AND CUT**

CORRECT

WRONG

205

What is the "11+"?
The "11+" is a complete warm-up programme that aims to reduce the most common injuries of both male and female football players. It is the advanced version of "The 11" injury prevention programme.

Who developed the "11+"?
The "11+" was developed by a group of international experts from FIFA's Medical Assessment and Research Centre (F-MARC), the Oslo Sports Trauma Research Center and the Santa Monica Orthopaedic and Sports Medicine Research Foundation. It is based on extensive experience with "The 11", PEP and other exercise-based programmes to prevent football injuries.

What are the advantages of the "11+"?
The prevention effect of the programme has scientifically been proven in a RCT. It is simple and does not require appliances, equipment (i.e. no extra costs) or specialist knowledge. It is a complete warm-up programme with different levels. It is efficient, as most of the exercises train several aspects and can replace other exercises.

Are the exercises new?
Most of the exercises are not new but yet have not become routine. The innovation is in putting these exercises together into a simple and practicable programme that should be the standard warm-up prior to every training session.

Why were these exercises in particular chosen?
The exercises are "evidence-based" or "best practice". They are designed to prevent the most frequent types of injury in football, i.e. groin and thigh strains as well as ankle sprains and knee ligament injuries.

What do the exercises achieve?
The exercises lead to a strengthening of the core and leg muscles, and in addition, static, dynamic and reactive neuromuscular control, coordination, balance, agility and jump technique are improved.

Why does the "11+" not include stretching exercises?
Research has shown that static stretching exercises have a negative influence on muscle performance, and results on the preventive effect of dynamic stretching are inconclusive. Stretching exercises are not recommended as

part of a warm-up programme, but can be performed at the end of the training session.

Who should do the "11+"?
The "11+" is specially designed for amateur and recreational players. The programme is for men and women of all levels of play and all ages (from around 14 years and up).

When should players do the "11+"?
The "11+" should be performed as a warm-up prior to every training session, and in a shortened version (parts 1 and 3) also before each match.

How often should players do the "11+"?
Before every training session (at least twice a week), and the running exercises (parts 1 and 3) before every match.

What should players pay special attention to when carrying out the exercises?
To be effective, it is important that each exercise is carried out with precision, exactly as described in this manual. Ideally, the coach should supervise the exercises and correct the players if necessary.

How long does it take to do the "11+"?
If the players are familiar with the exercises, 20 minutes in total.

How long does it take before the "11+" has an effect?
Depending on how often a player trains, about 10 – 12 weeks.

When can players stop practising the "11+"?
As long as players play football, they should perform the "11+" as the effects can diminish once training stops.

What about other preventive measures?
Other preventive measures are, of course, allowed and desired, especially fair play and wearing shin pads.

How old do players need to be to do the "11+"?
At least 14 years old. If players are younger, some exercises should not be performed, and for others, the intensity should be modified.

Do players need to warm-up before performing the "11+"?
No, the "11+" is a complete warm-up programme that replaces other warm-up exercises.

What footwear should be worn when doing the "11+"?
Ideally, the "11+" should be performed on a grass pitch in football boots.

Can the "11+" be performed in any order?
No, the sequence was chosen to provide a deliberate warm-up and progression.

When should players progress to the next level of the "11+"?
Players should begin with level 1. Only when an exercise can be performed without difficulty for the specified duration and number of repetitions should the player progress to the next level of this exercise.

The "11+" is a complete warm-up programme to reduce injuries among male and female football players aged 14 years and older.

The programme was developed by an international group of experts, and its effectiveness has been proven in a scientific study. Teams that performed the "11+" at least twice a week had 30–50% fewer injured players.

The programme should be performed, as a standard warm-up, at the start of each training session at least twice a week, and it takes around 20 minutes to complete. Prior to matches, only the running exercises (parts 1 and 3) should be performed.

For all exercises, correct performance is of great importance. Therefore, the coach should supervise the programme and correct the players if necessary.

Official publication of the Fédération Internationale de Football Association (FIFA)

Publisher
FIFA Medical Assessment and Research Centre (F-MARC)

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Appendix J

Board of Certification (BOC) Role Delineation/Practice Analysis 6th Ed. Content Outline

BOARD OF CERTIFICATION
FOR THE ATHLETIC TRAINER

Be Certain.™

Role Delineation Study/Practice Analysis, Sixth Edition
Content Outline
Domain Descriptions and Task Statements

Domain	Title	Description
1	**Injury/Illness Prevention and Wellness Protection**	**Educating participants and managing risk for safe performance and function.**
A key aspect of the athletic trainer's (AT) education and training is in the area of prevention and risk management. The AT is the front-line professional charged with this duty. Many individuals come to activity in less than ideal condition. They may suffer from disorders such as sickle-cell trait, diabetes or have other conditions predisposing them to injury or illness. Pre-participation screenings are critical to identifying risks and putting prevention plans into action. Additional prevention and risk management strategies undertaken by the AT range from on-site reviews for hazards, monitoring environmental conditions and educating participants on nutrition and performance enhancing drugs to monitoring for overtraining, maintenance of clinical and treatment areas, and development of emergency action plans.		
Task	**Description**	
0101	Minimize risk of injury and illness of individuals and groups impacted by or involved in a specific activity through awareness, education, and intervention.	
0102	Interpret individual and group pre-participation and other relevant screening information (e.g., verbal, observed, written) in accordance with accepted and applicable guidelines to minimize the risk of injury and illness.	
0103	Identify and educate individual(s) and groups through appropriate communication methods (e.g., verbal, written) about the appropriate use of personal equipment (e.g., clothing, shoes, protective gear, and braces) by following accepted procedures and guidelines.	
0104	Maintain physical activity, clinical treatment, and rehabilitation areas by complying with regulatory standards to minimize the risk of injury and illness.	
0105	Monitor environmental conditions (e.g., weather, surfaces, client work-setting) using appropriate methods and guidelines to facilitate individual and group safety.	
0106	Maintain or improve physical conditioning for the individual or group by designing and implementing programs (e.g., strength, flexibility, CV fitness) to minimize the risk of injury and illness.	
0107	Promote healthy lifestyle behaviors using appropriate education and communication strategies to enhance wellness and minimize the risk of injury and illness.	

Domain	Title	Description
2	**Clinical Evaluation and Diagnosis**	**Implementing standard evaluation techniques and formulating a clinical impression for the determination of a course of action.**

An AT may be asked to perform in one or more distinct evaluation areas: 1) the pre-participation examination which assists in determining the readiness of an individual to participate in physical activities, 2) an on-field evaluation for acute conditions that had occurred during activity using the primary and secondary survey models, 3) a clinical evaluation , often occurring in a clinical or athletic training facility and 4) the ongoing evaluation of progress of an injury or illness assisting the AT in advancing or modifying current care and making return to play decisions.
Through the use of a sequential evaluation process and with the understanding of the injury pathology and any co-morbidities of the affected individual the AT provides a clinical diagnosis, determine appropriate immediate care, and establish short and long term goals for the affected individual.

Task	Description
0201	Obtain an individual's history through observation, interview, and/or review of relevant records to assess current or potential injury, illness, or health-related condition.
0202	Examine by appropriate visual and palpation techniques the involved area(s) of an individual's body to determine the type and extent of the injury, illness, or health related condition.
0203	Examine by appropriate and specific tests (e.g., ROM, special tests, neurological tests) the involved area(s) of an individual's body to determine the type and extent of the injury, illness, or health-related condition.
0204	Formulate a clinical diagnosis by interpreting the signs, symptoms, and predisposing factors of the injury, illness, or health-related condition to determine the appropriate course of action.
0205	Educate the appropriate individual(s) about the clinical evaluation by communicating information about the current or potential injury, illness, or health-related condition to encourage compliance with recommended care.

Domain	Title	Description
3	**Immediate and Emergency Care**	**Employing standard care procedures and communicating outcomes for efficient and appropriate care of the injured.**

The profession of athletic training is unique in that the athletic trainer may be present at the time of an injury or emergency. This requires the clinician be prepared and proficient in all aspects of emergency care. Preparation includes writing, rehearsing and executing emergency action plans for every venue for which the AT is responsible. The AT must demonstrate excellent communication skills, both verbal and/or written, in order to transfer vital assessment information to the healthcare provider, parent, supervisors and others that are involved in the healthcare of the individual.

The recognition of signs and symptoms of life-threatening conditions is the cornerstone of effective management of emergencies. ATs have a vast knowledge of medical conditions that can quickly become emergencies and because the AT is often on-site, they are the primary healthcare professional able to intervene. There are times that injuries require care that warrant referrals. It is the ATs who recognizes these conditions and selects the most effective and safest method to transport the individual to the appropriate healthcare professional.

Task	Description
0301	Coordinate care of individual(s) through appropriate communication (e.g., verbal, written, demonstrative) of assessment findings to pertinent individual(s).
0302	Apply the appropriate immediate and emergency care procedures to prevent the exacerbation of non-life-threatening and life-threatening health conditions to reduce the risk factors for morbidity and mortality.
0303	Implement appropriate referral strategies, which stabilize and/or prevent exacerbation of the condition(s), to facilitate the timely transfer of care for conditions beyond the scope of practice of the Athletic Trainer.
0304	Demonstrate how to implement and direct immediate care strategies (e.g., first aid, Emergency Action Plan) using established communication and administrative practices to provide effective care.

Domain	Title	Description
4	**Treatment and Rehabilitation**	**Reconditioning participants for optimal performance and function.**

Following injury, the AT serves as the clinician who designs, administers and executes a plan of care. Included within this plan of care is the implementation of appropriate techniques, procedures, practices and methods that are designed to provide the patient with optimal outcomes. Acting under the direction of a physician and within the scope of practice acts and/or BOC Standards of Professional Practice, the athletic trainer provides a plan of care that is realized through the evaluation of the patient.

Protection from additional insult and appropriate steps toward optimal recovery are included in the ATs plan and execution of care. Effective and clear communication to the patient and appropriate individuals concerned with the patient's care is critical to achieving full return to activity. Treatment objectives are outlined using short and long-term goals. These goals are achieved using appropriate treatment/rehabilitation methods available to the AT. Selection of various treatment/rehabilitation modes is based on sound rationale, appropriate standards of health care, reliable clinical judgment and when available, evidence based medicine.

Task	Description
0401	Administer therapeutic and conditioning exercise(s) using appropriate techniques and procedures in order to aid recovery and restoration of function.
0402	Administer therapeutic modalities (e.g., electromagnetic, manual, mechanical) using appropriate techniques and procedures based on the individual's phase of recovery to restore functioning.
0403	Apply braces, splints, or other assistive devices according to appropriate practices in order to facilitate injury protection to achieve optimal functioning for the individual.
0404	Administer treatment for injury, illness, and/or health-related conditions using appropriate methods to facilitate injury protection, recovery, and/or optimal functioning for individual(s).
0405	Reassess the status of injuries, illnesses, and/or conditions using appropriate techniques and documentation strategies to determine appropriate treatment, rehabilitation, and/or reconditioning and to evaluate readiness to return to a desired level of activity.
0406	Provide guidance and/or referral to specialist for individual(s) and groups through appropriate communication strategies (e.g., oral and education materials) to restore an individual(s) optimal functioning.

Domain	Title	Description
5	**Organizational and Professional Health and Well-being**	**Understanding and adhering to approved organizational and professional practices and guidelines to ensure individual and organizational well-being.**

ATs are charged with many responsibilities including: (1) injury/illness prevention and wellness protection, (2) clinical evaluation and diagnosis, (3) immediate and emergency are, and (4) treatment and rehabilitation. However, in order to properly implement any type of comprehensive athletic training services, an organization must demonstrate and support an appropriate level of organizational and professional health and well-being. Together, organizational and professional health and well-being is defined as an organization's or professional association's ability to function effectively, to cope adequately, to change appropriately, and to grow from within. It is also the process by which the AT empowers patients and employees in the improvement of their health-related physical, mental and social well-being as well has physical and professional well-being of the institution and/or organization.

Whether covering a youth soccer tournament, working in one of several hospital satellite clinics, or running a collegiate athletic training program, the AT relies on these practices, standards, and guidelines. Maintenance of records and accurate documentation is mandatory for communication, reimbursement, risk management, and determining best practices. Emergency action plans with consideration for staffing, coordination of resources, liability, and equipment reduce the risk to the individual and organization. When organizing a health care team or making referrals related to injuries, illness and unhealthy lifestyle behaviors, the AT must be knowledgeable of their scope of practice and the state statutes that regulate their profession and the health professionals with whom they work. Additionally the AT engages in ongoing professional education to ensure the care provided by the organization and healthcare professionals adheres to best practices .For organizations and professions to maintain financial health, the AT must demonstrate the ability to utilize basic internal business skills including, strategic planning, human resource management, budgeting, and facility design. They must be able to apply external business skills, such as marketing and public relations to support organizational sustainability, growth, and development.

Task	Description
0501	Apply basic internal business functions (e.g., business planning, financial operations, staffing) to support individual and organizational growth and development.
0502	Apply basic external business functions (e.g., marketing and public relations) to support organizational sustainability, growth, and development.
0503	Maintain records and documentation that comply with organizational, association, and regulatory standards to provide quality of care and to enable internal surveillance for program validation and evidence-based interventions.
0504	Demonstrate appropriate planning for coordination of resources (e.g., personnel, equipment, liability, scope of service) in event medical management and emergency action plans.
0505	Demonstrate an understanding of statutory and regulatory provisions and professional standards of the practice of Athletic Training in order to provide for the safety and welfare of individual(s) and groups.
0506	Develop a support/referral process for interventions to address unhealthy lifestyle behaviors.

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Suggested Citation: Board of Certification. (2010). *The 2009 Athletic Trainer Role Delineation Study*. Omaha, NE: Stephen B. Johnson.

Appendix K

Appropriate Medical Care for Secondary School-Age Athletes: Consensus Statement

APPROPRIATE MEDICAL CARE FOR SECONDARY SCHOOL-AGE ATHLETES

CONSENSUS STATEMENT

Mission Statement

Establish recommendations for the prevention, care and appropriate management of athletic-related injury and illness specific to the secondary school-aged individual.

Consensus Statement

Athletic Health Care Team

The athletic health care team may be comprised of appropriate health care professionals in consultation with administrators, coaches, parents and participants. Appropriate health care professionals could be: certified athletic trainers*, team physicians**, consulting physicians, school nurses, physical therapists, emergency medical services (EMS) personnel, dentists and other allied health care professionals.

Recommendations for Appropriate Medical Care

Appropriate medical care of the secondary school-aged individual involves more than basic emergency care during sports participation. It encompasses the provision of many other health care services. While emergency medical care and event coverage are critical, appropriate medical care also includes activities of ongoing daily athletic health care.

The athletic health care team should have a designated athletic health care provider(s) who is educated and qualified to:

1. Determine the individual's readiness to participate.
2. Promote safe and appropriate practice, competition and treatment facilities.
3. Advise on the selection, fit, function and maintenance of athletic equipment.
4. Develop and implement a comprehensive emergency action plan.
5. Establish protocols regarding environmental conditions.
6. Develop injury and illness prevention strategies.
7. Provide for on-site recognition, evaluation and immediate treatment of injury and illness, with appropriate referrals.
8. Facilitate rehabilitation and reconditioning.
9. Provide for psychosocial consultation and referral.
10. Provide scientifically sound nutritional counseling and education.
11. Participate in the development and implementation of a comprehensive athletic health care administrative system (e.g. personal health information, policies and procedures, insurance, referrals).

Education

Designated athletic health care providers shall maintain expertise through continuing education and professional development.

All coaches should be trained in first aid, CPR and AED, utilization of athletic health care team professionals, injury prevention and modification of training in response to injury and illness.

The provision of appropriate medical care should be based on local needs and resources, with consideration of available personnel, state and local statutes, risk and type of activity.

DEFINITIONS

**Certified Athletic Trainer:* An allied health care professional who, upon graduation from an accredited college or university, and after successfully passing the NATABOC certification examination, is qualified and appropriately credentialed according to state regulations to work with individuals engaged in physical activity in the prevention of injuries and illnesses, the recognition, evaluation and immediate care of injuries and illnesses, the rehabilitation and reconditioning of injuries and illnesses, and the administration of this health care system. This individual must have current certification in CPR and be qualified in first aid and blood borne pathogens. Other health care professionals with equivalent certification and/or licensure would also meet this standard.

***Team Physician:* The team physician must have an unrestricted medical license and be an MD or a DO who is responsible for treating and coordinating the medical care of athletic team members. The principal responsibility of the team physician is to provide for the well being of individual athletes - enabling each to realize his or her full potential. The team physician should possess special proficiency in the care of musculoskeletal injuries and medical conditions encountered in sports. The team physician also must actively integrate medical expertise with other health care providers, including medical specialists, athletic trainers and allied health professionals. The team physician must ultimately assume responsibility within the team structure for making medical decisions that affect the athlete's safe participation. (Reference: Team Physician Consensus Statement, www.acsm.org)

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Appendix L

The International Knee Document Committee (IKDC) Form

2000

IKDC

KNEE FORMS

INTRODUCTION

The entire IKDC form, which includes a demographic form, current health assessment form, subjective knee evaluation form, knee history form, surgical documentation form, and knee examination form, may be used as separate forms. The knee history form and surgical documentation form are provided for convenience. All researchers are required to complete the subjective knee evaluation and knee examination form. Instructions for scoring the subjective knee evaluation form and the knee examination form are provided on the back of the forms.

TABLE OF CONTENTS

IKDC DEMOGRAPHIC FORM

Your Full Name _____

Your Date of Birth _____/_____/_____
Day Month Year

Your Social Security Number ____-___-_____ **Your Gender:** ❑ **Male** ❑ **Female**

Occupation _____

Today's Date _____/_____/_____
Day Month Year

The following is a list of common health problems. Please indicate "Yes" or "No" in the first column, and then skip to the next item. If you do have the problem, please indicate in the second column if you receive medications or some other type of treatment for the problem. In the last column, indicate if the problem limits any of your activities.

	Do you have the problem?		Do you receive treatment for it?		Does it limit your activities?	
	Yes	No	Yes	No	Yes	No
Heart disease	❑	❑	❑	❑	❑	❑
High blood pressure	❑	❑	❑	❑	❑	❑
Asthma or pulmonary disease	❑	❑	❑	❑	❑	❑
Diabetes	❑	❑	❑	❑	❑	❑
Ulcer or stomach disease	❑	❑	❑	❑	❑	❑
Bowel disease	❑	❑	❑	❑	❑	❑
Kidney disease	❑	❑	❑	❑	❑	❑
Liver disease	❑	❑	❑	❑	❑	❑
Anemia or other blood disease	❑	❑	❑	❑	❑	❑
Overweight	❑	❑	❑	❑	❑	❑
Cancer	❑	❑	❑	❑	❑	❑
Depression	❑	❑	❑	❑	❑	❑
Osteoarthritis, degenerative arthritis	❑	❑	❑	❑	❑	❑
Rheumatoid arthritis	❑	❑	❑	❑	❑	❑
Back pain	❑	❑	❑	❑	❑	❑
Lyme disease	❑	❑	❑	❑	❑	❑
Other medical problem	❑	❑	❑	❑	❑	❑
Alcoholism	❑	❑	❑	❑	❑	❑

Page 2 - IKDC DEMOGRAPHIC FORM

1. Do you smoke cigarettes?

   ❑Yes
   ❑No, I quit in the last six months.
   ❑No, I quit more than six months ago.
   ❑No, I have never smoked.

2. Your height _____ ❑centimeters ❑inches

3. Your weight _____ ❑kilograms ❑pounds

4. Your race (indicate all that apply)

   ❑White ❑Black or African-American ❑Hispanic

   ❑Asian or Pacific Islander ❑Native American Indian ❑Other

5. How much school have you completed?

   ❑Less than high school ❑Graduated from high school ❑Some college

   ❑Graduated from college ❑Postgraduate school or degree

6. Activity level

   ❑Are you a high competitive sports person?

   ❑Are you well-trained and frequently sporting?

   ❑Sporting sometimes

   ❑Non-sporting

IKDC CURRENT HEALTH ASSESSMENT FORM *

Your Full Name _____

Your Date of Birth _____/_____/_____
Day Month Year

Today's Date _____/_____/_____
Day Month Year

1. In general, would you say your health is: ❑Excellent ❑Very Good ❑Good ❑Fair ❑Poor

2. Compared to one year ago, how would you rate your health in general now?

   ❑Much better now than 1 year ago ❑Somewhat better now than 1 year ago ❑About the same as 1 year ago

   ❑Somewhat worse now than 1 year ago ❑Much worse now than 1 year ago

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

		Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
a.	Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	❑	❑	❑
b.	Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	❑	❑	❑
c.	Lifting or carrying groceries	❑	❑	❑
d.	Climbing several flights of stairs	❑	❑	❑
e.	Climbing one flight of stairs	❑	❑	❑
f.	Bending, kneeling or stooping	❑	❑	❑
g.	Walking more than a mile	❑	❑	❑
h.	Walking several blocks	❑	❑	❑
i.	Walking one block	❑	❑	❑
j.	Bathing or dressing yourself	❑	❑	❑

4. During the <u>past 4 weeks</u>, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

		YES	NO
a.	Cut down on the amount of time you spent on work or other activities	❑	❑
b.	Accomplished less than you would like	❑	❑
c.	Were limited in the kind of work or other activities	❑	❑
d.	Had difficulty performing the work or other activities (for example, it took extra effort)	❑	❑

5. During the <u>past 4 weeks</u>, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

		YES	NO
a.	Cut down on the amount of time you spent on work or other activities	❑	❑
b.	Accomplished less than you would like	❑	❑
c.	Didn't do work or other activities as carefully as usual	❑	❑

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

   ❑Not At All ❑Slightly ❑Moderately ❑Quite a Bit ❑Extremely

7. How much bodily pain have you had during the past 4 weeks?

   ❑None ❑Very Mild ❑Mild ❑Moderate ❑Severe ❑Very Severe

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

   ❑Not at All ❑A Little Bit ❑Moderately ❑Quite a Bit ❑Extremely

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
a. Did you feel full of pep?	❑	❑	❑	❑	❑	❑
b. Have you been very nervous?	❑	❑	❑	❑	❑	❑
c. Have you felt calm and peaceful?	❑	❑	❑	❑	❑	❑
d. Did you have a lot of energy?	❑	❑	❑	❑	❑	❑
e. Have you felt down-hearted and blue?	❑	❑	❑	❑	❑	❑
f. Did you feel worn out?	❑	❑	❑	❑	❑	❑
g. Have you been a happy person	❑	❑	❑	❑	❑	❑
h. Did you feel tired?	❑	❑	❑	❑	❑	❑

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

    ❑All of the time ❑Most of the time ❑Some of the time ❑A little of the time ❑None of the time

11. How TRUE or FALSE is each of the following statements for you?

	Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
a. I seem to get sick a little easier than other people	❑	❑	❑	❑	❑
b. I am as healthy as anybody I know	❑	❑	❑	❑	❑
c. I expect my health to get worse	❑	❑	❑	❑	❑
d. My health is excellent	❑	❑	❑	❑	❑

*This form includes questions from the SF-36™ Health Survey. Reproduced with the permission of the Medical Outcomes Trust, Copyright © 1992.

2000 IKDC SUBJECTIVE KNEE EVALUATION FORM

Your Full Name_____

Today's Date: _____/_____/_____ Date of Injury: _____/_____/_____
Day Month Year Day Month Year

SYMPTOMS*:

*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

1. What is the highest level of activity that you can perform without significant knee pain?

   4❑Very strenuous activities like jumping or pivoting as in basketball or soccer
   3❑Strenuous activities like heavy physical work, skiing or tennis
   2❑Moderate activities like moderate physical work, running or jogging
   1❑Light activities like walking, housework or yard work
   0❑Unable to perform any of the above activities due to knee pain

2. During the past 4 weeks, or since your injury, how often have you had pain?

	0	1	2	3	4	5	6	7	8	9	10	
Never	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	Constant

3. If you have pain, how severe is it?

	0	1	2	3	4	5	6	7	8	9	10	
No pain	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	Worst pain imaginable

4. During the past 4 weeks, or since your injury, how stiff or swollen was your knee?

   4❑Not at all
   3❑Mildly
   2❑Moderately
   1❑Very
   0❑Extremely

5. What is the highest level of activity you can perform without significant swelling in your knee?

   4❑Very strenuous activities like jumping or pivoting as in basketball or soccer
   3❑Strenuous activities like heavy physical work, skiing or tennis
   2❑Moderate activities like moderate physical work, running or jogging
   1❑Light activities like walking, housework, or yard work
   0❑Unable to perform any of the above activities due to knee swelling

6. During the past 4 weeks, or since your injury, did your knee lock or catch?

   0❑Yes 1❑No

7. What is the highest level of activity you can perform without significant giving way in your knee?
   4❑Very strenuous activities like jumping or pivoting as in basketball or soccer
   3❑Strenuous activities like heavy physical work, skiing or tennis
   2❑Moderate activities like moderate physical work, running or jogging
   1❑Light activities like walking, housework or yard work
   0❑Unable to perform any of the above activities due to giving way of the knee

SPORTS ACTIVITIES:

8. What is the highest level of activity you can participate in on a regular basis?

4❑Very strenuous activities like jumping or pivoting as in basketball or soccer
3❑Strenuous activities like heavy physical work, skiing or tennis
2❑Moderate activities like moderate physical work, running or jogging
1❑Light activities like walking, housework or yard work
0❑Unable to perform any of the above activities due to knee

9. How does your knee affect your ability to:

		Not difficult at all	Minimally difficult	Moderately Difficult	Extremely difficult	Unable to do
a.	Go up stairs	4❑	3❑	2❑	1❑	0❑
b.	Go down stairs	4❑	3❑	2❑	1❑	0❑
c.	Kneel on the front of your knee	4❑	3❑	2❑	1❑	0❑
d.	Squat	4❑	3❑	2❑	1❑	0❑
e.	Sit with your knee bent	4❑	3❑	2❑	1❑	0❑
f.	Rise from a chair	4❑	3❑	2❑	1❑	0❑
g.	Run straight ahead	4❑	3❑	2❑	1❑	0❑
h.	Jump and land on your involved leg	4❑	3❑	2❑	1❑	0❑
i.	Stop and start quickly	4❑	3❑	2❑	1❑	0❑

FUNCTION:

10. How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

FUNCTION PRIOR TO YOUR KNEE INJURY:

	0	1	2	3	4	5	6	7	8	9	10	
Couldn't perform daily activities	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	No limitation in daily activities

CURRENT FUNCTION OF YOUR KNEE:

	0	1	2	3	4	5	6	7	8	9	10	
Can't perform daily activities	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	No limitation in daily activities

Scoring Instructions for the 2000 IKDC Subjective Knee Evaluation Form

Several methods of scoring the IKDC Subjective Knee Evaluation Form were investigated. The results indicated that summing the scores for each item performed as well as more sophisticated scoring methods.

The responses to each item are scored using an ordinal method such that a score of 0 is given to responses that represent the lowest level of function or highest level of symptoms. For example, item 1, which is related to the highest level of activity without significant pain is scored by assigning a score of 0 to the response "Unable to perform any of the above activities due to knee pain" and a score of 4 to the response "Very strenuous activities like jumping or pivoting as in basketball or soccer". **For item 2, which is related to the frequency of pain over the past 4 weeks, the responses are reverse-scored such that "Constant" is assigned a score of 0 and "Never" is assigned a score of 10. Similarly, for item 3, the responses are reversed-scored such that "Worst pain imaginable" is assigned a score of 0 and "No pain" is assigned a score of 10.** Note: previous versions of the form had a minimum item score of 1 (for example, ranging from 1 to 11). In the most recent version, all items now have a minimum score of 0 (for example, 0 to 10). To score these prior versions, you would need to transform each item to the scaling for the current version.

The IKDC Subjective Knee Evaluation Form is scored by summing the scores for the individual items and then transforming the score to a scale that ranges from 0 to 100. **Note**: The response to item 10a "Function Prior to Knee Injury" is not included in the overall score. To score the current form of the IKDC, simply add the score for each item (the small number by each item checked) and divide by the maximum possible score which is 87:

$$\text{IKDC Score} = \left[\frac{\text{Sum of Items}}{\text{Maximum Possible Score}}\right] \text{x } 100$$

Thus, for the current version, if the sum of scores for the 18 items is 45 and the patient responded to all the items, the IKDC Score would be calculated as follows:

$$\text{IKDC Score} = \left[\frac{45}{87}\right] \text{x } 100$$

$$\text{IKDC Score} = 51.7$$

The transformed score is interpreted as a measure of function such that higher scores represent higher levels of function and lower levels of symptoms. A score of 100 is interpreted to mean no limitation with activities of daily living or sports activities and the absence of symptoms.

The IKDC Subjective Knee Form score can be calculated when there are responses to at least 90% of the items (i.e. when responses have been provided for at least 16 items). In the original scoring instructions for the IKDC Subjective Knee Form, missing values are replaced by the average score of the items that have been answered. However, this method could slightly over- or under-estimate the score depending on the maximum value of the missing item(s) (2, 5 or 11 points). Therefore, in the revised scoring procedure for the current version of a form with up to two missing values, the IKDC Subjective Knee Form Score is calculated as (sum of the completed items) / (maximum possible sum of the completed items) * 100. This method of scoring the IKDC Subjective Knee Form is more accurate than the original scoring method.

A scoring spreadsheet is also available at: www.sportsmed.org/research/index.asp This spreadsheet uses the current form scores and the revised scoring method for calculating scores with missing values.

2000 IKDC KNEE HISTORY FORM

Patient Name _____ Birthdate _____/_____/_____
Day Month Year

Date of Injury _____/_____/_____ Date of Initial Exam _____/_____/_____ Today's Date _____/_____/_____
Day Month Year Day Month Year Day Month Year

Involved Knee: ❑Right ❑Left

Contralateral: ❑Normal ❑Nearly Normal ❑Abnormal ❑Severely abnormal

Onset of Symptoms: (date) _____/_____/_____
Day Month Year

Chief Complaint:_____

Activity at Injury: ❑ADL ❑Sports ❑Traffic ❑Work

Mechanism of Injury:

❑Non-traumatic gradual onset ❑Traumatic non-contact onset
❑Non-traumatic sudden onset ❑Traumatic contact onset

Previous Surgery:

Type of Surgery: (check all that apply)

Meniscal Surgery

❑Medial meniscectomy ❑Lateral meniscectomy
❑Medial meniscal repair ❑Lateral meniscal repair
❑Medial meniscal transplant ❑Lateral meniscal transplant

Ligament Surgery

❑ACL Repair ❑Intraarticular ACL reconstruction ❑Extraarticular ACL reconstruction
❑PCL Repair ❑Intraarticular PCL reconstruction ❑Posterolateral corner reconstruction
❑Medial collateral ligament repair/reconstruction
❑Lateral collateral ligament repair/reconstruction

Type of Graft

Patella tendon graft ❑Ipsilateral ❑Contralateral
❑Single hamstring graft
❑2 Bundle hamstring graft
❑4 Bundle hamstring graft
❑Quadriceps tendon graft
❑Allograft
❑Other

Extensor Mechanism Surgery

❑Patella tendon repair ❑Quadriceps tendon repair

Patellofemoral Surgery

❑Extensor Mechanism Realignment

Soft Tissue Realignment

❑Medial imbrication ❑Lateral release

Bone Realignment

Movement of the tibial tubercle
❑Proximal ❑Distal ❑Medial ❑Lateral ❑Anterior

❑Trochleoplasty

❑Patellectomy

Osteoarthritis Surgery

❑Osteotomy

❑Articular Surface Surgery ❑Shaving ❑Abrasion ❑Drilling ❑Microfracture
❑Cell therapy ❑Osteochondral autograft transfer/mosaic-plasty ❑Other

Total number of previous surgeries_____

Imaging Studies:

❑Structural ❑MRI ❑CT ❑Arthrogram

❑Metabolic (Bone Scan)

Findings:

Ligament_____

Meniscus_____

Articular Cartilage_____

Bone _____

2000 IKDC SURGICAL DOCUMENTATION FORM

Patient's Name: _____ Date of Index Procedure: _____/_____/_____
Day Month Year

Postoperative Diagnosis:

1._____

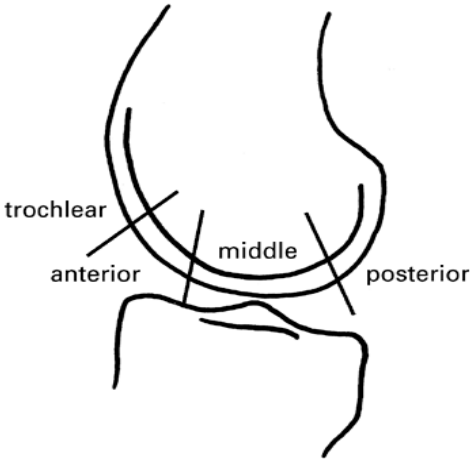
2._____

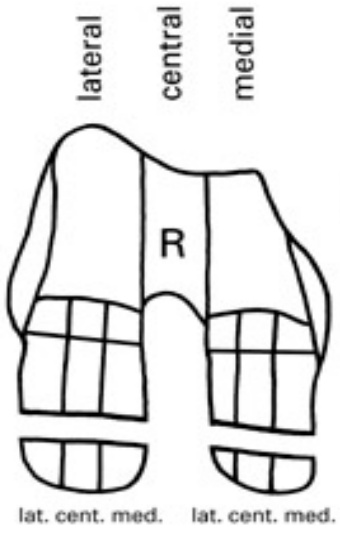
3._____

Status After Procedure:

ARTICULAR CARTILAGE STATUS:

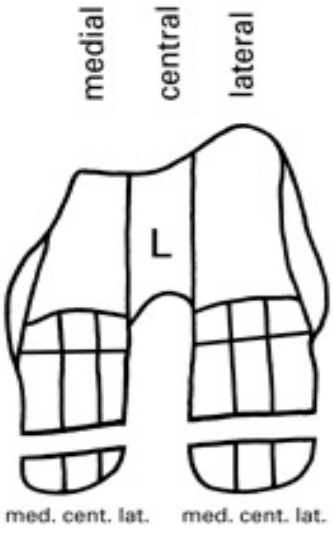
Document the size and location of articular cartilage defects on these figures according to the ICRS mapping system[c].

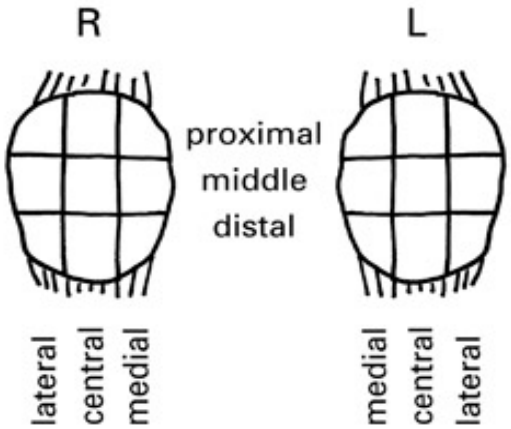


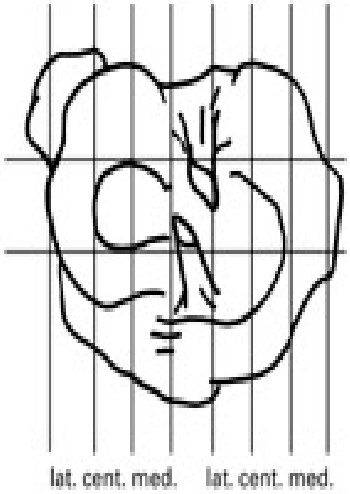


Trochlear

Condyle
anterior
central
posterior



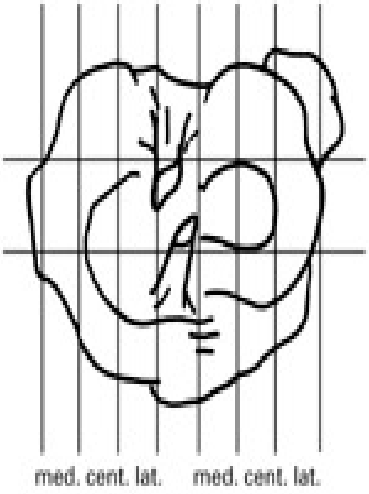




posterior

central

anterior



Record size, location and grade of articular cartilage lesions.

Femur

					First lesion	Second Lesion
Side	Right	Left				
Condyle	Medial	Lateral				
Sagittal plane	Trochlear	Anterior	Middle	Posterior		
Frontal plane	Lateral	Central	Medial			

Cartilage lesion (Grade) (*) ☐
Defect size pre-debridement ☐☐ mm
Defect size post-debridement ☐☐ mm

Tibia

				First lesion	Second Lesion
Side	Right	Left			
Plateau	Medial	Lateral			
Sagittal Plane	Anterior	Middle	Posterior		
Frontal Plane	Lateral	Central	Medial		

Cartilage lesion (Grade) (*) ☐
Defect size pre-debridement ☐☐ mm
Defect size post-debridement ☐☐ mm

Patella

				First lesion	Second Lesion
Side	Right	Left			
Sagittal plane	Distal	Middle	Proximal		
Frontal plane	Lateral	Central	Medial		

Cartilage lesion (Grade) (*) ☐
Defect size pre-debridement ☐☐ mm
Defect size post-debridement ☐☐ mm

Diagnosis: ❑ Traumatic cartilage lesion ❑OD ❑OA ❑AVN ❑Others

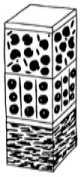
Biopsy/Osteochondral Plugs: Location: Number of Plugs:

Diameter of Plugs: mm

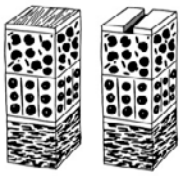
Treatment: ❑ Shaving ❑ Abrasion
❑ Drilling ❑ Microfracture
❑ Osteochondral autograft transfer/mosaic-plasty
❑ Cell therapy ❑ Other

Notes:

ICRS Grade 0 - Normal



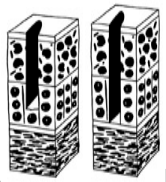
ICRS Grade 1 – Nearly Normal
Superficial lesions, Soft indentation (A) and/or superficial fissures and cracks (B)



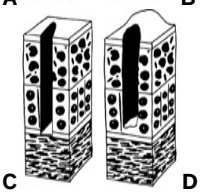
A B

ICRS Grade 2 – Abnormal
Lesions extending down to <50% of cartilage depth

ICRS Grade 3 - Severely Abnormal
Cartilage defects extending down >50% of cartilage depth (A) as well as down to calcified layer (B) and down to Blisters are included in this Grade (D)

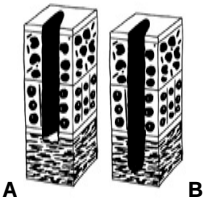


A B



C D

ICRS Grade 4 – Severely Abnormal
Osteochondral injuries, lesions extending just through the subchondral boneplate (A) or deeper defects down into trabecular bone (B). Defects that have been drilled are regarded as osteochondral defects and classified as ICRS-C.



A B

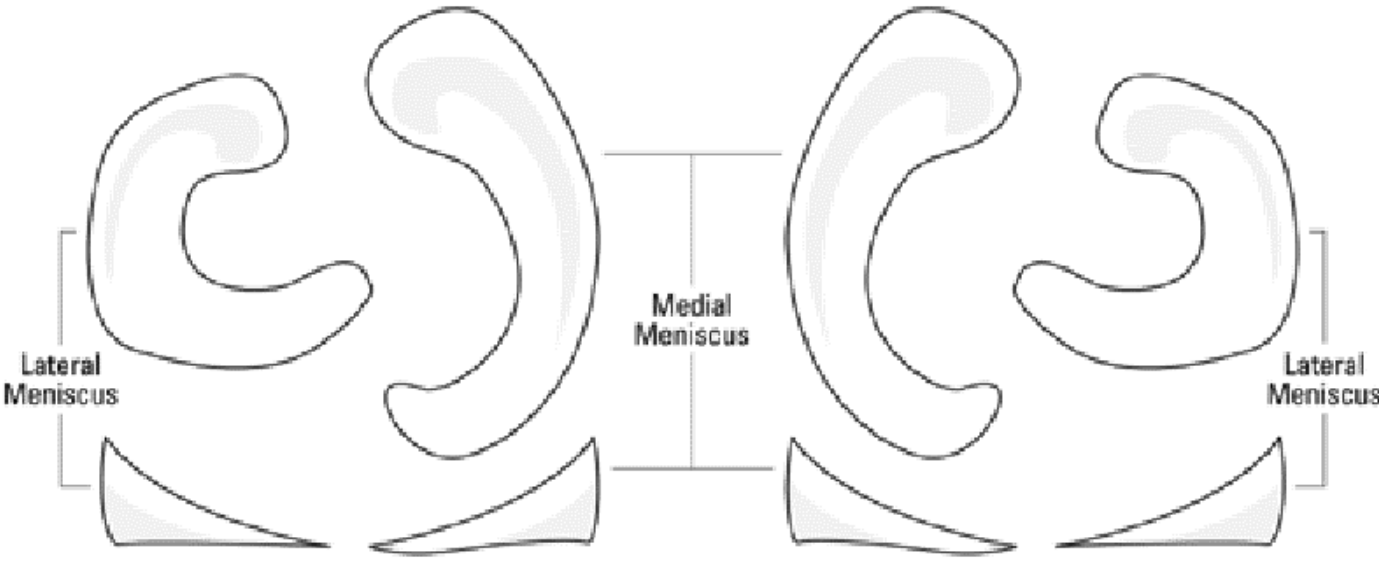
MENISCUS STATUS:

Procedure:

❑medial meniscectomy	❑lateral meniscectomy
❑medial meniscal repair	❑lateral meniscus repair
❑medial meniscal transplant	❑lateral meniscal transplant
❑medial abrade & trephine	❑lateral abrade & trephine

Right Knee **Left Knee**

Document tears of the menisci or meniscectomy on these figures



Medial:

❑Normal ❑1/3 Removed ❑2/3 Removed ❑3/3 Removed

Circumferential Hoop Fibers: ❑Intact ❑Disrupted

Remaining Meniscal Tissue: ❑Normal ❑Degenerative changes
❑Stable tear ❑Unstable tear
❑Tear left in situ

Lateral:

❑Normal ❑1/3 Removed ❑2/3 Removed ❑3/3 Removed

Circumferential Hoop Fibers: ❑Intact ❑Disrupted

Remaining Meniscal Tissue: ❑Normal ❑Degenerative changes
❑Stable tear ❑Unstable tear
❑Tear left in situ

LIGAMENT STATUS:

Procedure:

❑ACL repair ❑Intraarticular ACL reconstruction ❑Extraarticular ACL reconstruction
❑PCL repair ❑Intraarticular PCL reconstruction ❑Posterolateral corner repair/reconstruction
❑Medial collateral ligament repair/reconstruction
❑Lateral collateral ligament repair/reconstruction

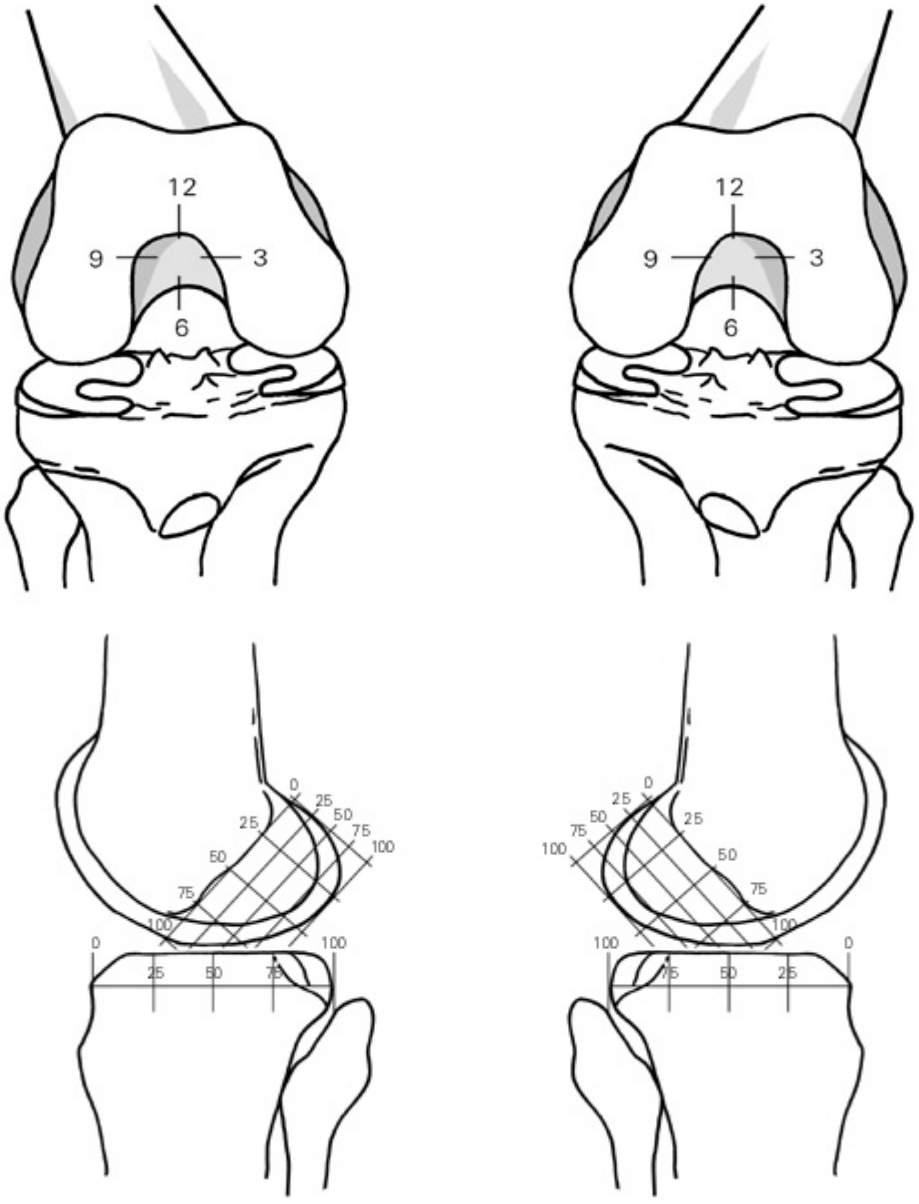
Graft:

❑Autologous patella tendon ❑Hamstring tendons ❑Quadriceps tendon
❑Other_____

Previous Graft Harvest:

❑Autologous patella tendon ❑Hamstring tendons ❑Quadriceps tendon

Document drill hole placement for ligament reconstruction on these figures.



2000
IKDC KNEE EXAMINATION FORM

Patient Name:_____ **Date of Birth:**_____/_____/_____
Day Month Year

Gender: ☐F ☐M **Age**:_____ **Date of Examination**:_____/_____/_____
Day Month Year

Generalized Laxity: ☐ight ☐normal ☐ax

Alignment: ☐bvious varus ☐normal ☐bvious valgus

Patella Position: ☐bvious baja ☐normal ☐bvious alta

Patella Subluxation/Dislocation: ☐entered ☐ubluxable ☐ubluxed ☐islocated

Range of Motion (Ext/Flex): Index Side: passive_____/_____/_____ active_____/_____/_____
Opposite Side: passive_____/_____/_____ active_____/_____/_____

SEVEN GROUPS	FOUR GRADES A Normal	B Nearly Normal	C Abnormal	D Severely Abnormal	*Group Grade A	B	C	D
1. Effusion	☐None	☐Mild	☐Moderate	☐Severe	☐	☐	☐	☐
2. Passive Motion Deficit								
ΔLack of extension	☐< 3°	☐3 to 5°	☐6 to 10°	☐> 10°				
ΔLack of flexion	☐0 to 5°	☐6 to 15°	☐16 to 25°	☐> 25°	☐	☐	☐	☐
3. Ligament Examination (manual, instrumented, x-ray)								
ΔLachman (25° flex) (134N)	☐-1 to 2mm	☐3 to 5mm(1+) ☐< -1 to –3	☐6 to 10mm(2+) ☐< -3 stiff	☐> 10mm(3+)				
ΔLachman (25° flex) manual max	☐-1 to 2mm	☐3 to 5mm	☐6 to 10mm	☐> 10mm				
Anterior endpoint:	☐Firm		☐Soft					
ΔTotal AP Translation (25° flex)	☐0 to 2mm	☐3 to 5mm	☐6 to 10mm	☐> 10mm				
ΔTotal AP Translation (70° flex)	☐0 to 2mm	☐3 to 5mm	☐6 to 10mm	☐> 10mm				
ΔPosterior Drawer Test (70° flex)	☐0 to 2mm	☐3 to 5mm	☐6 to 10mm	☐> 10mm				
ΔMed Joint Opening (20° flex/valgus rot)	☐0 to 2mm	☐3 to 5mm	☐6 to 10mm	☐> 10mm				
ΔLat Joint Opening (20° flex/varus rot)	☐0 to 2mm	☐3 to 5mm	☐6 to 10mm	☐> 10mm				
ΔExternal Rotation Test (30° flex prone)	☐< 5°	☐6 to 10°	☐11 to 19°	☐> 20°				
ΔExternal Rotation Test (90° flex prone)	☐< 5°	☐6 to 10°	☐11 to 19°	☐> 20°				
ΔPivot Shift	☐equal	☐+ glide	☐++ (clunk)	☐+++ (gross)				
ΔReverse Pivot Shift	☐equal	☐glide	☐gross	☐marked				
4. Compartment Findings			crepitation with		☐	☐	☐	☐
ΔCrepitus Ant. Compartment	☐none	☐moderate	☐mild pain	☐> mild pain				
ΔCrepitus Med. Compartment	☐none	☐moderate	☐mild pain	☐> mild pain				
ΔCrepitus Lat. Compartment	☐none	☐moderate	☐mild pain	☐> mild pain				
5. Harvest Site Pathology	☐none	☐mild	☐moderate	☐severe				
6. X-ray Findings								
Med. Joint Space	☐none	☐mild	☐moderate	☐severe				
Lat. Joint Space	☐none	☐mild	☐moderate	☐severe				
Patellofemoral	☐none	☐mild	☐moderate	☐severe				
Ant. Joint Space (sagittal)	☐none	☐mild	☐moderate	☐severe				
Post. Joint Space (sagittal)	☐none	☐mild	☐moderate	☐severe				
7. Functional Test								
One Leg Hop (% of opposite side)	☐≥ 90%	☐89 to 76%	☐75 to 50%	☐< 50%				
****Final Evaluation**					☐	☐	☐	☐

* Group grade: The lowest grade within a group determines the group grade

** Final evaluation: the worst group grade determines the final evaluation for acute and subacute patients. For chronic patients compare preoperative and postoperative evaluations. In a final evaluation only the first 3 groups are evaluated but all groups must be documented. Δ Difference in involved knee compared to normal or what is assumed to be normal.

IKDC COMMITTEE AOSSM: Anderson, A., Bergfeld, J., Boland, A. Dye, S., Feagin, J., Harner, C. Mohtadi, N. Richmond, J. Shelbourne, D., Terry, G. ESSKA: Staubli, H., Hefti, F., Hoher, J., Jacob, R., Mueller, W., Neyret, P. APOSSM: Chan, K., Kurosaka, M.

INSTRUCTIONS FOR THE 2000 IKDC KNEE EXAMINATION FORM

The Knee Examination Form contains items that fall into one of seven measurement domains. However, only the first three of these domains are graded. The seven domains assessed by the Knee Examination Form are:

1. *Effusion*
   An effusion is assessed by ballotting the knee. A fluid wave (less than 25 cc) is graded mild, easily ballotteable fluid – moderate (25-60 cc), and a tense knee secondary to effusion (greater than 60 cc) is rated severe.

2. *Passive Motion Deficit*
   Passive range of motion is measured with a gonimeter and recorded on the form for the index side and opposite or normal side. Record values for zero point/hyperextension/flexion (e.g. 10 degrees of hyperextension, 150 degrees of flexion = 10/0/150; 10 degrees of flexion to 150 degrees of flexion = 0/10/150). Extension is compared to that of the normal knee.

3. *Ligament Examination*
   The Lachman test, total AP translation at 70 degrees, and medial and lateral joint opening may be assessed with manual, instrumented or stress x-ray examination. Only one should be graded, preferably a "measured displacement". A force of 134 N (30 lbs) and the maximum manual are recorded in instrumented examination of both knees. Only the measured displacement at the standard force of 134 N is used for grading. The numerical values for the side to side difference are rounded off, and the appropriate box is marked.

   The end point is assessed in the Lachman test. The end point affects the grading when the index knee has 3-5 mm more anterior laxity than the normal knee. In this case, a soft end point results in an abnormal grade rather than a nearly normal grade.

   The 70-degree posterior sag is estimated by comparing the profile of the injured knee to the normal knee and palpating the medial femoral tibial stepoff. It may be confirmed by noting that contraction of the quadriceps pulls the tibia anteriorly.

   The external rotation tests are performed with the patient prone and the knee flexed 30° and 70°.
   Equal external rotational torque is applied to both feet and the degree of external rotation is recorded.

   The pivot shift and reverse pivot shift are performed with the patient supine, with the hip in 10-20 degrees of abduction and the tibia in neutral rotation using either the Losee, Noyes, or Jakob techniques. The greatest subluxation, compared to the normal knee, should be recorded.

4. *Compartment Findings*
   Patellofemoral crepitation is elicited by extension against slight resistance. Medial and lateral compartment crepitation is elicited by extending the knee from a flexed position with a varus stress and then a valgus stress (i.e., McMurray test). Grading is based on intensity and pain.

5. *Harvest Site Pathology*
   Note tenderness, irritation or numbness at the autograft harvest site.

6. *X-ray Findings*
   A bilateral, double leg PA weightbearing roentgenogram at 35-45 degrees of flexion (tunnel view) is used to evaluate narrowing of the medial and lateral joint spaces. The Merchant view at 45 degrees is used to document patellofemoral narrowing. A mild grade indicates minimal changes (i.e., small osteophytes, slight sclerosis or flattening of the femoral condyle) and narrowing of the joint space which is just detectable. A moderate grade may have those changes and joint space narrowing (e.g., a joint space of 2-4 mm side or up to 50% joint space narrowing). Severe changes include a joint space of less than 2 mm or greater than 50% joint space narrowing.

7. *Functional Test*
   The patient is asked to perform a one leg hop for distance on the index and normal side. Three trials for each leg are recorded and averaged. A ratio of the index to normal knee is calculated.

Appendix M

Marx Scale

MARX SCALE (ENGLISH VERSION)

Please indicate how often you performed each activity in your healthiest and most active state, in the past year. Kindly put a (☑) mark on the appropriate space after each item.

	Less than one time in a month	One time in a month	One time in a week	2 or 3 times in a week	4 or more times in a week
Running: running while playing a sport or jogging	0	1	2	3	4
Cutting: changing directions while running	0	1	2	3	4
Deceleration: coming to a quick stop while running	0	1	2	3	4
Pivoting: turning your body with your foot planted while playing sport; For example: skiing, skating, kicking, throwing, hitting a ball (golf, tennis, squash), etc.	0	1	2	3	4

Appendix N

NFHS Position Statement: Soft or Padded Headgear in Non-Helmeted Sports

National Federation of State High School Associations

Soft or Padded Headgear in Non-Helmeted Sports Position Statement

National Federation of State High School Associations (NFHS)
Sports Medicine Advisory Committee (SMAC)

The NFHS SMAC has developed the following position statement regarding soft or padded headgear products in non-helmeted sports:

The NFHS does not consider soft or padded headgear products as effective equipment in preventing a concussion in non-helmeted sports. As explained below, soft or padded headgear products may be worn in non-helmeted sports that allow for such optional equipment, but the intent of that equipment should be for reasons other than concussion prevention. Valid scientific research should be pursued to more definitively determine evidence-based efficacy regarding using such products to decrease the incidence of concussion. However, no currently available soft or padded headgear can prevent a concussion.

The NFHS recommends caution in using soft or padded headgear devices to permit medical clearance of a student-athlete, if he or she would otherwise not be medically cleared to participate in sports. Currently, wearing such headgear as a condition to play in order to prevent another concussion is not scientifically or medically supported; therefore, a medical waiver for wearing this type of equipment in the case of hastening return to play after a concussion is inappropriate. However, this equipment may be used to cover lacerations and sutures, if these devices are deemed appropriate within the sport's playing rules.

Current design and recommended use of these devices do not address the proposed mechanism of concussive injury, that being acceleration, deceleration and rotational forces acting on the brain. Schools should refer to equipment standards from the National Operating Committee on Standards for Athletic Equipment (NOCSAE), American Society for Testing Materials (ASTM), and the Hockey Equipment Certification Council, Inc. (HECC), when considering protective equipment for student-athletes, and monitor that the equipment is being used for mitigating the risk of injuries for which the equipment is designed.

When considering the use of optional soft or padded headgear products in non-helmeted sports, athletes and coaches should take the time to read the qualifying statements provided with such products that address specific limitations, particularly those related to preventing serious head injuries. Wearing such products may provide a false sense of security in concussion protection to student-athletes, coaches and parents. Moreover, a false sense of security in concussion protection may increase the likelihood that players, coaches and parents will consider a given medical condition to be adequately addressed and may cause them to place less importance upon avoiding head impact, reporting concussion symptoms and recovering fully before returning to play.

The NFHS SMAC will continue to monitor developments in soft and padded headgear and will consider adjustments to its position should valid scientific and clinical evidence arise.

Approved June 2013

DISCLAIMER – NFHS Position Statements and Guidelines

The NFHS regularly distributes position statements and guidelines to promote public awareness of certain health and safety-related issues. Such information is neither exhaustive nor necessarily applicable to all circumstances or individuals, and is no substitute for consultation with appropriate health-care professionals. Statutes, codes or environmental conditions may be relevant. NFHS position statements or guidelines should be considered in conjunction with other pertinent materials when taking action or planning care. The NFHS reserves the right to rescind or modify any such document at any time.