U.S. Army Center for Health Promotion and Preventive Medicine

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USACHPPM REPORT NO. 21-KK-08QR-08

Recommendations for Prevention of Physical Training (PT)-Related Injuries: Results of a Systematic Evidence-Based Review by the Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG)

U.S. Army Center for Health Promotion and Preventive Medicine
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14. ABSTRACT
The Military Training Task Force (MTTF) of the Defense Safety Oversight Council chartered a Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG) to 1) establish the evidence base for making recommendations to prevent injuries, 2) prioritize the recommendations for prevention programs and policies, and 3) substantiate the need for further research and evaluation on interventions and programs likely to reduce PT-related injuries. Of the 40 PT-related injury prevention strategies reviewed in the scientific literature, 3 were determined to be essential elements of a successful injury prevention program and not interventions in and of themselves. As a result of the work group process, one more essential element was added for a total of four. The remaining 37 interventions were categorized into 3 levels representing the strength of recommendation: recommended, not recommended, and insufficient evidence to recommend or not recommend. Six interventions had strong enough evidence to become JSPTIPWG recommendations for implementation in all four military Services immediately. Two interventions were not recommended due to evidence of ineffectiveness or harm and should be discouraged by leaders at all levels. This technical report identifies 29 injury prevention strategies that have yet to be evaluated (n=6) or that lack sufficient scientific evidence (n=23) to support Quad-Service recommendations at this time. Injury researchers interested in studying the prevention of PT-related injuries in the military should start with this list. The systematic process of evaluating interventions enabled the JSPTIPWG to build Quad-Service consensus around those injury prevention strategies that had enough scientific evidence to support a recommendation. The use of guidelines that required a sufficient level of scientific evidence before making any recommendation was key to prioritizing the recommendations. Preventing physical training-related injuries will have a significant effect on military operational readiness by decreasing entry-level attrition and separation due to injury.

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EXECUTIVE SUMMARY
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Recommendations for Prevention of Physical Training (PT)-Related Injuries: Results of a Systematic Evidence-Based Review by the Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG)

1. PURPOSE. The Military Training Task Force (MTTF) of the Defense Safety Oversight Council was formed to support the accident and injury prevention mandate of the Secretary of Defense with a focus on interventions that relate to all aspects of military training. The was chartered under the MTTF in September 2004 primarily to evaluate military physical training (PT) injury prevention programs, policies, and research and develop cross-Service recommendations to reduce PT-related injuries during and after initial entry training. Overall, the process used by the JSPTIPWG served three primary purposes:

a. Establish the evidence base for making recommendations to prevent injuries.

b. Prioritize the recommendations for prevention programs and policies.

c. Substantiate the need for further research and evaluation on interventions and programs likely to reduce PT-related injuries.

2. CONCLUSIONS.

a. Of the 40 PT-related injury prevention strategies reviewed in the scientific literature by the JSPTIPWG, 3 were determined to be critical components of a successful injury prevention program and not interventions in and of themselves. Therefore, rather than viewing these components as interventions, the JSPTIPWG agreed to classify them as “essential elements” that are necessary for the successful implementation of any injury prevention strategy. Because of lack of convincing scientific evidence for most of the strategies identified, the work group deemed it prudent to add one more essential element to the list (research and program evaluation), bringing the list of essential elements to 4 and the total intervention strategies considered to 37. The essential elements of an injury prevention program are:

(1) Education of Service members, especially leaders, in injury prevention principles and evidence-based strategies.

(2) Leadership enforcement of injury prevention policies and programs.

(3) Unit injury surveillance reporting.

(4) Investment of greater resources in research and program evaluation of training-related injury prevention interventions.

b. Of the 37 interventions, 6 were neither reviewed nor discussed by the work group. There are currently no JSPTIPWG recommendations for these interventions except that they be reviewed and discussed in a systematic manner. The remaining 31 interventions were categorized into 3 levels representing the strength of recommendation: recommended, not recommended, and insufficient evidence to recommend or not recommend. Six interventions (20 percent) had strong enough evidence to become JSPTIPWG recommendations. This was an unexpectedly low number, given that the majority of the interventions proposed had been thought by some members of the JSPTIPWG to be proven effective. Leaders should implement these recommendations and monitor injury rates and physical fitness to ensure recommended strategies are having the intended effect. Two interventions (6 percent) were not recommended due to evidence of ineffectiveness or harm: Leaders should discourage the use of back braces, harnesses, or support belts and advise against the use of anti-inflammatory medication prior to exercise in their units.

c. What stands out as a singularly important outcome of this work group effort is the significant number of interventions for which there is still insufficient evidence to support recommending the interventions as injury prevention strategies to the military Services at this time. Twenty-three (74 percent) of the interventions reviewed in the scientific literature cannot be recommended because of lack of evidence, poor quality evidence, conflicting evidence, or evidence of harm. Leaders should carefully weigh the benefits and costs of implementing any of these 23 unproven strategies in their units in order to conserve resources and maximize training time. For example, it would not be prudent to waste precious PT time with group stretching given that it has no proven injury prevention efficacy.

d. The lack of scientific evidence found for most injury prevention strategies supports the work group decision to add the fourth essential element (greater investment of resources in research and program evaluation of training-related injury prevention interventions) for successful injury prevention programs. Without further research and program evaluation of injury prevention strategies in military populations (and in comparable civilian populations), the rate of PT-related injuries will continue to be a burden on the Services and a health threat to Force readiness. Preventing injuries will have a significant effect on military operational readiness by decreasing entry-level attrition and separation due to injury. This technical report identifies 29 injury prevention strategies that have yet to be evaluated (n=6) or that lack sufficient scientific evidence (n=23) to support Quad-Service recommendations. Injury researchers interested in studying the prevention of PT-related injuries in the military should start with this list.

e. The systematic process of evaluating interventions enabled the JSPTIPWG to build Quad-Service consensus around those injury prevention strategies that had enough scientific evidence to support a recommendation. The use of guidelines that required a sufficient level of scientific evidence before making any recommendation was key to prioritizing the recommendations. While the initial effort of the work group sought to elucidate the proven strategies to reduce injuries in the basic training environment, the principles behind the six recommended interventions can be broadly and inexpensively applied to operational training environments among the Services with similar results.

3. DISCUSSION AND RECOMMENDATIONS. Recommendations related to each of the essential program elements and 37 injury prevention strategies are summarized below in five categories: Essential Elements of an Injury Prevention Program (*Not Interventions*); Recommended Interventions (*Based on Sufficient Scientific Evidence*); Interventions Not Recommended (Due to Evidence of Ineffectiveness or Harm); Interventions Without Sufficient Evidence to Recommend at This Time; and Interventions Without a Completed Review (*Interventions That Require a Systematic Literature Review, Work Group Discussion, and Objective Assessment*).

a. Essential Elements of an Injury Prevention Program (*Not Interventions*).

(1) Education of Service members, especially leaders, in injury prevention principles and evidence-based strategies (essential program element).

(2) Leadership enforcement of injury prevention policies and programs (essential program element).

(3) Unit injury surveillance reporting (essential program element).

(4) Investment of greater resources in research and program evaluation of training-related injury prevention interventions (essential program element).

b. Recommended Interventions (*Based on Sufficient Scientific Evidence*).

(1) Prevent overtraining (strongly recommended).

(2) Perform multiaxial, neuromuscular, proprioceptive, and agility training (recommended).

(3) Wear mouthguards during high-risk activities (recommended).

(4) Wear semirigid ankle braces for high-risk activities (recommended).

(5) Consume nutrients to restore energy balance within 1 hour following high-intensity activity (recommended).

(6) Wear synthetic blend socks to prevent blisters (recommended).

c. Interventions Not Recommended (Due to Evidence of Ineffectiveness or Harm).

(1) Wear back braces, harnesses, or support belts (not recommended).

(2) Take anti-inflammatory medication prior to exercise (not recommended).

d. Interventions Without Sufficient Evidence to Recommend at This Time.

(1) Stretch muscles before or after exercise (insufficient evidence to support).

(2) Reinitiate exercise at lower intensity levels for detrained individuals (insufficient evidence to support).

(3) Target specific muscles to strengthen (insufficient evidence to support).

(4) Replace running shoes at standard intervals (insufficient evidence to support).

(5) Warm up and cool down before and after activity (insufficient evidence to support).

(6) Place shorter Service members in front of formations to set the running pace and cadence (insufficient evidence to support).

(7) Manipulate stride length (insufficient evidence to support).

(8) Participate in a standardized, graduated marching (aka hiking) program (insufficient evidence to support).

(9) Gradually increase load-bearing during marching (insufficient evidence to support).

(10) Avoid hazardous exercises or exercise machines (insufficient evidence to support).

(11) Separate body weight assessment and maximal effort physical fitness tests (insufficient evidence to support).

(12) Wear shock-absorbing insoles (insufficient evidence to support).

(13) Wear running shoes based on individual foot shape (insufficient evidence to support).

(14) Wrap ankle with athletic tape prior to high-risk activity (insufficient evidence to support).

(15) Run on improved surfaces that minimize injury risk (insufficient evidence to support).

(16) Improve obstacle course landing surfaces (insufficient evidence to support).

(17) Adjust training loads by seasonal variations (insufficient evidence to support).

(18) Encourage smoking cessation programs to prevent musculoskeletal injuries (insufficient evidence to support).

(19) Educate Service members on safe lifting techniques (insufficient evidence to support).

(20) Apply ice to injuries early to prevent re-injury (insufficient evidence to support).

(21) Take oral contraceptives to decrease injury (insufficient evidence to support).

(22) Standardize the unit reconditioning program after rehabilitation (insufficient evidence to support).

(23) Predict injury risk through use of an injury risk index (insufficient evidence to support).

e. Interventions Without a Completed Review (*Interventions That Require a Systematic Literature Review, Work Group Discussion, and Objective Assessment*).

(1) Provide pre-basic training fitness assessment and fitness programs for the least fit (incomplete review).

(2) Individualize PT versus training as a group or unit (incomplete review).

(3) Wear knee braces (incomplete review).

(4) Wear forearm or elbow straps (incomplete review).

(5) Utilize allied health professionals in a pre-military treatment facility care setting (incomplete review).

(6) Accommodate for psychosocial issues related to injury (incomplete review).

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Recommendations for Prevention of Physical Training (PT)-Related Injuries: Results of a Systematic Evidence-Based Review by the Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG)

I. REFERENCES. References included in the literature searches relative to injury prevention intervention strategies are listed in paragraphs VI through X of this report. See Appendix A for a listing of process references used in this report.

II. PURPOSE. The Military Training Task Force (MTTF) of the Defense Safety Oversight Council (DSOC) was formed to support the accident and injury prevention mandate of the Secretary of Defense (SECDEF) with a focus on interventions that relate to all aspects of military training. The Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG) was chartered under the MTTF in September 2004 primarily to evaluate military physical training (PT) injury prevention programs, policies, and research and develop cross-Service recommendations to reduce PT-related injuries during and after initial entry training (IET).

III. AUTHORITY. Memorandum, The Secretary of Defense, 19 May 2003, subject: Reducing Preventable Accidents. See Appendix B.

IV. BACKGROUND.

A. Injuries represent the leading health problem of U.S. military personnel across the spectrum of health, from deaths and disabilities to hospitalization and outpatient treatment. Training-related injuries have been identified as the leading cause of clinic visits and have a very real impact on the readiness of the Force due to the amount of limited duty time that results from such injuries. Conservative estimates of time Service members are given physical activity restrictions approach 25 million limited duty days per year for all four Services combined. Service members on limited duty time are unable to perform their full duties and, as a consequence, many may be unable to deploy. Most of the overuse injuries sustained in a military environment are due to the cumulative effect of PT activities such as running, particularly for basic military trainees. Also, PT is responsible for a number of preventable acute or traumatic injuries. As a consequence of understanding the magnitude of the injury problem for the U.S. military, the SECDEF mandated in 2003 that rates of accidents and injuries must be significantly reduced (Appendix B).

B. In response to the SECDEF's instruction, the Deputy Secretary of Defense formed the DSOC to govern Department of Defense (DOD)-wide efforts to reduce preventable injuries and mishaps. The DSOC is chaired by the Under Secretary of Defense for Personnel and Readiness, who in turn chartered nine task forces to develop recommendations for policies, programs, and other investments to reduce preventable injuries and accidents. The MTTF was one of those chartered to support the SECDEF's accident and injury prevention mandate with a focus on the realm of interventions that relate to aspects of military training.

C. In support of the DSOC mission and due to the significant contribution PT makes toward the injury problem, the chairman of the MTTF chartered the JSPTIPWG; the JSPTIPWG met for the first time in 2005 (see Appendix C). The original purpose of the work group was two-fold: to evaluate military PT injury prevention programs, policies, and research for cross-Service recommendations to reduce PT-related injuries in and beyond IET; and to evaluate military footwear type, fitting, and replacement policy and practices to reduce injures related to inappropriate, improperly fitted or worn footwear. Soon after the formation of the work group, the members collectively determined that the second purpose was not well substantiated in the current body of scientific literature and deserved its own thorough evaluation and careful scientific review. The work group proposed a quad-Service project to study the influence of PT footwear on injury rates. This proposal was accepted, and the work group focused their efforts on recommendations to reduce PT-related injuries.

D. The 1988 Institute of Medicine report identified ad hoc public health decision making as a common obstacle to successful program and policy development and implementation.

1. The report stated: "…policy development in public health at all levels of government is often *ad hoc*, responding to the issues of the moment rather than benefiting from careful assessment of existing knowledge, establishment of priorities based on data, and allocation of resources according to an objective assessment of the possibilities for greatest impact." (pp. 114-115)

2. The report recommended that every public health agency should "regularly and systematically collect, assemble, analyze and make available information on the health of the community…" and promote "…use of scientific knowledge in decision making about public health…" (p. 141)

E. A group of 14 civilian and military injury experts from the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) and the Johns Hopkins Center for Injury Research and Policy (JHCIRP) developed a test set of criteria that would enable an unbiased, objective determination of Service-wide priorities. The process used (Appendix D) clearly identified the largest and most severe health problems for the Army. Appendix E contains the criteria categories and causes of unintentional injury hospitalization. Scores ascribed to different causes of injury ranged from a low of 91 to a high of 308 out of a possible 420. The top five Army injury problems identified by this process, and the scores received for each, were:

1. Physical Training–308.

2. Privately Owned Motor Vehicles–271.

3. Athletics and Sports–261.

4. Excessive Heat–255.

5. Military Vehicles–252.

F. The JSPTIPWG adapted the criteria and applied a systematic approach to identify existing scientific evidence of intervention effectiveness for the prevention of PT-related injuries and prioritized the interventions into levels of strength of recommendation. The process for making these recommendations is fully explained in an August 2005 MTTF White Paper (Jones, et al. 2005). Therefore, the process serves three additional purposes for the JSPTIPWG:

1. Establishes the evidence base for making recommendations to prevent injuries.

2. Prioritizes the recommendations for prevention programs and policies.

3. Substantiates the need for further research on interventions or programs likely to reduce injuries.

G. In order to begin a list of interventions, the work group looked to past work by expert panels. The work group was able to find recommendations resulting from work by the the Naval Health Research Center (NHRC) as far back as 1994. A panel of Army experts met in 1999 at the Army's largest basic training post, Fort Jackson, under the direction of the Army Surgeon General (ASG) and the U.S. Army Training and Doctrine Command (USATRADOC), and prioritized their findings and recommendations. In 2000, the Morbidity and Mortality Weekly Report (MMWR™), a weekly epidemiological digest published by the Centers for Disease Control and Prevention (CDC), summarized recommendations to reduce injury risk in women (Gilchrist, et al. 2000). The Army Musculoskeletal Injury Prevention Plan (MIPP) was a collection of evidence-based interventions compiled by the USACHPPM for the ASG in 2002. This compilation of recommendations for the prevention of musculoskeletal injuries in basic training was endorsed by the ASG and sent to the USATRADOC as medical recommendations to reduce injuries. Some of those recommendations were adopted in varying degrees. That same year, the Navy independently produced a set of recommendations of their own. Scientists from the U.S. Army Research Institute of Environmental Medicine (USARIEM) summarized the literature relative to the prevention and control of musculoskeletal injuries associated with PT training in the form of a medical bulletin. Table 1 summarizes the key recommendations in a manner that allowed the work group to assess commonalities among panels. (MMWR™ is a trademark of CDC, Atlanta, Georgia.)

Table 1. Previous Injury Prevention Recommendations of Subject Matter Expert (SME) Panels

Recommended PT Injury Prevention	Expert Panel/SME Recommendations					
	Army MIPP 2002	NHRC 1997	Fort Jackson 1999	MMWR Women 2000	Navy Outcomes 1999/2000	USARIEM (In Press)
1. Exercise/Training Programs				applicable to men, civilian population and general lifestyle, not just basic PT		
1a. Running volume (intensity, duration, frequency, overload)	• limit unit runs • 20-minute maximum run • 25-mile maximum distance in 9 weeks • count near maximum military training as maximum PT	• progressive ramp-up • less formation, more individual runs • add conditioning runs in second phase		individualize frequency, intensity and duration based on fitness		decrease frequency, duration and distance
1b. Fitness level (ability groups)	run in ability groups		initial physical assessment and training plan at recruiting station	• tailor programs to fitness and activity levels • less fit should start at own level and progress more slowly	arriving recruits	
1c. Other types of training (strength, cross-training, job specific)	• include core body manage-ment skills • strength training • agility and movement skills		cross-training equipment in recruit areas		• strength • endurance • job specific	
1d. Preventives (warm-up/ cool-down, proprioception, stretching)	low intensity dynamic warm-up	• add warm-up and cool-down routines • stretch pre and post PT				warm-up/ cool down (w)
1e. Technique (stride length, short-to-tall formation)	run in rout step (no cadence)					

Recommended PT Injury Prevention	Expert Panel/SME Recommendations					
	Army MIPP 2002	NHRC 1997	Fort Jackson 1999	MMWR Women 2000	Navy Outcomes 1999/2000	USARIEM (In Press)
1f. Progression/overload with increased fitness (standardization, preconditioning, remedial)	• standardize gradual systematic exercise program • eliminate remedial PT • PT 4-6 days/ week with no more than 3 non-consecutive strenuous foot days • minimize initial fitness stress (1,1,1,) • limit frequency of maximum fitness assessments (3 in 9 weeks)	slower progressive ramp-up of load-bearing conditioning hikes	• change recruiter quota system • initial physical assessment and training plan at recruiting station			avoid harmful exercises (w)
1g. Recovery period (training and testing)	• rebuild fitness gradually for those missing 1 week of training • enforce work/rest ratios • 48-hour minimum rest between heavy training and maximum fitness test • fitness assessment re-takes minimum of 3 days			• if injury occurs, allow sufficient recovery and rehabilitation time • less fit should start at a low level and progress more slowly		
1h. Elimination of harmful exercise/avoidance of high-risk exercise (deep knee bends, mule kick, sit-ups, etc.)						
1i. Exercise program management (separating weighing and fitness testing)		• decrease total running mileage and increase muscle strength and endurance • modify daily calisthenics • schedule PT events to maximize benefits and minimize overuse injuries				

Recommended PT Injury Prevention	Expert Panel/SME Recommendations					
	Army MIPP 2002	NHRC 1997	Fort Jackson 1999	MMWR Women 2000	Navy Outcomes 1999/2000	USARIEM (In Press)
2. Equipment & Environment						
2a. Footwear (shoes, insoles, socks)	• replace running shoes • non-cotton socks and sock liners		• antiperspirant sock • sock systems			• shoe prescrip-tion (w) • insoles • wicking socks • antiper-spirant • new running shoes
2b. Joint support (bracing and taping)	ankle braces for previously injured					• knee brace • ankle braces for previously injured • ankle taping
2c. Mouthguards, helmets, pads, and reflective material	mandatory mouth -guard use where risk of high injury		safety equipment (mats, etc.)			
2d. Running and landing surfaces (obstacle course)			soft run track with proper lighting at each training center			soft, level running surfaces (w)
2e. Environmental temperature						
3. Education						
3a. Injury prevention	for cadre and leadership		• incorporate IET injury prevention training into all programs of instruction • revise the Drill Sergeant military treatment facility (MTF) curriculum to be battle- focused and hands-on for IET environment		• train Sailors & Marines • train trainers	education (w)
3b. Health behavior (alcohol, smoking, other)				• association of smoking with higher exercise injury risks adds reason to cease smoking • higher risk of exercise injuries for extremes of body comp add incentive to keep weight in normal range		smoking cessation (w)

Recommended PT Injury Prevention	Expert Panel/SME Recommendations Army MIPP 2002	NHRC 1997	Fort Jackson 1999	MMWR Women 2000	Navy Outcomes 1999/2000	USARIEM (In Press)
				• inform smokers of possibly higher injury risks and encourage smoking cessation		
3c. Technique (running form, safe lifting)						
3d. Health care provider (profile writing training)			develop and standardize a basic combat training (BCT) profile form and an advanced individual training (AIT) site-specific profile form			
3e. Self-treatment						
4. Nutrition, Supplements & Hydration						
5. Medication & Medical Care						
5a. Medications	facilitate easy access to ice					
5b. Rehabilitation	• cadre-supervised profile PT (minor) • standardized process for rehab (serious) • reconditioning PT (between profile and full duty) • MTF liaison to unit		• establish and resource a formalized and standardized IET physical training and rehabilitation program (PTRP) at all IET installa-tions • increase personnel for special programs • research implementa-tion: standup and monitor PTRP and fitness training unit across USATRADOC now	past injuries increase risk of new exercise injuries & argue for adequate recovery and rehabilitation	standardize secondary injury prevention units to emphasize early intervention, aggressive rehab, and structured reconditioning	• wobble board • stretching (w) • targeted strengthen-ing (w)
5c. Early intervention					standardize secondary injury prevention units	
6. Leadership/ Accountability Issues						
6a. Responsibility for injury rates	• use same risk mgt process applied to mission on injury prevention • Battalion		• establish and resource a formalized & standardized IET PTRP program • change recruiter		• apply operational risk management (ORM) • provide quality info to	

Recommended PT Injury Prevention	Expert Panel/SME Recommendations					
	Army MIPP 2002	NHRC 1997	Fort Jackson 1999	MMWR Women 2000	Navy Outcomes 1999/2000	USARIEM (In Press)
	Injury Control Advisory Council • monitor/ report injury profile rates • reward high PT pass rates (deemphasize focus on unit PT scores or include zeros for non-takers) • prohibit "motivational/ punitive" PT • identify high-risk trainees		quota system • establish a quality profile PT program for all IET units based on installation resources • review and update Field Manual (FM) 21-20 to include injury prevention		decision makers supporting injury prevention	
6b. Focus on PT past performance			coordinate research efforts: identify test beds; allocate resources; prioritize research topics			
6c. Psychosocial issues						
7. Surveillance & Evaluation						
7a. Command injury visibility	Master Fitness and Profile Tracking System		develop surveillance systems (identify and link appropriate databases)			
7b. Screening: Injury Risk Index			develop and standardize a BCT profile form and an AIT site-specific profile form			pre-participation screen (w)
8. OTHER						
8a. Return on Investment					• need better process for estimating cost • must do cost-benefit analysis	
8b. Marketing to Change Culture					identify importance	
8c. ORM – Taking ORM and emphasizing musculoskeletal injury prevention. ORM plays an integral role in all injury prevention initiatives. It impacts all of the injury prevention initiatives that are addressed into the DOD system. It serves as an "umbrella" that covers all injury prevention initiatives.	X				X	

Recommended PT Injury Prevention	Expert Panel/SME Recommendations					
	Army MIPP 2002	NHRC 1997	Fort Jackson 1999	MMWR Women 2000	Navy Outcomes 1999/2000	USARIEM (In Press)
Surveillance – provide quality information to decision makers in support of injury prevention. 1. Assess and improve/replace existing injury related databases. 2. Standardize and link databases to integrate safety, recruit outcome, personnel information, and other data in support of injury and disease and nonbattle injury surveillance and prevention. 3. Develop and define reporting criteria for training related injuries.					X	

V. METHODOLOGY.

A. The JSPTIPWG consisted of 29 civilian and military experts in fitness and injury, safety, and health. Appendix F contains a list of participants invited to serve on the JSPTIPWG by the Chair of the MTTF of the DSOC.

B. A brief summary of the JSPTIPWG's evaluation of the evidence base included:

1. Establishing inclusion and exclusion criteria when evaluating scientific evidence (Appendix G).

2. Clearly defining the study types included to ensure consistency among reviewers (Appendix H).

3. Conducting literature searches to identify scientific reports relevant to PT-related injury prevention using PubMed® (Medline®), Defense Technical Information Center (DTIC), Cochrane Reviews, and other pertinent search engines (Appendix I). (PubMed® and Medline® are registered trademarks of the U.S. National Library of Medicine, Bethesda, Maryland.)

4. Assessing the literature that did not meet inclusion criteria.

5. Documenting PT-related injury prevention intervention references (Appendix J) and categorizing them by study type in a matrix (Appendix K).

6. Evaluating the scientific quality of the intervention and risk factor studies that met the inclusion criteria (Appendices L and M).

7. Assessing the overall strength of the evidence for each intervention and "grading" each intervention using a rating scheme adapted from the U.S. Preventive Services Task Force (USPSTF) (Appendix N).

8. Developing criteria to objectively score and rank recommended interventions (Appendix O).

9. Applying those criteria to produce a prioritized list of recommended PT-related injury prevention strategies.

C. During two phone conferences, the working group members established the systematic literature search and review process, developed inclusion and exclusion criteria for studies identified in the search process, and delegated responsibility for each of the intervention topics to be searched.

D. The initial list of topics included 27 interventions, divided into the following categories: Exercise/Training Programs; Equipment and Environment; Education; Nutrition, Supplements and Hydration; Medication and Medical Care; Leadership/Accountability Issues; and Surveillance and Evaluation (Appendix P).

E. The teleconference discussions expanded this original list of 27 interventions to 49 interventions shown in Table 2.

Table 2. Expansion of Interventions

Category	Subcategory	Intervention
Exercise/Training Programs	1. Running Volume	Reduction in running frequency, duration, and distance
	2. Running Volume	Reinitiating exercise at lower intensity levels for the detrained (at what point of detraining should one revert to lighter training loads?)
	3. Running Volume	No PT on days when exhaustive military training occurs
	4. Running Volume	Increase marching while decreasing running
	5. Fitness Level	Run in ability groups by time, not distance
	6. Other types of training–Strength	[Pre-injury] Targeted muscle strengthening
	7. Other types of training–Cross-training	"Cross-training" (yoga, tai chi, aquatics for exercise)
	8. Other types of training–Job specific	Job-specific strength training–align conditioning with readiness physical demands
	9. Preventives	Warm-up/Cool-down
	10. Preventives	Multi-axial and Proprioceptive Training: training on non-stable platforms (e.g., wobble board, exercise ball, etc.)
	11. Preventives	Pre- and Post-exercise Stretching
	12. Technique Training	Run and march at own stride length (rout step)
	13. Technique Training	Place shorter service members in front of formations to set running pace (if running or marching in step)
	14. Progression/ Overload with increased fitness	Standardized and graduated/progressive exercise (including running) program
	15. Progression/ Overload with increased fitness	Standardized Graduated Hiking Program
	16. Progression/ Overload with increased fitness	Introduction of flak vests in BCT: Increases in load-bearing equipment
	17. Progression/ Overload with increased fitness	Pre-accession fitness program
	18. Progression/ Overload with increased fitness	Does mass or individual training in like units affect injury rates? If individual training produces similar performance with less injury, at what point in training might trainees direct their own training?
	19. Progression/ Overload–Remedial Exercise	Discontinue or modify use of PT as corrective tool

Category	Subcategory	Intervention
	20. Progression/ Overload–Remedial Exercise	Eliminate extra PT sessions for the least fit individuals (commonly known as "remedial PT")
	21. Recovery	Determine the ideal and absolute minimum recovery period between maximal effort fitness tests
	22. Elimination/ Avoidance of harmful exercise	Avoidance of "harmful" exercises (e.g., deep knee bends, mule kicks, sit-ups)
	23. Exercise Program Management	Would injury rates and performance be affected if body weight was assessed at a time other than a maximal effort physical fitness test?
Equipment & Environment	24. Footwear	Replace running shoes every 400-600 miles
	25. Footwear	Shock-absorbing insoles
	26. Footwear	Socks and antiperspirants to prevent blisters
	27. Footwear	Individual prescription of running shoe based on foot type
	28. Joint Support	Joint bracing (especially with history of previous injury–ankle, knee, etc)
	29. Joint Support	Ankle taping
	30. Equipment	Mouthguards, helmets, pads, reflective material
	31. Environment	Running surfaces that minimize injury
	32. Environment	Obstacle course landing areas and serial review of same
	33. Environment	Adjustment of training load by seasonal variations (when environmental temperatures are high)
Education	34. Injury prevention	Injury prevention education to leadership, cadre and troops
	35. Health behavior	Smoking and alcohol cessation programs
	36. Technique	Incorporate safe lifting technique training into PT
	37. Technique	Train Service members in special awareness and core body movement and management skills (how to run, jump, land, cut, and decelerate)
	38. Healthcare Provider Education	Healthcare professional profile writing–especially on BCT/AIT training
	39. Self treatment	Early cryotherapy self intervention (crushed ice and ice massage)
Nutrition, Supplements & Hydration	40. Nutrition, Supplements and Hydration	Pre- and Post-PT nutrition, supplementation, and hydration

Category	Subcategory	Intervention
Medication & Medical Care	41. Medications	Pre-exercise loading anti-inflammatory medication
	42. Medications	Oral contraceptive use increases knee stability (potentially reducing risk of anterior cruciate ligament (ACL) injuries in women)
	43. Rehabilitation	Standardized reconditioning program for the recently injured
	44. Early Intervention	Use of allied health professionals in locations more forward of fixed facility treatment (e.g., Sports Medicine and Rehabilitation Therapy clinics)
Leadership/ Accountability Issues	45. Leadership Accountability	Rate commanders and exercise leaders (trainers, drill sergeants, etc) on their unit injury rate (just as is done for average PT scores)
	46. Leadership Accountability	Rate commanders and exercise leaders on percent of individuals passing fitness test (instead of the average of just those who perform the test)
	47. Psychosocial	Psychosocial issues related to injury: peer, leader, and organizational influences; depression, stress, anxiety, and job satisfaction
Surveillance & Evaluation	48. Surveillance	Provide commanders injury rate information on their unit and challenge them to reduce it
	49. Screening	Can an injury risk index be developed that would categorize individuals by level of risk (à la Framingham Cardiac Risk Index) through survey and musculoskeletal evaluation – Assessing behavior and intrinsic risk factors such as: Age Gender Ethnicity Musculoskeletal strength and endurance Aerobic fitness History of physical activity Musculotendinous flexibility Tobacco use behavior (particularly smoking) Body mass index Foot arch height Knee Q-angle Injury history (especially ankle)

F. Each of the 49 intervention topics was assigned to a group of several JSPTIPWG members who conducted literature searches on most and reviewed and rated studies related to each intervention. The literature review process was detailed in five steps which were scheduled to be completed before the first face-to-ace meeting. The work group—

1. Conducted an online literature search for the specific intervention topic from at least three standard scientific search engines (human studies only, in English for years 1970 to 2005). Contributors were asked to document the date of the search, search terms used, total number of hits of the search, and a breakdown of the number included and excluded per standard criteria (Appendix I).

2. Created a bibliography of the studies that met the inclusion criteria (Appendix J). The study had to relate to the intervention being investigated and had to be injury research with injury outcomes, relevant injury research with non-injury outcomes that are markers for injury, or a systematic review of original research. Systematic reviews of randomized clinical trials (RCT) were considered the highest level of evidence followed by single RCTs.

3. Scored the quality of each intervention and risk factor study using two standardized quality scoring forms (Appendices M and N) adapted from a published scoring system developed by Thacker and colleagues (Thacker, et al. 1999). See Appendix Q.

4. Completed a classification matrix of the literature search. Contributors were asked to classify the references into one of six categories of research and to annotate whether the intervention and risk factor studies had a positive, negative, or neutral effect on injuries. The matrix also provided a column for quality score annotation. Classification included studies in one of the following six study types (Appendix N):

a. Intervention Studies (injury outcomes).

b. Analytic Risk Factor or Cause Studies (injury outcomes).

c. Descriptive Epidemiology Studies (injury outcomes).

d. Clinical Case Series Studies (injury outcomes).

e. Other Research (non-injury outcomes).

f. Reviews.

5. Concluded with a level of recommendation using a format adapted from the USPSTF. Injury outcomes were of prime importance as they most clearly demonstrated the effect of a given strategy on the ultimate goal of reducing injuries. Other process measures or

non-injury outcomes that were markers of muscle damage or related to performance were considered less conclusive. However, the weight and quality of the evidence (including non-injury outcomes in some instances) also factored into the decision making process.

G. At the time the face-to-face meeting began, literature searches had been completed on 35 of the 49 original intervention topics. Intervention studies were identified and reviewed for 23 (66 percent) of the 35 topics; no intervention studies had been found in the literature for 12 (34 percent) of the topics.

H. The face-to-face meeting objectives were to apply systematic, objective criteria to—

1. Identify PT injury prevention strategies/interventions that have enough evidence to support implementation now.

2. Identify promising interventions, modifiable risk factors, and causes of injuries that deserve priority for future research funding based on scientific evidence.

3. Identify strategies that do not work and do not need further investigation or that may be too costly for the prevention benefit.

4. Use the data and results of the priority identification process to make recommendations for military PT injury prevention and research.

I. On the first day of the meeting, the group reviewed injury data showing the importance of the problem of PT-related injuries for each of the military Services. The group discussed the recommendations from six previous expert panels and SMEs and cross-walked those with the topics researched by the JSPTIPWG to identify commonalities. Then the group reviewed several key published and unpublished PT-related injury intervention studies prior to the JSPTIPWG's discussion and evaluation of the group's list of interventions. The following issues were discussed:

1. What data are available from each service to support the four steps of the public health process (surveillance, research, intervention testing, and evaluation of interventions) for injury prevention as it applies to military recruits?

2. How do rates of injury during basic training established using centralized medical surveillance data (Defense Medical Surveillance System)) compare with rates observed in more focal studies and from other surveillance systems?

3. What recommendations have previous expert panels made?

4. What specific recommendations have been made most frequently by past panels?

5. What have been the greatest successes of past panels?

6. What has limited dissemination or implementation of previous recommendations?

7. What lessons can the group learn from previous panels?

8. What can we learn from previous successful and unsuccessful military intervention trials?

9. How would we apply our rating scales to examples of military intervention studies reporting positive and negative results?

J. On the second day of the meeting, the JSPTIPWG received briefings by JSPTIPWG members who led the literature review teams in the topic areas previously established. The following questions and issues formed the framework for discussions during the day:

1. What injury prevention strategies or problems have been the subject of the most research?

a. What is the total number of studies identified by the literature searches using the search terms chosen?

b. How many peer-reviewed papers and technical reports did the preliminary searches identify?

2. For which interventions/prevention strategies have intervention studies been conducted?

a. How many?

b. What were the average scores for the intervention studies the search identified?

c. Were the results consistent in the direction (reduced injuries, increased injuries, had no effect)?

d. How many of the studies were multi-interventional?

e. What interventions should be recommended for implementation now?

f. Are there any interventions that should not be recommended at this time?

3. How many risk factor or cause of injury studies did the searches identify relevant to the prevention strategy/problem researched (i.e., how many of the studies identified a potentially modifiable risk factor or cause)? What potential interventions/injury problems should we recommend for research and funding in the near future?

4. For process recommendations such as establishing or improving injury surveillance or improving leadership and accountability, what kind of evidence/support materials can be used as a basis for the JSPTIPWG positions?

5. What can be learned from the preliminary literature searches?

a. Hw can the process be improved?

b. Which prevention strategies should the group focus on for further review?

6. What could the group do to improve the intervention quality rating process? Should the group design a separate scoring system/card for risk factor/cause of injury studies?

7. Once the quality of research has been established, how does the group objectively rank the priority for implementing prevention strategies?

a. Can the group apply the DSOC criteria?

b. Would it be preferable to use the USACHPPM criteria?

c. What about the USPSTF criteria?

K. The briefings described the available studies and rated the quality of each. In that way, all 29 JSPTIPWG members and consultants had an opportunity to see and comment on the quality review scores. Some of the factors that weighed in on the discussion were the number of intervention studies demonstrating effectiveness (RCTs, observational studies, or systematic reviews); the consistency of the evidence (the number of studies showing efficacy versus no efficacy or harm); the quality of the evidence (scores $\leq$3 = low quality, 4-6 = average quality, $\geq$7 = high quality); and the number of other interventions included in each study (multiple versus single).

L. After discussing all of the intervention topics on which literature searches had been completed, the JSPTIPWG decided that to be considered effective, strategies had to be shown to reduce injury rates by more than one or two prospective, randomized (or observational) studies; the results had to consistently show a reduction across multiple studies; and the quality of at least some of the studies had to be high. Intervention strategies with these characteristics were considered to have sufficient strength of scientific evidence to make Quad-Service recommendations. The group agreed that the best criterion for objectively ranking the priority for implementing strategies was an adaptation of the USPSTF guidelines (Appendix N). Interventions were categorized as—

1. Essential Elements of an Injury Prevention Program (*Not Interventions*).

2. Recommended Interventions (*Based on Sufficient Scientific Evidence*).

3. Interventions Not Recommended (Due to Evidence of Ineffectiveness or Harm).

4. Interventions Without Sufficient Evidence to Recommend at This Time.

5. Interventions Without a Completed Review (*Interventions That Require a Systematic Literature Review, Work Group Discussion and Objective Assessment*).

M. The recommended interventions were then prioritized using the refined USACHPPM-JHCIRP set of criteria that provided a systematic means of rating injury prevention interventions and objectively comparing total scores of competing interventions. The following set of criteria and weighted points associated with each criterion was established and each recommended intervention was measured against these criteria (Appendix O):

1. Strength of the Evidence (20 pts) (quality of the science).

2. Magnitude of the Effect (20 pts).

a. Amount of health benefit.

b. Size of population affected.

3. Practicality (20 pts).

a. Feasible.

b. Startup cost.

c. Acceptable.

d. Existing infrastructure.

4. Timeliness of Reduction in Injury Rates (10 pts).

a. Implementation time.

b. Result time.

5. Sustainability (10 pts).

a. Effort to keep going.

b. Maintenance cost.

c. Training.

6. Measurable Outcomes (10 pts) (measurable reductions)

7. Collateral Benefits (10 pts).

a. Positive impact on other health or readiness outcomes (e.g., improved fitness).

b. Decrease attrition.

c. Decrease in other health problem, etc.

N. Each recommended intervention was rated on a 5-point scale, with 1 being low and 5 being high, for each of the seven criteria listed above. The points given by raters were then divided by 5 and multiplied by the maximum number of points for specified criteria and the products added to get the total points for a particular intervention (100 points maximum).

O. The third day was devoted to reviewing and approving the intervention categorization by the strength of evidence and prioritization of the strongly recommended interventions, writing the recommendations in such a way as to be acceptable to all Services, and agreeing on the outstanding tasks yet to be completed. The following questions and issues formed the framework for discussions during the day:

1. How would you list and categorize the recommendations?

2. What DOD or Service policies or guidelines support the recommendations for preventive action?

3. For those recommendations/guidelines that are applicable to all four Services, what does the group need to do to make/describe/express their applicability across the Services?

a. For example, how does the group establish ability group cut points and speeds and amounts of running for the different Services?

b. Are Service-specific tables of these needed or could the group set a common standard?

4. What immediate recommendations for action should the group make and in what order of priority?

5. How can the group use the work already done to make more solid recommendations?

6. What work remains to be done to add value to the current effort and to refine and add to the recommendations so that the group can publish the results in a peer-reviewed journal.

P. Public health decisions must often consider all available scientific evidence, not just RCTs. As a result, the next step of the evidence evaluation process was to identify other studies of value to decisions about injury prevention research priorities in addition to completing the reviews on the remaining 14 interventions. In the months that followed the 3-day face-to-face meeting, JSPTIPWG members conducted further literature reviews to identify all published research related to the original topics. These and other studies considered for further review included research studies with injury and non-injury outcome(s) and reviews of injury research.

Q. In this second round of reviews, the JSPTIPWG members provided quality scores for the "Analytic Risk Factor and Cause Studies" using a score sheet similar to that used for interventions (see Appendix M). Quality scores were not computed for descriptive epidemiology, clinical case series, or reviews since these study types are not expected to significantly contribute to the intervention evidence base. In some cases where reviews were not completed, the editor performed an expedited review in order to comment about the rationale behind the intervention strategy. However, since the work group had been dissolved, no consensus could be reached by the group; therefore these strategies were placed in their own section of this report. The interventions without enough evidence to recommend and those interventions not completed represent an ideal starting point for further research and evaluation.

R. The results of the working group's efforts are detailed in paragraphs VI–X of this report and summarized in paragraph XI. Most of the potential injury prevention strategies are presented in the following format:

1. Introduction. This section states the purpose for conducting a review of the particular intervention strategy and includes the search terms used.

2. Discussion. This section provides a discussion of the background on the body of evidence as well as specific studies and their quality as deemed appropriate.

3. Recommendation. The JSPTIPWG made their final recommendation based on a format adapted from the USPSTF.

4. Classification Matrix. The literature meeting the inclusion criteria is classified by study type and presented in a table. The table includes the reviewer's assessment of quality and direction of the evidence.

5. References. This section provides a list of full references meeting the inclusion criteria that were considered in making the recommendation.

VI. ESSENTIAL ELEMENTS OF AN INJURY PREVENTION PROGRAM (*NOT INTERVENTIONS*).

A. Educate Military Service Members, Especially Leaders, on Injury Prevention Principles and Strategies (Essential Program Element).

1. Introduction. The purpose of this review was to identify the strength of evidence for injury prevention education of military leadership relative to injury prevention principles and strategies. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: musculoskeletal, injury, prevention, education.

b. Total number of hits resulting from the search: 116.

c. Total number of studies that meet the inclusion criteria: 3.

2. Discussion. There are only three randomized trials that demonstrate the effect of education on musculoskeletal injury risks or rates, but those are in conjunction with other interventions. Education as a specific intervention by itself is difficult to measure as studies use education as a component of multiple intervention or community-based programs. One such program demonstrated a 75 percent reduction in soccer injuries when coaches and players were educated and supervised by physicians and physiotherapists. Injuries were reduced 30 percent in Army initial entry trainees when an education program was combined with other interventions. While it is difficult to precisely measure the effect of education alone on injury rates, results of these and many other studies have provided scientific evidence that significant occupational risks for musculoskeletal injuries and disorders exist in the military and that effective interventions are available to reduce that risk in Service members. The dissemination of information regarding effective strategies for the prevention of injury is vital to the support of military commanders in

their responsibility to protect the fighting force. Therefore, rather than addressing education as an independent injury prevention intervention, the work group unanimously agreed that education should be considered an essential element of any successful injury prevention program in the military despite the multi-interventional nature of the aforementioned randomized trials.

3. Recommendation. The JSPTIPWG recommends injury prevention education for military personnel, including all levels of military leadership, as a part of institutionalized continuing military education and distance learning programs. The work group considers education an essential injury prevention program element when these education programs reference and advocate proven (evidence-based) prevention strategies. The reduction of injuries is most likely to occur if all levels of leadership (command and cadre) understand the injury risk factors Service members face and which strategies are effective in preventing injuries. Education is the first step in identifying and disseminating evidence-based interventions that can be implemented at the unit level and is an essential component of any successful injury reduction program. Through education, leadership can be empowered with the knowledge and skills necessary to effectively reduce injuries in their sphere of influence.

4. Classification Matrix. Table 3 contains the classification matrix of literature search results.

Table 3. Classification Matrix of Literature Search Results: Educate Military Service Members, Especially Leaders, on Injury Prevention Principles and Strategies

Categories of Study Types											Total
Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
3											3
Author/ Year	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
Walters/2002		+	3								
Knapik/2004	M	+	8								
Ekstrand/1993	M	+	5								

5. References.

Ekstrand J, Gillquist J, Liljedahl SO. Prevention of soccer injuries. Supervision by doctor and physiotherapist. Am J Sports Med. 1993 May-Jun;11(3):116-20.

Knapik JJ, Bullock SH, Canada S, Toney E, Wells JD, Hoedebecke E, Jones BH. Influence of an injury reduction program on injury and fitness outcomes among soldiers. Inj Prev 2004;10:37-42.

Walters, Terry J. Injury Prevention in the U.S. Army, A Key Component of Transformation. Army War College Carlisle Barracks PA. Dated: 09 APR 2002. Report XA/USAWC.

B. Leadership Enforcement of Unit Injury Prevention Policies and Programs (Essential Program Element).

1. Introduction. The purpose of this review would have been to identify the strength of evidence for establishing leadership enforcement of unit injury prevention policies and programs. The work group deemed a literature review not to be necessary. A summary of salient points that lead to the final recommendation are presented in the discussion below.

2. Discussion. The value of leader responsibility and accountability cannot be overemphasized. In many aspects of life, when someone who is responsible is held accountable, the rate of progress improves. While a literature review likely would not reveal any studies that specifically address the impact of leadership responsibility and accountability on injury rates, the work group deemed leadership enforcement as an essential element of any successful injury prevention program at all unit levels.

a. Leaders should assume responsibility and be held accountable for all the outcomes of PT programs conducted in their units. Physical fitness test scores are only one outcome of PT; injury rates are another equally important outcome. Since a significant number of injuries seen in the military occur in association with PT, unit injury rates provide another important measure of the success or failure of unit PT. Leaders should focus on fitness test pass rates and injury rates as the best composite assessment of PT program effectiveness and modify their PT program as needed to reduce injuries, thereby improving performance and readiness.

b. Leaders should place more emphasis on the percent of trainees passing the fitness test rather than the highest average unit score when measuring unit success on the fitness tests. The custom of achieving the highest unit average fitness test score usually causes leaders to push the least fit trainees to overreach their capability. Pushing the least fit trainees beyond their capacity to recover has two potentially detrimental effects: a greater risk of injury and diminished physical performance, two cardinal signs of overtraining. Conversely, this tradition of achieving the highest unit average fitness test score may cause some leaders to dismiss certain unit members as injured and, therefore, not feel responsible for them when assessing their unit fitness status. For example, a leader always looks better if his average unit fitness score does not include the injured individual who could not take the test. If average unit fitness test scores are used at all, the "zero" scores for trainees who cannot take the fitness test due to an injury should be included when computing the unit average score. This practice ensures that the fitness test average score more accurately reflects true unit physical readiness by including the effects of injury.

c. The ideal in requiring leadership accountability for injuries would be for leaders to consider both the unit fitness test pass rates and unit injury rates (versus just unit average fitness test scores) when rating officers and noncommissioned officers since physical readiness is a function of both physical performance and injury.

3. Recommendation. The JSPTIPWG recommends military and civilian leadership enforcement of injury prevention policies and programs at all levels, including the accountability down to the unit, for injury rates and fitness test pass rates. The work group considers leadership enforcement an essential injury prevention program element. The unit commander is the critical agent for injury prevention intervention, and the success of any program is directly related to the level of visible command support and involvement. Effective command emphasis on injury prevention includes accountability and must be consistent, lasting, and based on evidence-based strategies and common sense to reduce exposure to injury risk during combat, PT, and field training exercises. These same principles can also apply to off-duty recreational and leisure activities.

C. Unit Injury Surveillance Reports (Essential Program Element).

1. Introduction. The purpose of this review would have been to identify the strength of prevention evidence for a program that would provide military commanders with a regular report of their own unit injury rates, causes of injuries, and severity of injuries as measured by limited duty profiles or chits. The work group deemed a literature review not to be necessary. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

2. Discussion. Injuries are decidedly the greatest health threat to the military Services. A health problem as big as musculoskeletal injuries requires a systematic approach using the public health process. The first step in that process is to have surveillance of the problem. Surveillance not only reveals the size of the problem but can give insights into the solutions. Surveillance is ultimately needed to monitor and evaluate the effectiveness of strategies once put into place. Understanding the cause of injury helps leaders prevent the injury.

With improvements to the military electronic health record (Armed Forces Health Longitudinal Technology Application (AHLTA)), injury diagnoses could be coded with a detailed enough cause to prevent the injury.

a. While the idea of providing commanders with injury rate and cause information began as an effort to prove the effectiveness of surveillance on injury rates, the work group determined that surveillance itself would not have been studied as an isolated intervention but rather qualifies as a necessary component of a larger process to reduce injuries. The work group agreed that surveillance is an absolutely essential program element of any successful injury prevention program. Surveillance provides the data necessary for marking current status, setting goals for improvement, targeting interventions at the unit level, and serves as an instrument to evaluate intervention success. As mentioned during discussion of leadership enforcement, it is understood that unit commanders could influence their injury rates by simply understanding where they stand, what causes the injuries, and setting goals to improve. This is not possible unless surveillance of injuries (including cause and severity) and fitness are routine and easily summarized. As discussed previously, unit injury rates should be used as a barometer of PT program success or failure just as is done with fitness test scores. Since the PT program is a significant contributor to the cause of injuries seen in the military (particularly in the new recruit environment), high injury rates indicate there needs to be a modification of that program. Installation and unit commanders can establish their own baseline injury rates over two or three training cycles. Future injury rates should be successively lower than the previous quarter's average rates.

b. With adequate and timely injury and fitness surveillance reports, commanders at all levels could routinely monitor unit injuries, performance, fitness test pass rates and report through the chain of command (for example, reviews and analysis or quarterly training briefs). This would likely have the effect of encouraging greater command responsibility for unit physical performance and musculoskeletal health.

3. Recommendation. The JSPTIPWG recommends unit level and centralized surveillance and reporting. Injury surveillance is critical for at least three reasons: data on injury causes and physical fitness facilitates the prioritization of resources, research, and the targeting of interventions to reduce injury rates as a matter of force health protection; without surveillance of injuries, there is no way to know whether prevention efforts are effective; and surveillance of physical fitness (scores and pass rates) ensures that physical fitness is not adversely affected by injury prevention efforts. The work group considers both unit and centralized surveillance an essential injury prevention program element. The work group encourages units to conduct their own injury and fitness surveillance through simple tools (e.g., spreadsheets). Additionally, the work group supports efforts to centralize injury surveillance through mandatory injury cause coding of acute and overuse injuries in the military outpatient electronic health record (AHLTA) and follow-up reporting of such to unit leaders.

D. Invest Greater Resources in Research and Program Evaluation of Training-Related Injury Prevention Interventions (Essential Program Element).

1. Introduction and Discussion. As a result of the efforts of the work group in determining the breadth and strength of the evidence for injury prevention interventions, it was discovered that 23 (62 percent) of the interventions studied did not have sufficient evidence in the literature from which to make broad Service-wide recommendations. In many cases, there simply were no scientific studies to prove the strategies were effective; or the evidence was of poor quality, the evidence was conflicting, or the balance of the benefits and harms could not be determined. This was an alarming statistic. This highlights why the work group added this fourth essential element. Without research and program evaluation of injury prevention strategies in military populations (and in comparable civilian populations), the rate of PT-related injuries will continue to be a burden on the Services and a health threat to Force readiness. This technical report identifies 29 injury prevention strategies that have yet to be evaluated or have been found to have insufficient evidence to make Quad-Service recommendations. Epidemiologists interested in studying the prevention of injuries in the military could start with this list.

2. Recommendation. The JSPTIPWG recommends a greater investment of resources (DOD-wide) in the evaluation of intervention strategies to reduce injuries, the leading health problem impacting U.S. military force readiness. Preventing injuries will have a significant effect on military operational readiness by decreasing entry-level attrition and separations due to injury. The JSPTIPWG found very few interventions with sufficient scientific evidence to evaluate effectiveness, which underscores the need for more research and program evaluation of interventions to prevent musculoskeletal injuries.

VII. RECOMMENDED INTERVENTIONS (*BASED ON SUFFICIENT SCIENTIFIC EVIDENCE*).

A. General. After determining the recommended interventions on the basis of the available evidence, all 29 members of the work group applied objective criteria (Appendix O) to score and rank the recommendations hierarchically. These recommendations are provided in order of the strength of the evidence, magnitude of the effect, practicality, timeliness of reduction, sustainability, measureable outcomes, and collateral benefit (Table 4).

Table 4. Overall Scores for Recommendations in Rank Order

Order	Intervention	Score	SD	Median	Minimum	Maximum
1	Preventing Overtraining	86.3	8.5	87	68	100
2	Perform Multiaxial, Neuromuscular, Proprioceptive, and Agility Training	77.7	7.8	76	66	94
3	Wear Mouthguards During High-Risk Activities	74.2	11.6	74	48	100
4	Wear Semirigid Ankle Braces for High-Risk Activities	70.1	10.3	68	50	90
5	Consume Nutrients to Restore Energy Balance Within 1 Hour Following High-Intensity Activity	67.0	11.6	66	54	94
6	Wear Synthetic Blend Socks to Prevent Blisters	Note: Intervention not scored as it was added after convening the face-to-face meeting.				

Legend:
SD = standard deviation

B. Prevent Overtraining (Strongly Recommended).

1. Introduction. Physical training is necessary to condition Service members for their occupational/warrior tasks and to provide protection against cardiovascular and bone health threats. In classic military tradition, however, efforts to exceed the standards have contributed to the injury epidemic present today. The biggest presumed impact on the prevention of overtraining in the military population is the reduction of running. A number of methods to reduce the amount of running were often combined in the literature reviewed. The purpose of this review was to identify the strength of evidence for interventions that led to the reduction of overtraining the musculoskeletal system. Rationale for combining interventions and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: exercise, running, fitness, injuries, and volume.

b. Total number of hits resulting from the search: 286.

c. Total number of studies that meet the inclusion criteria: 51.

2. Discussion. There is a preponderance of military and civilian research that high running volume significantly increases the risk for lower extremity injury. During initial military

training, about 25 percent of men and about 50 percent of women incur one or more PT-related injuries. About 80 percent of these injuries are in the lower extremities and are of the overuse type—a condition brought about by PT volume overload (generally excessive running relative to initial fitness level and running capability of the individual). The work group recognized that there were other interventions being considered that had a net effect of reducing running volume and should, therefore, be combined into the one recommendation that clearly conveys the key principle of the prevention of overtraining. The effect of running mileage, duration, frequency, and intensity on overtraining is discussed. Other strategies that have the net effect of reducing running and, therefore, may reduce the likelihood of overtraining are discussed in this recommendation: avoiding combinations of strenuous military training and PT, exercising in a gradually progressive manner, running in groups based on level of ability (run times), avoiding the practice of giving extra PT sessions to the least fit Service members, refraining from or modifying the use of PT as a corrective tool, utilizing interval training more, and allowing adequate musculoskeletal recovery.

a. Reduce running mileage. Given the very strong evidence showing higher running mileage as an injury risk factor, an obvious intervention is to reduce the amount of running performed by Service members. This intervention has been tested experimentally among recruits in a 12-week Marine Corps boot camp. Table 5 below shows the running distances, stress fracture incidence, and final 3-mile run times for three groups of U.S. Marine recruits, with each group performing different amounts of organized running. A 40 percent (22-mile) reduction in running distance was associated with a 54 percent reduction in stress fracture incidence with an insignificant change (3 percent) in run times. Thus, reducing running mileage reduced stress fracture incidence with essentially no effect on aerobic fitness. If the 33 miles of running in 12 weeks is prorated for the 9-week Army BCT cycle, the total mileage is 25. Costs were tabulated in terms of dollars saved and time gained as a result of this simple intervention. In 1995, it was estimated that reducing running mileage saved $4.5 million in medical care costs and nearly 15,000 training days annually by preventing stress fractures at this Marine Corps Recruit Depot. Both of these benefits are critical in maintaining the operational readiness of the Fleet Marine Force.

Table 5. Mileage, Stress Fracture Incidence, and Average Final 3-Mile Run Times Among Three Groups of Male U.S. Marine Corps Recruits

Marines (n)	Total run distance over 12 weeks (mi)	Stress fracture incidence (%)	Final 3-mile run times (min:sec)
1136	(High) 55 miles	3.7%	20.20
1117	(Medium) 41 miles	2.7%	20.44
1097	(Low) 33 miles	1.7%	20.53
	22-mile reduction	54% reduction	Not a statistically significant change

(1) In a 1994 study (Table 6) in which Soldiers who ran 56 miles in 12 weeks were compared to Soldiers who ran 130 miles in 12 weeks, the Soldiers who ran fewer (74) miles during 12 weeks of BCT training decreased their injury incidence by 24 percent and maintained their fitness. It is important to note that while they decreased the running mileage, they increased the miles marched (the high mileage run group marched 68 miles; the low mileage run group marched 117 miles). Increased marching is probably more realistic a scenario in wartime.

Table 6. Mileage, Injury Incidence, and Average Final 2-Mile Run Times Among Two Groups of Male and Female U.S. Army Recruits

Running Mileage	Injury Incidence	Final 2-Mile Run Time (min:sec)
(High) 130 miles	54%	13:45
(Low) 56 miles	41%	13:28
74 mile reduction	24% reduction	Not a statistically significant change

(2) In a more recent study of Army BCT, one battalion running a total of 17 miles plus engaging in an undetermined amount of interval training, lowered injury rates by one third with similar improvements in 2-mile run times compared to a battalion that ran a total distance of 38 miles during the 9-week basic-training cycle. It is important to note that very little running per week during the early weeks of BCT was performed. In other words, running mileage gradually increased with most of the miles run toward the end of BCT. Another study (Table 7) compared male Naval recruits assigned to basic training divisions that ran either 12 to 18 miles or 26 to 44 miles. The lower mileage division had lower injury rates and 1.5-mile run time improvements that were the same as the higher mileage divisions. In other words, a reduction of 20 miles of running during Naval recruit training reduced injuries by 20 percent without negatively affecting physical fitness.

Table 7. Mileage, Injury Incidence, and Average Improvement in 1.5-Mile Run Times Among Two Groups of Male U.S. Navy Recruits

Running Mileage	Injury Incidence	Average Improvement in 1.5-Mile Run
High (26-44)	22.4%	1:02
Low (12-18)	16.4%	1:00
Average 20-mile reduction	27% reduction	Not a statistically significant change

(3) Similar results were obtained with Australian Army recruits when running was replaced with a graduated program of foot marches with backpack loads. This intervention reduced all lower limb injuries by 43 percent and knee injuries by 53 percent. The USATRADOC Standardized Physical Training Program for BCT, which incorporates less running mileage and a greater variety of exercises, was implemented in April 2004. Since that time, injuries have been reduced by 21 percent compared to a traditional BCT PT program.

b. Reduce running duration and frequency. There are physiological thresholds above which increases in running duration and frequency do not result in a commensurate increase in fitness, but *do* result in higher injury rates (particularly for people with average and below average fitness levels). Among previously sedentary young adult males, running above thresholds for duration and frequency dramatically increases risk of injury with little improvement on maximal oxygen uptake (a measure of cardiovascular endurance that correlates with run-time performance).

(1) Table 8 below indicates that a running duration of 45 minutes versus 30 minutes three times a week increases the injury incidence (percent of subjects injured) by 125 percent (over 2 times) without any significant change in maximal oxygen uptake.

(2) Table 9 indicates that a running frequency of 5 times per week versus 3 times per week for 30 minutes increases the injury incidence by 225 percent (over 3 times) without any significant change in maximal oxygen uptake. The bottom line is that the amount of running can be dramatically reduced to prevent injuries without significantly decreasing the cardiorespiratory endurance of Service members. Injuries can be expected to increase disproportionately with little additional fitness improvements if running is performed more than 3 times per week or if the amount of time spent running in a single session is greater than 30 minutes. This threshold is not necessarily an absolute and may vary between Services and between units. The American College of Sports Medicine (1998) cautions against increased frequency: “The amount of improvement in cardiorespiratory endurance increases with frequency of training, but the magnitude of change is smaller and tends to plateau when frequency of training is increased

above 3 days per week. The value of the added improvement in cardiorespiratory endurance that occurs with training more than 3-5 days per week is minimal to none, yet the incidence of injury increases disproportionately."

Table 8. Running Duration, Injuries, and Cardiovascular (CV) Endurance*

Duration (in/day)	Injury Incidence (percent)	Change in CV Endurance (percent maximal oxygen uptake)
0	0	-.7
15	22	8.7
30	24	16.1
45	54	16.9
From 30 to 45 min/day	125% increase	5% greater (not a statistically significant change)

*Training: running 3 days/week, 85-90% maximum heart rate (MHR) (Pollock, et al. 1977)

Table 9. Running Frequency, Injuries, and CV Endurance*

Frequency (days/week)	Injury Incidence (percent)	Change in CV Endurance (percent maximal oxygen uptake)
0	0	-3.4
1	0	8.3
3	12	12.9
5	39	17.4
From 3 to 5 days/wk	225% increase	35% greater (not a statistically significant change)

*Training: running 30 min, 85-90% MHR (Pollock, et al. 1977)

c. Exercise at the appropriate intensity. The minimum threshold for PT required to achieve desired training effects has been less well characterized for Service members. However, many studies among civilian populations suggest that cardiorespiratory fitness improvements require aerobic exercise at an intensity that produces heart rates between 55 and 90 percent of a person's maximum heart rate. The lower end of this broad range is appropriate for initially low-fit individuals; those who have been training for a while can work at the higher end. Cardiorespiratory fitness can be improved by many activities other than running. Aerobic activities that provide alternatives to running include: graduated walking or marching, stair climbing, swimming, bicycling, cross-country skiing, rope-skipping, exercise to music, etc.

d. Avoid combinations of strenuous military training and PT. Commanders at all levels should actively avoid combinations of military training and PT that exceed physiologic thresholds of overtraining and result in higher injury rates and no improvement in fitness. Commanders can monitor profile (limited duty excusal) rates and fitness test pass rates and run times to determine if their units are overtraining. Signs that a unit is overtraining include high or increasing lower body injury profile rates, decreased fitness test pass rates, and slower average run times.

e. Exercise in a gradually progressive manner. Military research demonstrates that the gradual introduction of running mileage reduces injury incidence. A program which systematically and progressively increases running mileage to a maintenance point reduces injury rates and fosters much improvement in physical fitness (particularly important for new recruits, those changing units, or those returning to PT after time off for an injury or leave).

f. Run in groups based on level of ability (run times). Physical training injury prevention programs that target those Service members at the highest risk of injury (those of average or below average fitness) ensure that the running mileage for the least fit Service members is appropriate for their fitness level. The use of initial fitness test performance (run times) to place Service members in ability groups of similar fitness levels provides each Service member with a more appropriate level of physiological stimulus to enhance fitness and minimize injury risk. (Running a certain amount of time, not a certain distance, means that slower (less fit) individuals run shorter distances than the faster (most fit) individuals, thus accommodating low and high fitness groups simultaneously). Formation running is contrary to training in ability groups as it tends to overtrain the least fit and may provide an inadequate training effect for the most fit and should, therefore, be limited. Also, running a fixed amount of time should accommodate military training schedules better as units can start and end together.

g. Avoid the practice of giving extra PT sessions to the least fit Service members. Two factors are important in this regard: more training causes more injuries; and the least fit Service members are two to three times more likely to be injured as their more fit counterparts, especially in the recruit training environment. Therefore, giving the least fit trainees more training is likely to cause even higher risks and more injuries in this group. In order to reduce injuries and attrition rates while maximizing physical performance, the core of any PT program must be targeted directly at these Service members of average and below average fitness levels. Service members of below average fitness who overreach their physical capability have an increased risk of overtraining. Remedial PT programs that require the least fit Service members, especially recruits, to do more training than fit Service members may increase the risk of overtraining and injury with little or no fitness improvement. (Gradual, progressive ability group training programs improve fitness with less risk of overtraining and injury.)

h. Refrain from or modify use of PT as a corrective tool. The common practice of utilizing PT as a punitive, corrective, or motivational tool has the potential to cause excessive training overload and lead to overtraining due to its unpredictable frequency and volume, particularly when overstressing the lower body. Therefore, punitive PT (especially running) is counterproductive from a physical performance and injury perspective. The end result will likely be reduced readiness because of an increased injury risk and decreased physical performance.

Furthermore, any activity we want Service members to embody for a lifetime should not be used for punishment. Other methods to discipline new recruits should be sought or the amount and type of physical demands placed on a new recruit should be limited and standardized (e.g., a standard number of push-ups per day).

i. Utilize interval training. Interval training is an excellent way to train the cardiovascular energy systems of the body that may be required for performance of military duties while minimizing mileage wear and tear on the lower extremities. Military studies that have included interval training with reduced total running mileage have shown fitness improvements as great as or greater than those with long-slow sustained running. Interval running is performed with multiple bouts of all-out (high intensity) running interspersed with periods of recovery. These types of activities include intervals, shuttle runs, and hill/stair running. Intervals are performed by adhering to a work-to-recovery ratio of 1:3 or 1:2. For example, a work-to-recovery ratio of 1:3 would be an all-out bout of 10 seconds followed by a relative relief period (walk or slow jog) of 30 seconds (progressively 15:45 and 20:60). A 1:2 work-to-recovery ratio would be an all-out bout for 10 seconds followed by a relative relief period of 20 seconds (progressively 15:30, 20:40 and 30:60). Caution must be observed with the use of intervals. It would be prudent to perform this exercise no more than once per week and ensure gradual progression. Interval repetitions may start around 5 and progress to a maximum of 10 by adding no more than 1 repetition every 2 weeks. Shuttle runs (running back and forth between two fixed distance lines) or repeated runs up and down a hill or stairs are other forms of interval running that can be conducted in similar ratios as previously described. Interval running can be conducted individually as well as in ability groups.

j. Allow adequate musculoskeletal recovery. Soft tissue (muscles, tendons, cartilage, etc.) needs time in between exercise bouts to recover and build. It is during this recovery time that structures are strengthened. If recovery is not allowed, the rate of breakdown outpaces the body's ability to build up and injuries are the likely result. Periodization training is the term used when looking at the larger issue of recovery for optimizing performance while minimizing injury in athletic performance. This type of training is characterized as an on-again-off-again type of training, and the literature discusses this as a sound way to prevent overtraining. Furthermore, delayed onset muscle soreness (DOMS) peaks around 48 hours after an intense exercise bout and makes exercise difficult. One should balance the body's need for a physiologic training overload with the need for recovery and rebuilding by coordinating military training and PT to—

(1) Avoid exhaustive military training or PT (e.g., obstacle courses, long road marches with heavy loads, longer runs, maximal effort physical fitness testing, etc.) on the same or successive days.

(2) Allow adequate recovery time between administrations of maximal effort physical fitness tests to prevent overtraining and increase the likelihood of improved physical performance. (Since muscle soreness peaks at 48 hours the minimum recovery time would be 3 to 5 days).

(3) Alternate training days that emphasize lower body weight-bearing physical activity with training days focused on upper body conditioning.

(4) Minimize the accumulated weight-bearing stress on the lower body from marching/hiking, movements to training sites, drill and ceremony, obstacle courses, running, etc., by not over scheduling such activities on the same or successive days.

3. Recommendation. The JSPTIPWG recommends a standardized PT program that controls the amount of total body overload performed, particularly for the lower extremities. Lower extremity overtraining (caused largely by excessive distance running) results in higher injury rates, lowered physical performance, decreased motivation, and increased attrition. Good evidence was found that PT programs, especially in initial military training, that reduce distance running miles prevent overtraining and reduce injury rates while maintaining or improving physical fitness. The elements described below should be incorporated to assist in reducing running mileage.

a. Commanders at all levels actively avoid combinations of military training and PT that exceed physiologic thresholds of training, as exceeding these thresholds result in higher injury rates with minimal or no improvement in fitness. Commanders can monitor profile (limited duty excusals) rates and fitness test pass rates and run times to determine if their units are overtraining. Signs that a unit is overtraining include high or increasing lower body injury profile rates, decreased fitness test pass rates, and slower average run times.

b. Other ways to achieve this objective include the following recommendations:

(1) Follow a gradual, systematic progression of running distance and speed beginning with lower mileage and intensity, especially for those just starting or restarting a PT program (e.g., new recruits, those changing units, or those returning to PT after time off for an injury or leave). This practice provides for less total running over a finite period of time.

(2) Structure PT injury prevention programs to target those Service members at the highest risk of injury (those of average or below average fitness) by ensuring that the running mileage for the least fit Service members is appropriate for their fitness level.

(a) Group Service members according to physical ability. For example, fitness test performance (run times) can be used to place Service members in groups of their peers with similar fitness levels. This provides each Service member with a more appropriate level of physiological stimulus to enhance fitness and minimize injury risk.

(b) Run for specified time periods, not distance. Running for specified time periods, not distance, allows the least fit to run shorter distances than the most fit, thus accommodating low and high fitness groups simultaneously.

(c) Limit running in formation. Placing limits on unit formation running allows a greater chance that Service members are provided an adequate training effect for maximum improvement through ability group running.

(d) Avoid the practice of giving extra PT sessions to the least fit Service members, especially recruits, since this will increase the risk of overtraining and injury with little or no fitness improvement. (Gradual, progressive ability group training programs improve fitness with less risk of overtraining and injury.)

(e) Refrain from or modify the use of PT as a punitive, corrective, or motivational tool as it has the potential to cause excessive training overload that can lead to overtraining. Other methods to discipline new recruits should be sought or the amount and type of physical demands placed on a new recruit should be limited and standardized (e.g., a maximum number of push-ups allowed per day). An activity that we want Service members to embody for a career and a lifetime should not be used for punishment.

(3) Replace some distance runs with interval running (multiple bouts of short distance, high intensity running interspersed with periods of recovery) that increases speed and stamina more rapidly than distance running while limiting total running miles.

(4) Balance the body's need for a physiologic training overload to improve fitness with the need for recovery and rebuilding by coordinating military training and PT to—

(a) Avoid exhaustive military training or PT (e.g., obstacle courses, long road marches with heavy loads, longer runs, maximal-effort physical fitness testing, etc.) on the same or successive days.

(b) Allow adequate recovery time between administrations of maximal effort physical fitness tests to prevent overtraining and increase the likelihood of improved physical performance. (Since muscle soreness peaks at 48 hours, the minimum recovery time would be 3 to 5 days.)

(c) Alternate training days that emphasize lower body weight-bearing physical activity with training days focused on upper body conditioning.

(d) Minimize the accumulated weight-bearing stress on the lower body from marching/hiking, movements to training sites, drill and ceremony, obstacle courses, running, etc., by not over scheduling such activities on the same or successive days.

4. Classification Matrix. Table 10 contains the classification matrix of literature search results.

Table 10. Classification Matrix of Literature Search Results: Prevent Overtraining

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	12				10			21	0	1	7	51
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year***	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
	Knapik 2004 (military)	M	+	8	Koplan 1995 (civilian)	+	7.3	Beck/1985		Johnston/2003	Almeida/1997	
	Knapik 2003 (military)	M	+	8	Koplan 1982 (civilian)	+	5.3	Browning/2000			Gillespie/2000	
	Rudzki 1999 (military)	M	+	5	Marti 1988 (civilian)	+	7.3	Fredericson/ 1996			Jones/2002	
	Pope 1999 (military)	M	+	5	Macera 1989 (civilian)	+	9.3	Haverstock/ 2001			Kellett/1986	
	Pollock 1977 (civilian)	M	+	4	Sullivan 1984 (civilian)	+	1.3	Hreljac/2004			Renstrom/1985	
	Rudzki 1997-II (military)		+	8	Jacobs 1986 (civilian)	+	6.0	Jones/1994	Continued from "Descriptive Epidemiology"		VanMechelen/ 1992	
	Rudzki 1997-I (military)		+	8	Brunet 1990 (civilian)	+	2.0	Jones/1999			Yeung/2001	
	Pester 1992 (military)	M	+	1	Bennell/1999	+	Not scored	Kaeding/2001	Paty/1998			
	Knapik/2003 (ADA411764)	M	+	Not scored	Deuster/1997	+	Not scored	Karlsson/2004	Paty/1994			
	Knapik/2004 (ADA420942)		+	Not scored	Reynolds/1990	+	Not scored	Kaufman/2000	Pell/2004			
	Rice/2002		+	Not scored				Kennedy/2005	Reeder/1996			
	Buist/2008		-	Not scored				Macera/1992	Sherrard/ 2004			
								McCully/1986	Watson/1998			
								McKeag/1992	Wexler/1995			

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C. Perform Multiaxial, Neuromuscular, Proprioceptive, and Agility Training (Recommended).

1. Introduction. The purpose of this review was to identify the strength of evidence supporting multiaxial, neuromuscular and proprioceptive training (including training on non-stable platforms) to reduce injuries. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: cross-training, neuromuscular, training, coordination, agility, balance, proprioception, knee, ankle, injury prevention, multiaxial, prevention of ACL injuries.

b. Total number of hits resulting from the search: 8,011.

c. Total number of studies that meet the inclusion criteria: 116.

2. Discussion. Rehabilitation of soccer players with ankle sprains using a wobble board for balance, coordination, and proprioceptive training has been shown to be effective in preventing subsequent ankle sprains in an RCT. Evidence from research with handball players and soccer players suggests that this training may also prevent ankle sprains and anterior cruciate ligament injuries in healthy athletes. This and many other studies utilize exercises that are designed to improve awareness and control of knees and ankles during standing, running, cutting, jumping, and landing. Some programs consist of exercises and partner-perturbation with an inflatable ball, wobble board, and balance mat. A prospective cluster RCT demonstrated that some neuromuscular and proprioceptive activities specifically designed for a single sport (team handball) significantly reduced musculoskeletal injuries in youth aged 15 to 17. Risk for all injuries combined and also for lower limb injuries were significantly reduced in athletes, who performed the task-specific neuromuscular exercises over a 2-year follow-up, compared to age- and skill-matched control athletes. Research on exercises that develop core body stabilization, agility, and multiaxial movement skills has been performed in military populations without the balls, balance mats and wobble boards unlike the civilian studies mentioned. These programs are showing reductions of injury rates by 20 to 30 percent in basic trainees.

a. Aside from the neurophysiological learning that takes place to assist athletes and military Service members in moving their bodies in smoother, more coordinated fashion, the neuromuscular, multiaxial, proprioceptive, and agility conditioning in PT sessions reduces injury risk for other reasons—

(1) Incorporating these activities into a finite training period reduces the trainees' excessive exposure to running activities, thereby reducing lower body injury risk.

(2) The musculoskeletal stresses of training are more evenly distributed across the body (and in different axes of motion) by these types of drills, thereby reducing injury risk (unlike running, which focuses stress narrowly in the lower body).

(3) Strength and stabilization exercises directed at the body core (trunk) represent many of the same movements required during more complex combat activities, and this may increase the likelihood of improved military occupational task performance and possibly reduce injuries.

b. Recent effectiveness of a neuromuscular and proprioceptive training program in competitive female youth soccer players in decreasing anterior cruciate ligament injuries has been demonstrated over a 2-year period. The program, which consisted of a number of activities in addition to sport-specific agility drills (such as strengthening, stretching, education, and plyometrics), resulted in a 74 percent reduction in anterior cruciate ligament tears. A 6-week, preseason neuromuscular training intervention program, done 3 times a week for one to 1 ½ hours reduced the rate of non-contact ACL injuries in females by 72 percent. The majority of these programs (and the intervention studies of them) that involve neuromuscular, multiaxial, and proprioceptive exercises are, by definition, multi-interventional. Many systematic reviews are supportive of this type of training for the reduction of musculoskeletal injuries.

3. Recommendations. The JSPTIPWG recommends that multiaxial (many plains of motion), neuromuscular (coordinated muscular movement), proprioceptive (body position sense), and agility (non-linear movement) exercises be included as a regular component of military PT programs. The work group found good evidence that injuries are reduced by increasing the proportion of PT time devoted to exercises that vary musculoskeletal stress in multiple plains and improve body coordination, position sense, and agility.

4. Classification Matrix. Table 11 contains the classification matrix of literature search results.

Table 11. Classification Matrix of Literature Search Results: Perform Multiaxial, Neuromuscular, Proprioceptive, and Agility Training

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	15				4			13	2	63	19	116
	Author/ Year*	**M**	**+/- /x**	**Score**	**Author/ Year***	**+/- /x**	**Score**	**Author/ Year***	**Author/ Year***	**Author/ Year***	**Author/ Year***	
Literature Reviews	Caraffa, A / 96	M	+	3	Andersen T / 04	+	3.33	Gwinn D / 00	Hardin J / 97	Ageberg, E / 01	Barclay-Goddard R / 04	
	Cahill B / 78	M	+	2	Hewett T / 05	+	6	Harmon K / 98	Mattacola C / 97	Bandettini, M / 03	Cerulli G / 01	
	Emery, C / 05	M	+	9	Loudon J / 96	+	3	Henderson N / 00		Bartlett, M / 02	Crossley K / 99	
	Carter N / 01	M	+	7	Smith, J / 97	+	4	Jones B / 93		Benesch, S / 00	Delfico A / 98	
	Hewett, T / 90	M	+	5				Kaufman K / 00		Bernier, J / 98	Frank J / 90	
	Olsen , O / 05	M	+	8				Knapik J / 02		Blackburn, J / 03	Hewett T / 00	
	Mandelbaum B / 05	M	+	5				Krivickas L / 97		Blackburn, J / 00	Hewett T / 01	
	Myklebust, G / 03	M	+	5				O'Connor, F / 00		Hurley, M / 98	Hewett T / 05	
	Soderman, K / 00	M	X	7				Olsen O / 04		Chappell, J / 02	Lephart S / 97	
	Stasinopoulis, D / 04	M	+	3				Potter, R / 02		Cook, G / 99	Lloyd D / 01	
	Verhagen, E / 04	M	+	9				Sherrard, J / 04		Cowling, E / 02	Myer, G / 04	
	Wedderkopp, N / 99	M	x	7				Snedecor, M / 00		Cowling, E / 01	Myer, G / 04	
	Wedderkopp, N / 03	M	x	8				Tropp/1985		Cowling, E / 01	Risberg, M / 04	
	Heidt R / 00	M	+	4						DeMont, R / 04	Thacker, S / 03	

Table 11. Classification Matrix of Literature Search Results: Perform Multiaxial, Neuromuscular, Proprioceptive, and Agility Training (continued)

References Found/ Literature Reviews	Categories of Study Types											Total
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
	Author/ Year*	**M**	**+/-/x**	**Score**	**Author/ Year***	**+/-/x**	**Score**	**Author/ Year***	**Author/ Year***	**Author/ Year***	**Author/ Year***	
Literature Reviews	Myklebust/2007		+	None provided						Eils, E / 01	Thacker, S / 99	
										Ekdahl, E / 89	Thacker, S / 02	
	Continuation of “Other Research Studies (non-injury outcome)									Emery, C / 03	Verhagen, E / 00	
	Myer/2006				Malliou/2004			Rozzi/1999		Ettlinger, C / 95	Yeung, E / 01	
	Irmischer/2004				Matavulj/2001			Shelbourne/1999		Fagenbaum, R / 03	Griffin/2006	
	Ihara/1986				McLean/2004			Sheth/1997		Ford, K / 03		
	Irrgang				McNair/1990			Simonsen/2000		Fitzgerald, G / 00		
	Kaminski/2003				Newton/1999			Swanik/1999		Gervais, P / 97		
	Kaminski/1998				Onate/2001			Tropp/1988		Grabiner, M / 92		
	Kingma/2004				Osborne/2001			Tsang/2004		Gribble, P / 04		
	Kollmitzer/2000				Paterno/2004			Vengust/2002		Hiemstra, L / 01		
	Kovacs/2004				Pettitt/2002			Wilson/1993		Hoffman, M / 95		
	Leanderson/1993				Pintsaar/1996			Riemann/2004		Hoffman, M / 99		
	Lepers/1997				Riemann/2003					Hoiness, P / 03		
	Liu-Ambrose/2003				Risberg/2001					Holm, I / 04		

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D. Wear Mouthguards During High-Risk Activities (Recommended).

1. Introduction. The purpose of this review was to identify the strength of evidence for the use of mouthguards during high-risk activities to reduce the risk of orofacial injuries. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: mouthguards, mouth protectors.

b. Total number of hits resulting from the search: 806.

c. Total number of studies that meet the inclusion criteria: 20.

2. Discussion. Orofacial injuries are often caused by the same vigorous activities and exercises that can lead to musculoskeletal injuries. Mouthguards are mandated as essential protective equipment in sports such as football, ice hockey, men's lacrosse, and boxing. The American Dental Association and the International Academy of Sports Dentistry currently recommend that mouthguards be used in 29 sport or exercise activities including acrobatics, basketball, bicycling, boxing, equestrian events, extreme sports, field events, field hockey, football, gymnastics, handball, ice hockey, inline skating, lacrosse, martial arts, racquetball, rugby, shotputting, skateboarding, skiing, skydiving, soccer, softball, squash, surfing, volleyball, water polo, weightlifting, and wrestling. Studies have compared mouthguard users and nonusers in many sports including football, rugby, basketball, and hockey. Despite the fact that there are study design problems in virtually all the investigations, most studies support the concept that mouthguards reduce or tend to reduce the incidence of orofacial injuries. A pilot study was initiated at Fort Leonard Wood, Missouri, in 1999 that targeted injuries during pugil stick training, M16 with bayonet training, and confidence course training. Providing Army trainees with mouthguards for these activities decreased the total number of dental injuries by 74 percent. Mouthguards have also been recommended by some to reduce the incidence of concussions but prospective cohort investigations show little difference in concussion incidence between mouthguard users and nonusers. Further research of good methodological quality is needed regarding mouthguards and concussion. See systematic review for more information.

3. Recommendation. The JSPTIPWG recommends all Services provide mouthguards for all Service members participating in activities with a high risk for orofacial injuries. The work group found good evidence that mouthguards reduce orofacial injuries when worn during activities with high orofacial injury risk. Examples of potential high-risk activities listed by the work group include combatives, obstacle and confidence courses, rifle/bayonet training, etc., and contact sports such as basketball, football, etc. The evidence is insufficient to recommend for or against mouthguards as a means of preventing concussion injuries.

4. Classification Matrix. Table 12 contains the classification matrix of literature search results.

Table 12. Classification Matrix of Literature Search Results: Wear Mouthguards During High-Risk Activities

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	19				0			*	*	*	1	20*
Literature Reviews	**Author/ Year†**	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
	Maestrello-deMoya/1989		+	3							Knapik/2007	
	DeWet/1981		+	3								
	Alexander/1995		+	3								
	Morton/1979		+	2								
	LaBella/2002		+	6								
	Marshall/2005		x	8								
	Blignaut/1987		x	2								
	Cohen/1952		+	2								
	Cohen/1961		+	2								
	Cohen/1962		+	2								
	Chapman/1985		+	3								
	Chapman/1985		+	3								
	McNutt/1989		+	3								
	Heintz/1968		+	1								
	Moon/1961		+	3								
	Jan/1964		+	2								
	Davies/1997		+	3								
	Caglar/2005		x	3								
	Dunbar/1962		+	2								

*A number of descriptive epi, case series, reviews and other studies were found, but the reviewer opted not to include them due to the overwhelming intervention evidence.
†See references that follow for full citation.

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E. Wear Semirigid Ankle Braces for High-Risk Activities (Recommended).

1. Introduction. The purpose of this review was to identify the strength of evidence for the use of semirigid ankle braces to prevent inversion or eversion ankle sprains. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: ankle injury, risk factor, cause; ankle injury risk factor; sprain, ankle sprain; ankle, ankle brace.

b. Total number of hits resulting from the search: 95.

c. Total number of studies that meet the inclusion criteria: 26.

2. Discussion. Ankle braces have been consistently demonstrated to reduce ankle injuries during high-risk activities such as basketball, soccer, and parachute landing falls. A systematic review employing meta-analysis methods pooling data from numerous studies estimates that the relative risk of ankle injury while wearing an ankle brace is only 53 percent of the injury risk without bracing. Among civilian athletes, the protection is greatest among those with previous ankle injuries, but remains significantly high for previously uninjured athletes as well. During U.S. Army Airborne operations, 30 to 60 percent of injuries involve the ankle. Well-controlled research has demonstrated that during Airborne jump operations, those wearing an outside-the-boot brace had 0.6 ankle inversion injuries/1000 jumps compared to 3.8 injuries/1000 jumps for those who did not wear the brace. In an operational research study of Rangers over a 3-year period, ankle injuries were 3 times higher among those not wearing braces. In spite of the demonstrated effectiveness of ankle braces in reducing ankle injuries among parachutists, this intervention was discontinued over concerns of cost. During the period after the brace was discontinued, hospitalizations for severe ankle injuries rose by 70 percent. The ankle brace was reinstituted for airborne operations in February 2005, and a central funding mechanism was established to pay for and replace the braces. Ankle braces are particularly appropriate for certain high-risk activities—especially for Service members with a history of previous ankle sprains.

3. Recommendation. The JSPTIPWG strongly recommends that semirigid ankle braces be utilized during participation in high-risk physical activity. The work group found good evidence that semirigid ankle braces reduce ankle injuries when participating in high-risk physical activity such as airborne operations (parachuting), basketball, and soccer, and may prevent ankle injuries in other similar high-risk activities. Also, the work group found good evidence that semirigid ankle braces reduce reinjury among individuals with previous moderate or severe ankle sprains.

4. Classification Matrix. Table 13 contains the classification matrix of literature search results.

Table 13. Classification Matrix of Literature Search Results: Wear Semirigid Ankle Braces for High-Risk Activities

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	11				9			2		0	4	26
Literature Reviews	**Author/ Year***	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year†**	(shaded)
	Sitler		+	8	Milgrom/1991	+	5	Verhagen/2004			Beynnon/2002	
	Surve		+	7	Baumhauer/ 1995	+	4	Leanderson/1993			Knapik/2003	
	Rovere		+	6	Hosea/2000	+	3				Thacker/1999	
	Sharpe		+	6	McGuine/2000	+	5				Nigg/1988	
	Garick		+	6	Beynnon/2002	+	5					
	Barrett		+	7	Willems/2005	+	7					
	Milford		+	5	Mei-Dan/2005	+	5					
	Schmidt		+	6	Giza/2003							
	Mann		+	6	Jensen/1998							
	Amoroso		+	7								
	Schumacher		+	6								

*See references that follow for full citation.

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F. Consume Nutrients to Restore Energy Balance Within 1 Hour Following High-Intensity Activity (Recommended).

1. Introduction. The purpose of this review was to identify the strength of evidence for restoring energy balance through adequate nutrition to lower injury risk. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: nutrition, muscle injury, stress fracture, hydration, muscle damage, training injury, exercise, injury, protein.

b. Total number of hits resulting from the search: 66.

c. Total number of studies that meet the inclusion criteria: 24.

2. Discussion. Research indicates that restoring muscle glycogen (carbohydrate stores in the muscle) decreases markers (indicators) of muscle damage due to physical activity. Sustained physical activity and intermittent high-intensity activity deplete the body's glycogen stores and fatigue muscles, which reduces the muscle's ability to protect joints. Research shows a link between muscle glycogen depletion and markers of muscle damage, fatigue and musculoskeletal pain. Studies of active women also indicate a negative energy balance is a risk factor for stress fractures of the bone. Fluid replacement beverages are always needed after activity.

a. While both civilian and military research have provided evidence that consuming foods that restore energy balance overcomes fatigue, minimizes muscle damage, and protects against heat injury, the timing of the nutritional intervention is critical. Research indicates that consuming a combination of carbohydrates and protein within a 60-minute window immediately following very strenuous exercise initiates repair of muscles damaged during the activity and begins the replenishment of muscle glycogen stores. During this time, metabolic environment is optimized for rebuilding what was used or broken down during the exercise. If the nutrients are consumed more than 60 minutes after the end of the exercise bout, the metabolic environment is less able to absorb the nutrients, thus diminishing recovery.

b. The ideal balance of nutrients needed to allow for the most rapid replenishment of muscle glycogen to optimize and accelerate the recovery process is roughly 12 to 18 grams of protein and 50 to 75 grams of carbohydrate (a ratio of 1 gram of protein for every 4 grams of carbohydrate).

3. Recommendation. The JSPTIPWG recommends consuming 12 to 18 grams of protein and 50 to 75 grams of carbohydrate and a fluid replacement beverage within 1 hour after very strenuous, continuous physical activity (e.g., road marching/hiking lasting longer than 1 hour) to minimize muscle damage and optimize recovery. The work group found sufficient evidence that consuming this balance of nutrients within a 1-hour time frame restores energy balance and optimizes recovery from musculoskeletal breakdown caused by the activity. Collateral benefits such as reduced risk of heat-related illness and enhanced physical performance can be expected.

4. Classification Matrix. Table 14 contains the classification matrix of literature search results.

Table 14. Classification Matrix of Literature Search Results: Consume Nutrients to Restore Energy Balance Within 1 Hour Following High-Intensity Activity

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	15				3			1	0	0	5	24
	Author/ Year*	**M**	**+/- /x**	**Score**	**Author/ Year***	**+/- /x**	**Score**	**Author/ Year***	**Author/ Year**	**Author/ Year**	**Author/ Year***	
Literature Reviews	Bloomer 2004		+	8	Bennell 1996	+	7	Armstrong 2004			Alon/2002	
	Flakoll 2004		+	6	Bennell 1995	+	5				Hawley/2006	
	Kreider 1999		X	7	Korpelainen 2001	X	3				Peake/2007	
	Knitter 2000		+	5							Shirreffs/2004	
	Panton 2000		+	6							Slater/2000	
	Paddon-Jones 2001		X	3								
	Saunders 2004		+	4								
	Shafat 2004		+	3								
	Umeda 2004		+	2								
	Ivy 2002		+	8								
	Ivy 2003		+	8								
	Rasmussen 2003		+	6								
	Rowlands 2007		+	6								
	Tarnopolsky 1997		+	6								
	Zawadzki 1992		+	5								

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G. Wear Synthetic Blend Socks to Prevent Blisters (Recommended).

1. Introduction. The purpose of this review was to identify the strength of evidence for the use of polyester blend socks to prevent blisters to the feet. Although not strictly musculoskeletal injuries, foot blisters are among the most common injuries experienced by Soldiers and Marines, especially in recruit training, and can cause infection and limitations in duty. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: blister, blisters, blisters and risk factors.

b. Total number of hits resulting from the search: 91.

c. Total number of studies that meet the inclusion criteria: 16.

2. Discussion.

a. Moisture-wicking socks. Blisters appear to be caused by friction between the skin and sock; that friction is exacerbated by moisture produced by sweating. Special hydrophobic (having little or no affinity for water) socks, designed to reduce foot moisture, appear to reduce the likelihood of foot blisters. In Marine recruits undergoing 12 weeks of training, 39 percent of those wearing the standard U.S. military wool/cotton sock experienced blisters or cellulitis resulting in limited duty. Among those wearing a liner sock composed of polyester (thought to "wick" or draw away moisture from the skin) with the standard sock, the foot friction injury rate was 16 percent (a 56 percent decrease in blister injuries). A third group of recruits had a comparable 17 percent injury rate while wearing the same polyester liner with a very thick wool/polyester blend sock designed to assist with the wicking action while reducing friction. Thus, both experimental sock systems were successful in reducing blisters.

b. Foot antiperspirants. Minimizing foot moisture through the use of emollient-free antiperspirants has been thought to reduce the incidence of foot blisters. A prospective double-blinded investigation examined foot blisters in U.S. Military Academy cadets who used either a placebo or an antiperspirant preparation (20 percent solution of aluminum chloride hexahydrate in a denatured ethyl alcohol base). Cadets were asked to apply the preparations to their feet for 5 consecutive evenings prior to a 21-kilometer (km) foot march. Cadets performed the march on a hot day, and their feet were examined for blisters before and after the march. Although there was variable compliance with the 5-day application schedule, when groups were compared who had used the preparations for at least 3 days prior to the march, the antiperspirant group had a considerably lower blister incidence compared to the placebo (21 versus 48 percent). However, 57 percent of those in the antiperspirant group experienced skin irritation (irritant dermatitis) compared to only 6 percent in the placebo group. The irritant dermatitis problem was also cited in another study suggesting this side effect needs to be addressed before this intervention can be widely recommended.

3. Recommendation. The JSPTIPWG recommends the use of synthetic blend socks (e.g., polyester, acrylic, and nylon versus cotton socks) to prevent blisters to the feet during physical training. The work group found at least fair evidence that synthetic blend socks prevent blisters to the feet, especially during long-distance marching.

4. Classification Matrix. Table 15 contains the classification matrix of literature search results.

Table 15. Classification Matrix of Literature Search Results: Wear Synthetic Blend Socks to Prevent Blisters

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	7				5			2	0	0	2	16
Literature Reviews	**Author/ Year**	**M**	**+/-/x**	**Score**	**Author/ Year***	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
	Knapik/1996		+	7	Bush/2000	+	5	Naylor/1955			Knapik/1996	
	Herring/1993		+	7	Patterson/1994	+	7	Akers/1972			Knapik/1995	
	Herring/1990		-	7	Knapik/1999	+	7					
	Jagoda/1981	M	+	8	Hoeffler/1975	+	2					
	Knapik/1998		+	8	Reynolds/2000	+	8					
	Reynolds/1995		-*	7								
	Darregrand/ 1992		-*	7								

*Study on emollients only.

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VIII. INTERVENTIONS NOT RECOMMENDED (DUE TO EVIDENCE OF INEFFECTIVENESS OR HARM).

A. Wear Back Braces, Harnesses, or Support Belts (Not Recommended).

1. Introduction. The purpose of this review was to identify the strength of evidence for the use of back braces to prevent low back sprains and strains. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below. Due to the number of systematic reviews and governmental agency positions on the use of back belts, the reference lists for this prevention intervention come from National Institute for Occupational Safety and Health (NIOSH) Publication 94-122 (1994) and systematic reviews. No classification matrix of references exists since the systematic reviews graded the quality of the studies.

2. Discussion. Back belts have been aggressively promoted as a preventive measure against back injuries in healthy individuals during lifting activities for a couple of reasons: it is theorized that back belts increase the intra-abdominal pressure (IAP), which is thought to decrease compressive forces on the lumbar spine, and also minimize movement of some lumbar segments. These theories have not been substantiated in the literature. In fact, in 1992, the Director of NIOSH formed a working group to review the scientific literature on back belt usage in healthy individuals. The CDC report (DHHS (NIOSH) 1994) concluded that back belt effectiveness was unproven. That same year, the Office of The Surgeon General (OTSG) issued a memorandum stating "The blanket use of back belts to prevent or minimize back injuries resulting from lifting is not supported by the Office of the Surgeon General" because the Occupational Safety and Health Administration did not accept back belts as personal protective equipment (OTSG 1994). A systematic review on the prevention of back injuries in 1997 concluded that there was no evidence for the effectiveness of lumbar supports. In 1998, Department of Defense Instruction (DODI) 6055.1 directed that "DoD does not recognize back support belts or wrist splints as personal protective equipment, or the use of these devices in the prevention of back or wrist injuries." Two independent systematic reviews published in 2001 came to the same conclusion; there is moderate to strong evidence that lumbar supports or back

belts are not effective in primary prevention, and there is no evidence that back belts are effective for secondary prevention of low back injury. Another literature review in 2003 came to the same conclusion. Based on the overwhelming amount of scientific evidence showing the ineffectiveness of back belts as well as the number of government agencies that did not support their use, it was the consensus of the work group that back belts could not be endorsed as a low back injury prevention intervention in healthy individuals.

3. Recommendation. The JSPTIPWG does not recommend the use of back braces, harnesses, or support belts for the prevention of low back injuries. The work group found at least moderate to strong evidence that back belts/supports are ineffective or that the potential harms outweigh the benefits. These findings support the DOD position that back support belts are not personal protective equipment, and use of these devices for the prevention of back injuries is not endorsed (DODI 6055.1, para E6.1.3).

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B. Take Anti-inflammatory Medication Prior to Exercise (Not Recommended).

1. Introduction. The purpose of this review was to identify the strength of evidence for pre-exercise administration of nonsteroidal anti-inflammatory medications (e.g., ibuprofen) to minimize risk of injury during subsequent activity. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: nonsteroidal anti-inflammatory drug (NSAID) and injury, prevention, exercise, pre-exercise, loading, anti-inflammatory.

b. Total number of hits resulting from the search: 198.

c. Total number of studies that meet the inclusion criteria: 13.

2. Discussion.

a. Contraction-induced muscle damage, especially from eccentric muscle contractions, is known to cause a substantial inflammatory response. This response itself can cause tissue damage beyond that originally sustained by the muscle. It is hypothesized that administration of a NSAID prior to an exercise would control that inflammatory response, thus diminishing tissue damage. One study demonstrated that the pre-administration of diclofenac sodium (Voltaren®) significantly reduces measures of exercise-induced skeletal muscle damage. While not injury-related, another study found that the preoperative administration of oral rofecoxib (another NSAID) provided a significant analgesic benefit and decreased the opioid requirements in patients undergoing abdominal hysterectomy. Other studies have shown mixed responses of creatine kinase (CK) and neutrophils (indirect markers of muscle damage) to post-injury doses of ibuprofen (Motrin®), another NSAID). One other study indicates that therapeutic doses of naproxen do not prevent CK release into the plasma but decrease the perception of muscle soreness and positively influence quadriceps peak torque. One final study revealed that intake of ibuprofen can decrease muscle soreness induced after eccentric exercise but cannot assist in restoring muscle function. The results are inconsistent with regard to NSAID use prior to activity, and many of these studies observed the markers for muscle damage as a surrogate for injury; none actually demonstrated a reduction in injury rates from pre-exercise NSAIDs. (Voltaren® is a registered trademark of Novartis Corporation, New York, New York; Motrin® is a registered trademark of Johnson and Johnson Corporation, New Brunswisk, New Jersey.)

b. Furthermore, there are harmful risks to taking NSAIDS that must be considered. Some of the most common risks of NSAID use are stomach discomfort, gastrointestinal bleeding and ulceration. One way to counter these common side effects is to ingest food with the medication. The consumption of food immediately prior to a vigorous activity to buffer the effects of the medication may cause significant discomfort during activity. Kidney, heart, liver, and skin problems can also occur, most related to the inhibition of prostaglandin synthesis. Kidney failure has been reported during marathons, in part due to these substances in the body combined with dehydration and strenuous effort that takes place over several hours. The majority of gastrointestinal side effects of NSAIDs are symptomatic responses, such as bloating, cramping, pain, acid reflux, and diarrhea or constipation. These are not symptoms one would care to experience while participating in physical activity. Lastly, NSAIDs have been the cause of more than 76,000 hospitalizations and 7600 deaths in the U.S. annually.

3. Recommendation. The JSPTIPWG does not recommend taking anti-inflammatory medication prior to exercise for the prevention of injuries. The work group found insufficient evidence for the efficacy of pre-administration of anti-inflammatory medication for the prevention of injuries. The potential harms outweigh any potential benefits.

4. Classification Matrix. Table 16 contains the classification matrix of literature search results.

Table 16. Classification Matrix of Literature Search Results: Take Anti-Inflammatory Medication Prior to Exercise

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	3				3			2	0	5	0	13
Literature Reviews	**Author/ Year***	**M**	**+/- /x**	**Score**	**Author/ Year***	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year***	**Author/ Year**	
	Tokmakidis SP/2003	M	+	7	Van Staa, TP / 2000	x	7	O'Grady/2000		Baker, J / 2005		
	Bourgeois, J / 1999	M	x	6	Sheikh RA, / 2002	x	4	Pizza/1999		Olsen,NV/99		
	Loram/2005		x	Not scored	Bauer, DC / 1996	x	7			Walker,RJ/94		
										Hungin/2001		
										Tamblyn/1997		

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IX. INTERVENTIONS WITHOUT SUFFICIENT EVIDENCE TO RECOMMEND AT THIS TIME.

A. Stretch Muscles Before or After Exercise (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to establish the strength of evidence to support the practice of pre-exercise and post-exercise stretching for the prevention of musculoskeletal injuries. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: stretching, flexibility, injury and sports injury.

b. Total number of hits resulting from the search: 1,915.

c. Total number of reviews that meet the inclusion criteria: 93.

2. Discussion. For many years sports medicine professionals have recommended stretching prior to physical activity as a method for reducing the risk of injury. Prior to the meeting of the work group, a member of the JSPTIPWG published an extensive review at a level that exceeded reviews performed for other potential interventions. Since systematic reviews are now viewed as a higher order of evidence than single RCTs, no effort was made to look at individual studies beyond those contained within the five systematic reviews which examined hundreds of citations and all came to the same conclusion. Studies performed to date generally show that stretching prior to or both prior to and after PT do not reduce the risk of injury. There simply is not sufficient evidence to endorse or recommend discontinuing routine stretching before or after exercise to prevent injury among competitive or recreational athletes or Service members. The few studies that did show an effect of stretching on injuries suffered from serious design flaws such as including pre-exercise stretching with warm-up in the intervention. However, studies failing to show stretching reduced injuries also suffer from limitations. Studies to date have not specifically targeted individuals with limited flexibility. Studies show that stretching can increase flexibility, although these suggest that the most efficient timing of stretching may be when muscles are warm (possibly after exercise). Additionally,

epidemiological data indicate that both extremes of flexibility (too much or too little) are associated with increased injury rates. Thus, future stretching studies need to selectively target individuals with low flexibility to determine whether stretching timed appropriately during training can increase flexibility and reduce injuries for these Service members.

3. Recommendation. The JSPTIPWG cannot recommend organized stretching as a means for preventing PT-related injuries. The work group found good evidence that stretching is ineffective as an injury prevention strategy in a generally young, healthy population. Also, there is insufficient evidence that it may cause harm. Therefore, while the work group cannot endorse stretching, it also cannot recommend discontinuing stretching before or after exercise in those who perceive a benefit. Studies to date have not specifically targeted individuals with limited range of motion. Because epidemiological data suggest that both extremes of flexibility (too much or too little) are risk factors associated with increased injury rates, the work group recommends research selectively targeting individuals with limited range of motion to determine the effect of stretching in this select population.

4. Classification Matrix. Table 17 contains the classification matrix of literature search results.

Table 17. Classification Matrix of Literature Search Results: Stretch Muscles Before or After Exercise

										Hartley-O/1990	Safran/1989	
References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	9				10			4		48	22	93
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year***	
	Andrish/1974		x	4	Ekstrand/1982	+		Hume/2000		Bandy/1994	Thacker/2004	
	Bixler/1992	M	x	4	Howell/1984	x		Jones/1999		Bandy/1998	Weldon/2003	
	Pope/1998		x	8	Jones/1993	+		Kerner/1983		Chang/2001	Herbert/2002	
	Cross/1999		x	5	Macera/1989	x		Lee/1989		Condon/1987	Holland/1968	
	Hartig/1999		+	5	Nicholas/1970	-	5			Cronelius/1998	Shrier/1999	
	Pope/2000		x	8	Walter/1989	x				Cornelius/1995	ACSM/1998	
	Hilyer/1990		x/ +	7	Wilber/1995	x	7			Cornwell/2001	Thacker/2002	
		x= injuries += reduce severity			Kalenak/1975	x				Craib/1996	Anderson/1991	
	Ekstrand/1983	M	+	7	Kirby/1981	x				dePino/1985	Beaulieu/1980	
	Van Mechelen /1993	M	x	8	Knapik/1991	+*				Devries/1961	Corbin/1984	
										DeVries/1980	Entyre/1987	
										Entyre/1986	Garrett/1996	
										Fowles/2000	Holt/1996	
										Gambetta/1997	Hubley/1990	
										Gleim/1990	Knapik/1992	
										Godges/1993	Knudson/2000	
										Godges/1989	Lopez/1981	
					* imbalances related to injury					Halbertsma/ 1999	Neuberger/1969	

Table 17. Classification Matrix of Literature Search Results: Stretch Muscles Before or After Exercise (continued)

References Found/ Literature Reviews	Categories of Study Types											Total
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				Risk Factor/Cause + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			Descriptive Epidemiology	Case Series	Other Research Studies (non-injury outcome)	Reviews	
	Author/ Year*	M	+/- /x	Score	Author/ Year*	+/- /x	Score	Author/ Year*	Author/ Year*	Author/ Year*	Author/ Year*	
Literature Reviews										High/1989	Worrell/1992	
								Continuation of "Other Research Studies		Holt/1970	van Mechelen/ 1992	
								(non-injury outcome)		Hortobagyi/ 1985	Macera/1992	
								Ross/1999		Hurley/1984		
								Skubic/1957		Johansson/1999		
								Smith/1965		Kokkonen/1998		
								Sullivan/1992		Lucas/1984		
								Wallin/1985		mcCue1953		
								Walter/1996		Madding/1987		
								Wiktorsson-Moller/1983		Massey/1961		
								Wilson/1991		Merlino/1959		
								Zebas/1985		Nelson/2001		
								Shellock/1983		Prentice/1983		
								McHugh/1999		Roberts/1999		
								Moller/1985		Rodenburg/ 1994		
								Muido/1946		Rosenbaum/ 1995		

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Walter, S.D., Hart, L.E. McIntosh, J.M., J.R. Sutton. The Ontario cohort study of running-related injuries. *Arch. Intern. Med*. 149:2561-2564,1989.

Weldon, S.M., R.H. Hill. The efficacy of stretching for prevention of exercise-related injury: a systematic review of the literature. *Man. Ther*. 8:141-150,2003.

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Wilber, C.A., Holland, G.J., Madison, R.E., S.F. Loy. An epidemiological analysis of overuse injuries among recreational cyclists. *Orthop. Clin. Sci*. 16:201-206,1995.

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Zebas, C.J., Rivera, M.S. Retention of flexibility in selected joints after cessation of a stretching exercise program. In: Dotson, C.O, Humphrey, J.H. (eds): *Exercise Physiology: Current Selected Research, New York, AMS Press, Inc*., 1985, pp: 181-191.

B. Reinitiate Exercise at Lower Intensity Levels for Detrained Individuals (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for reinitiating exercise at a lower intensity for detrained individuals in order to avoid injury. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: reinitiating exercise in military, reinitiating exercise, and detraining.

b. Total number of hits resulting from the search: 106.

c. Total number of studies that meet the inclusion criteria: 3.

2. Discussion. The question regarding the exact point at which enough detraining has occurred that the risk of musculoskeletal injury is significantly increased when one resumes training has not been answered in the literature. It is well understood that there is a significant reduction in cardiorespiratory fitness (50 percent stroke volume) within just 2 weeks of stopping intense physical training and a return to pretraining cardiorespiratory fitness after as short a period of time as 10 weeks. The musculoskeletal system seems more resistant to decreases in training as strength gains are maintained with as little as one resistance training session per week. Even though no studies have been performed that address the risk of injury on reinitiating exercise after periods of detraining, it may be prudent to reinitiate activity and rebuild fitness gradually for trainees who miss more than 2 weeks of PT (such as those returning from leave of absence, new-starts to units, or those returning from a period of limited duty). Expecting trainees to immediately return to the running volume achieved before training was interrupted may overload their capacity inasmuch as some detraining has occurred.

3. Recommendation. The evidence is insufficient to recommend for or against reinitiating exercise at lower levels for the detrained. When individuals stop training due to

injury, illness, vacation, or other reasons, they gradually become detrained or lose a portion of their fitness gains. Therefore, it would seem prudent to reinitiate activity at lower than previous levels (see overtraining recommendation). However, there is insufficient evidence to determine how many days of detraining require reinitiating exercise at lower levels. The JSPTIPWG recommends further research into how much detraining requires a lower level of intensity and a shorter duration of exercise to prevent injury.

4. Classification Matrix. Table 18 contains the classification matrix of literature search results.

Table 18. Classification Matrix of Literature Search Results: Reinitiate Exercise at Lower Intensity Levels for Detrained Individuals

References Found/ Literature Reviews	Categories of Study Types											Total
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	0				0			0	0	3	0	3
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year***	**Author/ Year**	
										Coyle/1984		
										Fringer/1974		
										Graves/1988		

*See references that follow for full citation.

5. References.

Coyle EF, Martin WH, Sinacore DR, et al. Time course of loss of adaptation after stopping prolonged intense endurance training. J Appl Physiol 1984;57:1857-1864.

Fringer MN, Stull AG. Changes in cardiorespiratory parameters during periods of training and detraining in young female adults. Med Sci Sports 1974;6:20-25.

Graves JE, Pollock ML, Leggett SH, et al. Effect of reduced training frequency on muscular strength. Int J Sports Med 1988;9:316-319.

C. Target Specific Muscles to Strengthen (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for targeted muscle strengthening and job-specific strength training for the reduction of injuries. Rationale for combining interventions and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: target muscle strengthening, job-specific strength training, strength training, occupational strength, occupational conditioning, work hardening, ergonomics, occupational strength analysis, human performance measures, functional capacity, strength training injury prevention.

b. Total number of hits resulting from the search: 319.

c. Total number of studies that meet the inclusion criteria: 11.

2. Discussion.

a. Therapeutic exercise has long been widely prescribed as a treatment for many injuries, especially those that involve the lower back, with demonstrated efficacy for decreasing symptoms of pain and stiffness while improving range of motion, work capacity and overall function. It has been postulated that injuries might be prevented by focusing on strengthening exercises of "inherently weaker" specific body areas depending upon the desired function or the specific relationship to job performance. Targeted muscle strengthening and job-specific strength training were initially thought of as separate interventions; however, as these interventions were reviewed, it became clear that the literature treats these interventions as one and the same idea.

b. One study demonstrates eccentric overloading of hamstrings reduces injury incidence in elite soccer players. While other studies show that the incidence of anterior cruciate ligament injuries, particularly in female athletes, may be reduced through targeted muscle strengthening, the most research conducted addressing the effect of exercise on a particular body part has been that of the low back. Strengthening muscles to prevent injury has been shown to be effective for those who work in the strip mining industry, firefighters, and men's college soccer players. Additionally, therapeutic exercise does not increase the incidence of back injury, even with those with a history of such. In military recruits, it appears that lower body strength levels (within 1 standard deviation of the population mean) are associated with reduced incidence of stress fractures during military training.

3. Recommendation. The evidence is insufficient to recommend for or against targeted muscle strength training and job- or sport-specific strength training for the prevention of injuries. Scientific evaluation of targeted muscle strength training is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined. The work group concludes that more research or program evaluation on the precise series or combinations of strengthening exercises for military training should be conducted.

4. Classification Matrix. Table 19 contains the classification matrix of literature search results.

Table 19. Classification Matrix of Literature Search Results: Target Specific Muscles to Strengthen

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	2				1			0	0	8	0	11
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year***	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year***	**Author/ Year**	
	Myer	M	+	7	Canham-Chervak	x	7			Knapik/2004		
	Askling		+	1						McCarthy/1992		
										Von Restorff/2000		
										Kraemer/2001		
										Roberts/2002		
										Dziados/1987		
										Bell/1993		
										Marcinik/1985		

*See references that follow for full citation.

5. References.

Askling C, Karlsson J, Thorstensson A. Hamstring injury occurrence in elite soccer players after preseason strength training with eccentric overload. Scan J Med Sci Sports 13(4): 244-50, 2003.

Bell NS, Jones BH. Injury risk factors among male and female Army trainees. USARIEM, Abstract presented to APHA, October 1993.

Canham-Chervak M, et al. Determining physical fitness criteria for entry into Army basic combat training: can the criteria be based on injury risk? USACHPPM, 29-HE1395-00, January 2000.

Dziados JE, et al. Physiological determinants of load bearing capacity. USARIEM, T19-87, June 1987.

Myer, GD, Ford, KR, Hewett, TE. Methodological approaches and rationale for training to prevent anterior cruciate ligament injuries in female athletes. Scand J Med Sci Sports. 14(5):273-4, 2004.

Knapik JJ, et al. Secular trends in the physical fitness of American youth, young adults and Army recruits. USACHPPM, 12-HF01Q9B-04, August 2004.

Kraemer WJ, Mazzetti SA, Nindl BC, Gotshalk LA, Volek JS, Bush JA, Marx JO, Dohi K, Gomez AL, Miles M, Fleck SJ, Newton RU, Hakkinen K. Effect of resistance training on women's strength/power and occupational Performances. Med Sci Sports Exerc 2001 Jun;33(6):1011-25.

Marcinik EJ, Hodgdon JA, Englund CE, O'Brien JJ. Changes in fitness and shipboard task performance following circuit weight training programs featuring continuous or interval running. NAVHLTHRSCHC-85-33, August 1985.

McCarthy J. et al. Combined strength and endurance training: functional and morphological adaptations to ten weeks of training. NHRC-92-26, September 1992.

Roberts MA, O'Dea J, Boyce A, Mannix ET. Fitness levels of firefighter recruits before and after a supervised exercise training program. J Strength Cond Res 2002 May;16(2):271-7.

Von Restorff W. Physical fitness of young women: carrying simulated patients. Ergonomics 2000 Jun;43(6):728-43.

D. <u>Replace Running Shoes at Standard Intervals (Insufficient Evidence to Support)</u>.

1. Introduction. The purpose of this review was to identify the strength of evidence for the practice of replacing running shoes at certain intervals to prevent lower extremity injuries (and to determine the best interval at which shoes should be replaced). Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: running shoes, age of shoe, running injuries, prescription, replacing shoes, shoe replacement.

b. Total number of hits resulting from the search: 2,203.

c. Total number of studies that meet the inclusion criteria: 9.

2. Discussion.

a. Shoes worn during PT may be an important piece of equipment related to injury prevention. Soldiers in the U.S. Army have used running shoes instead of combat boots for PT since the early 1980s, even without the influence of any definitive study. Despite the relatively large number of studies on the biomechanics of running shoes, the hypothesized effects on injury reduction and wide use of running shoes instead of boots, data linking running shoes to actual cases of injuries are very sparse. The only study providing data for injuries and the age of running shoes showed a general trend of rising stress fracture incidence with older shoes, with the stress fracture incidence doubling at 6 months to 1 year, although the small group of subjects with the oldest shoes had no stress fractures. Investigators studying Israeli infantry recruit training reported foot overuse injury rates of 18 percent for those wearing high-top basketball shoes compared to 34 percent for those wearing standard lightweight infantry boots.

b. The answer to the question as to how long a running shoe should last is not easy. Over time, the midsoles begin to lose their cushioning capability, but since the outsoles of the shoe are so durable, cushioning may be long gone before the tread shows significant wear. Depending on the shoe, running conditions, body weight and running form, shoe manufacturers say that a shoe should last around 400 miles of use. Independent biomechanical studies on shoes report that shoes maintain a significant shock-absorbing capability up to 600 miles. Since it can be difficult to recognize the signs of wear simply with shoe inspection, one would have to rely upon a calculation of miles worn. However, based on just one study, specific recommendations on the precise schedule of shoe replacement is difficult.

3. Recommendation. Reports from shoe manufacturers and biomechanical studies on running shoes show that shoes should provide satisfactory support and cushion for 400 to 600 miles of use and, therefore, should be replaced accordingly to prevent injury. However, the work

group concludes that the scientific evidence (direct measures of injury) is insufficient to recommend for or against replacing running shoes for the prevention of injuries at a specified mileage interval. The work group recommends that this specific research question be addressed.

4. Classification Matrix. Table 20 contains the classification matrix of literature search results.

Table 20. Classification Matrix of Literature Search Results: Replace Running Shoes at Standard Intervals

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	0				1			0	1	5	2	9
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year***	**Author/ Year***	**Author/ Year***	
					Taunton et al/2003	+/-	8		Burgess & Ryan/1985	Nigg & Segesser/1988	Gardner/1988	
										Cook et al./1985	Thacker/2002	
										Cook, Kester, & Brunet/1985		
										Miles et al/2003		
										Clowers et al/2004		

*See references that follow for full citation.

5. References.

Burgess I, Ryan MD. Bilateral fatigue fractures of the distal fibulae caused by a change of running shoes. Medical Journal of Australia 1985;143(7):304-305.

Clowers KG, Zhang S, Wortley M, Kohstall C. Longitudinal perception about cushioning, fit, and comfort of a running shoe over 400 miles. Medicine and Science in Sports and Exercise 2004;36(5):Supplement, S267.

Cook SD, Kester MA, Brunet ME. Shock absorption characteristics of running shoes. American Journal of Sports Medicine 1985;13(4):248-253.

Cook SD, Kester MA, Brunet ME, Haddad RJ Jr. Biomechanics of running shoe performance. Clinical Sports Medicine 1985;4(4):619-626.

Gardner LI Jr, Dziados JE, Jones BH, Brundage JF, Harris JM, Sullivan R, Gill P. Prevention of lower extremity stress fractures: a controlled trial of a shock absorbent insole. American Journal of Public Health 1988; 78(12):1563-1567.

Miles KA, Smith J, Riemer E, Schaefer MP, Dahm DL, Kaufman K. Wear characteristics of common running shoes. Medicine and Science in Sports and Exercise 2003; 35(5):Supplement 1, S237.

Nigg BM. Segessor B. The influence of playing surfaces on the load on the locomotor system and on football and tennis injuries. Sports Medicine 1988; 5(6):375-385.

Taunton JE, Ryan MB, Clement DB, McKenzie DC, Lloyd-Smith DR, Zumbo BD. A prospective study of running injuries: the Vancouver Sun Run "in training" clinics. British J Sports Med 2003;37:239-244.

Thacker SB, Gilchrist J, Stroup DF, Kimsey CD. The prevention of shin splints in sports: a systematic review of literature. Medicine & Science in Sports & Exercise. 34(1): 32-40, 2002.

E. Warm-Up and Cool-Down Before and After Activity (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to establish if warming up the body (raising the heart rate and body temperature) and cooling down the body (lowering the heart rate and body temperature) by moving through a range of motion (at low intensity) expected in the ensuing activity are influential interventions in reducing musculoskeletal injuries. Reasons for

pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: warm-up, cool-down, injury prevention, and randomized controlled trial or RCT.

b. Total number of hits resulting from the search: 10.

c. Total number of studies that meet the inclusion criteria: 1 (systematic review).

2. Discussion. The JSPTIPWG made a conscious decision to isolate those activities that may or may not be performed in association with a warm-up. For example, stretching is a common activity often associated with a warm-up, but it is an activity that can be performed at any time during a training session. Therefore, stretching is considered a separate intervention apart from the warm-up and is discussed in an earlier paragraph of this report. Other types of activities like proprioceptive and neuromuscular activities also are associated with the warm-up and often are found when searching the literature for warm-up information. These types of activities may or may not be performed in association with the warm-up and also are considered a separate intervention (discussed earlier). A systematic review of warm-up activity found five studies, all of high quality (7–9 (mean=8) out of 11) and reporting sufficient data (quality score>7) on the effects of warming up relative to reducing injury risk in humans. Some of these studies included stretching among other activities. Three of the studies found that performing a warm-up prior to performance significantly reduced the injury risk, and the other two studies found that warming up was not effective in significantly reducing the number of injuries. Since the number of studies showing no effect in preventing injuries is nearly the same as those showing a positive effect, enough doubt is cast on the practice of warm-up such that the work group cannot recommend it at this time. However, there is insufficient evidence to discontinue the strategy as well. The recent review of literature provides a comprehensive reference list to which the reader is referred for the entire breadth of studies on warm-up and associated activity.

3. Recommendation. Evidence of the effectiveness of warm-up and cool-down activites on the prevention of injuries is lacking; therefore the JSPTIPWG cannot recommend for or against this intervention. The work group recommends that this specific research question be studied in military populations.

4. Classification Matrix. Table 21 contains the classification matrix of literature search results.

Table 21. Classification Matrix of Literature Search Results: Warm-Up and Cool-Down Before and After Activity

References Found/ Literature Reviews	Categories of Study Types												Total
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**		
No. of Refs Found	0				0						1		1
Literature Reviews	**Author/ Year***	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year***		
											Fradkin 2006		

*See references that follow for full citation.

5. References.

Fradkin, AJ, Gabbe BJ, Cameron PA, Does warming up prevent injury in sport? The evidence from randomized controlled trials. J Sci Med Sport. 2006 Jun;9(3):214-20.

F. Place Shorter Service Members in Front of Formations to Set Running Pace and Cadence ((Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for placing Service members in front of military marching or running formations to reduce musculoskeletal injury, particularly stress fractures of the hip. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: stride length, step length, run, walk, march, injury and musculoskeletal injury or soft-tissue injury, stress fractures, shin splint.

b. Total number of hits resulting from the search: 56.

c. Total number of studies that meet the inclusion criteria: 3.

2. Discussion. When an individual is forced to lengthen their stride beyond what would be considered comfortable, it is theorized that this creates significant increases in stress on the pelvis. It has been observed that female trainees are at greater risk for stress fractures of the pubic ramus than their male counterparts. Two observational studies over 25 years ago suggest that placing trainees by their physical height with the shorter stature trainees at the front of marching or running formations would reduce injury. While it appears to make sense to shorten the stride to one that is most comfortable for the shortest trainees, it ignores the impact on the taller trainees who are forced to adjust their stride to be much shorter than is efficient for them. A recent descriptive study reaffirms that the shortest and lightest Navy recruits have higher rates of pelvic stress fractures. However, a prospective randomized intervention trial has yet to be performed to definitively test this hypothesis and the impact this intervention may have on taller trainees.

3. Recommendation. Evidence is weak for placing Service members in ranks from front to back by physical height as an intervention strategy to prevent lower extremity injuries; therefore the JSPTIPWG cannot recommend for or against this intervention. The work group recommends that a randomized trial be performed to definitively test this hypothesis and the impact this intervention may have on taller Service members.

4. Classification Matrix. Table 22 contains the classification matrix of literature search results.

Table 22. Classification Matrix of Literature Search Results: Place Shorter Service Members in Front of Formations to Set Running Pace and Cadence

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	3											3
	Author/ Year*	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
Literature Reviews	Kelly/2000	M	+	4								
	Reinker/1979		+	2								
	Ozburn/1981		+	1								

*See references that follow for full citation.

5. References.

Kelly EW, Jonson SC, Cohen ME, Shaffer R. Stress fractures of the pelvis in female Navy recruits: an analysis of possible mechanisms of injury. Mil Med 2000;165:142-146.

Ozburn MS, Nichols JW. Pubic ramus and adductor insertion stress fractures in female basic trainees. Mil Med 1981;146:332-334.

Reinker KA, Ozburne S. A comparison of male and female orthopaedic pathology in basic training. Mil Med 1979;144:532-6.

G. Manipulate Stride Length (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the evidence of the effectiveness of manipulating stride length as opposed to running in cadence (to the beat of a caller). Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: stride length, step length, run, walk, march, injury and musculoskeletal injury or soft-tissue injury, stress fractures, shin splints.

b. Total number of hits resulting from the search: 56.

c. Total number of studies that meet the inclusion criteria: 8.

2. Discussion. Allowing trainees to run at a self-chosen stride (not in step or cadence) would seem to be a possible answer to reducing pelvic stress fractures in the shortest trainees while not adversely impacting the stride of the taller trainees. One study demonstrated a significant reduction (11.2 percent to .6 percent) in pelvic stress fractures in female recruits by using just such an intervention. However, while this study was well designed, controlled and analyzed, the self-chosen stride intervention was coupled with a number of other interventions making it difficult to assess the contribution of self-chosen stride length alone. Another study observed a complete absolution of pelvic stress fractures by eliminating a required stride length. However, this was a very small sample, and the time period of observation was not reported. A more recent study confirms that understriding may cause more soreness than a preferred stride length. Furthermore, an additional benefit of allowing self-selected stride length is that individuals naturally choose a stride that is most energy efficient for them. This more efficient running pattern has implications for preventing overtraining (the primary recommendation is this report).

3. Recommendation. Evidence that stride length manipulation is a cause of lower extremity injuries is lacking or of poor quality; therefore the work group concluded that the

evidence is insufficient to recommend for or against allowing Service members to run at a self-chosen stride length for the prevention of injuries. However, as the current research does not indicate that a self-chosen stride length causes any harm and shows that it can be an effective strategy in improving energy efficiency, it may aide in the prevention of overtraining. Therefore, the JSPTIPWG recommends that this specific intervention be given priority by research or program evaluation in military populations.

4. Classification Matrix. Table 23 contains the classification matrix of literature search results.

Table 23. Classification Matrix of Literature Search Results: Manipulate Stride Length

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	3									5		8
	Author/ Year*	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year***	**Author/ Year**	
Literature Reviews	Pope/1999	M	+	7						Cavanagh/ 1987		
	Hill/1996		+	2						Cavanagh/ 1982		
	Rowlands/2001		+	5						Elliott/ 1979		
										McNeill/ 2002		
										Vaughn/ 1994		

*See references that follow for full citation.

5. References.

Cavanagh PR. The biomechanics of lower extremity action in distance running. Foot Ankle 1987;7:197-217.

Cavanagh PR, Williams KR. The effect of stride length variation on oxygen uptake during distance running. Med Sci Sports Exerc 1982;14:30-35.

Elliott BC, Blanksby BA. Optimal stride length considerations for male and female recreational runners. Br J Sports Med 1979;13:15-18.

Hill PF, Chatterji S, Chambers D, Keeling JD. Stress fractures of the pubic ramus in female recruits. J Bone Joint Surg Br 1996;78:383-6.

McNeill AR. Energetics and optimization of human walking and running: the 2000 Raymond Pearl memorial lecture. Am J Hum Biol 2002;14:641-8.

Pope RP. Prevention of pelvic stress fractures in female Army recruits. Mil Med 1999;164:370-3.

Rowlands AV, Eston RG, Tilzey C. Effect of stride length manipulation on symptoms of exercise-induced muscle damage and the repeated bout effect. J Sports Sci 2001;19:333-40.

Vaughan CL. Biomechanics of running gait. Crit Rev Biomed Eng 1984;12:1-58.

H. <u>Participate in a Standardized, Graduated Marching (aka Hiking) Program (Insufficient Evidence to Support)</u>.

1. Introduction. The purpose of this review was to identify the strength of evidence for a standardized graduated marching (hiking) program to avoid injury. The exact meaning of this intervention evolved during the review process: hiking and marching were replaced with walking, fitness, and military load carriage. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: walking program, injury prevention, RCT (no useful results with “hiking” or “marching”).

b. Total number of hits resulting from the search: 8.

c. Total number of studies that meet the inclusion criteria: 0.

2. Discussion. The terms hiking and marching are used interchangeably in the military. When searching for the term "hiking" in the literature, one finds references to recreational cross-country walking or mountain climbing. What is meant by the phrase "graduated hiking" in this intervention is gradual increases in military marching (generally with a load), not mountain climbing. If the intervention is to increase the amount of marching in military training at the expense of a decreased amount of running, then this would have a positive effect on the prevention of injuries as several studies have shown that decreasing running mileage reduces injuries. This would, therefore, be included in the recommendation to reduce overtraining. However, no study has yet been performed to test the hypothesis that a graduated marching program alone reduces injuries.

3. Recommendation. Evidence that a standardized graduated marching (hiking) program is effective is lacking; therefore the JSPTIPWG cannot recommend for or against a standardized graduated marching (hiking) program alone for the prevention of injuries. The work group recommends that this specific research question be addressed.

4. References. None.

I. <u>Gradually Increase Load-Bearing During Marching (Insufficient Evidence to Support)</u>.

1. Introduction. The purpose of this review was to identify the strength of evidence for gradual increases in load-bearing during marching (e.g., flak vests, load-bearing equipment, etc.) as a training aid in basic combat training to prevent injuries. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: body armor, bulletproof vests, protective equipment, flak vests, load carriage, back packs, stress fractures, injuries.

b. Total number of hits resulting from the search: 978.

c. Total number of studies that meet the inclusion criteria: 14.

2. Discussion. The introduction of increased load carriage through the gradual application of military flak vests/body armor or back packs has been suggested as a method of PT by increasing physiologic loads. The theory is to create both an anaerobic and aerobic stimulus that would prevent injuries while simultaneously providing realistic training for the combat Service member who will expect to be subjected to such loads in deployed environments. While there is a suggestion of positive influence of progressive load carriage in a study of the Australian Army, the study was conducted in combination with a multitude of interventions.

There is a dearth of literature on the topic of progressive load carriage relating to the prevention of injuries in trainees in basic military training.

3. Recommendation. Evidence that a gradual application of load bearing reduces injuries is lacking; therefore the work group cannot recommend for or against the gradual application of load bearing for the prevention of injuries in basic military training. The JSPTIPWG recommends that this specific research question be addressed.

4. Classification Matrix. Table 24 contains the classification matrix of literature search results.

Table 24. Classification Matrix of Literature Search Results: Gradually Increase Load-Bearing During Marching

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	3*				1			0	0	10	0	14
Literature Reviews	**Author/ Year***	**M**	**+/- /x**	**Score**	**Author/ Year***	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year***	**Author/ Year**	
	Rudzki/1997 part I	M	+		Burton/1996	+	2			Cline, Coast, & Arnall/1999		
	Rudzki/1997 part II	M	+							Muza, Banderet, & Forte/1996		
	Rudzki/1997 part III	M	+							Cadarette et al/2001		
										Martin & Nelson/1982		
										Martin & Nelson/1982		
										Harman et al/2000		
										Woods et al/1997		
										White/1999		
										Winslow et al/1999		
										Montain & Stamm/2000		

*Reviewer did not provide a score for these references.

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Winslow G, Riddick R, Finkel M, Greene T. System evaluation report (SER) for the interceptor body armor. USA Operational Test and Evaluation Command SER 98-99, 10 June 1999.

Woods RJ, Polcyn AF, O'Hearn BE, Rosenstein RA, Bensel CK. Analysis of the effects of body armor and load-carrying equipment on soldiers' movements. Part III: gait analysis. NATICK/TR-98/004.

J. Avoid Hazardous Exercises or Exercise Machines (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for avoiding so-called hazardous exercises to minimize injury risk. Various sources describe certain exercises and exercise machines as hazardous or harmful but do not support their statements with evidence. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: elimination of harmful exercise, avoidance of harmful exercise, harmful exercises in military, harmful exercises, hazardous exercises, harmful exercise and injury prevention, deep-knee bends, jumping jacks, full sit-up, straight leg sit-up, double leg lift, donkey kick, mule kick, floor-lying bicycle, squat thrust, standing toe touch, hurdler stretch, hyperextending or overrounding the back, full neck circle, backbend, exercise machines.

b. Total number of hits resulting from the search: 80.

c. Total number of studies that meet the inclusion criteria: 1.

2. Discussion. There are some anecdotal reports of a few callisthenic exercises common in gymnasiums and part of military PT programs among the Services that are reputed to either cause injury or aggravate existing injuries (such as those mentioned in the search terms above). Frequently, popular civilian Web sites will post information about harmful exercises or exercise machines that allegedly cause injury based on theoretical rationale. However, this information is anecdotal. No harmful exercises are found when searching for "harmful exercises" per se. One must have in mind a specific suspect exercise in order to net any result. For example, the sit-up has been maligned for some time as a cause of injury in the U.S. Army. One investigation revealed that neither the sit-up nor any other of the Army Physical Fitness Test (APFT) events (push-up and 2-mile run) pose any particular acute injury risk to active-duty Soldiers. However, the study explains that Soldiers who reported a history of injury related to the APFT were more likely to report injury during the APFT again. The investigator encourages further examination into whether injury susceptibility during testing and training for specific APFT events is related to a history of previous injury.

3. Recommendation. Evidence of the effectiveness of eliminating or avoiding any specific exercise or exercise machine as an injury prevention intervention is lacking; therefore the JSPTIPWG cannot recommend for or against eliminating or avoiding any specific exercise or exercise machine to prevent injuries. The work group recommends that research on specific exercises or exercise machines reputed to either cause injury or aggravate existing injuries be addressed individually through research or program evaluation.

4. Classification Matrix. Table 25 contains the classification matrix of literature search results.

Table 25. Classification Matrix of Literature Search Results: Avoid Hazardous Exercises or Exercise Machines

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	0				0			1	0	0	0	1
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year***	**Author/ Year**	**Author/ Year**	**Author/ Year**	
								Evans/2005				

*See reference that follow for full citation.

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Evans R, Reynolds K, Creedon J, Murphy M. Incidence of acute injury related to fitness testing of U.S. Army personnel. Mil Med 2005 Dec;170(12):1005-11.

K. Disassociate Body Weight Assessment and Maximal Effort Physical Fitness Tests (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify if injury rates were affected by disassociating body weight assessment and maximal effort physical fitness testing as a means to avoid injury. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: risk factors, body composition, athletic injuries/etiology physical fitness, body composition and injury and fitness.

b. Total number of hits resulting from the search: 114.

c. Total number of studies that meet the inclusion criteria: 0.

2. Discussion. This intervention yielded no results. This question is posed because of the convenient practice of assessing body height and weight against military standards at the same time as administration of the physical fitness test. Generally, the military Services assess body height and weight prior to the physical fitness test which requires maximal effort on the part of the Service member. There is reason to believe that there are some Service members who are borderline overweight by Service standards, and these members starve themselves from food and liquids for some time prior to being assessed for body weight in order to ensure that they can meet the standard. Although there are no studies that demonstrate this phenomenon, the Service member would be attempting a maximal effort physical fitness test in a state of dehydration and undernourishment. The theory is that those who are dehydrated and undernourished not only are at a disadvantage with regard to performance, but also may be susceptible to greater injury risk. A fast and convenient method of determining the prevalence of such a practice could be performed through the use of an anonymous survey.

3. Recommendation. Evidence that disassociating body weight assessment and a maximal effort physical fitness testing is an effective injury prevention strategy is lacking; therefore the JSPTIPWG cannot recommend for or against disassociating body weight assessment and a maximal effort physical fitness test as a means to avoid injury. The work group recommends that this specific research question be addressed.

4. References. None.

L. Wear Shock-Absorbing Insoles (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for inserting shock-absorbing insoles into footwear to reduce the risk of injury to the lower extremities. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: shock-absorbing insoles.

b. Total number of hits resulting from the search: 80.

c. Total number of studies that meet the inclusion criteria: 19.

2. Discussion. Studies of shock-absorbing insoles in the boots of young recruits report mixed results for reducing lower limb injuries overall, but insoles may be effective in reducing stress fractures. One systematic review employing meta-analysis methods pooling data from three studies estimates that shock-absorbing insoles reduce the number of stress fractures or stress reactions by over 50 percent. Computations derived from these methods suggest that for every 20 Soldiers wearing polyurethane or neoprene insoles, one stress fracture or stress reaction will be avoided. However, caution must be exercised in interpreting these results because the studies are few and have design flaws. Other similarly flawed studies have failed to demonstrate a reduction in stress fracture incidence with shock-absorbing insoles. Another systematic review of interventions for preventing shin splints concluded that the most encouraging current evidence favors the use of shock-absorbing insoles, but, here again, the serious flaws in reported studies prevent a recommendation for widespread insole use. Given the quality of shock-absorbing materials found in today's running shoes, inserts may not provide any added benefit until the shock-absorbing properties of the shoe have been compromised. Inserting insoles into military combat boots may reduce lower extremity stress moreso than the boot alone. Perhaps there are higher-risk populations that would benefit from this intervention, but for others it would have marginal or no effect. It appears efforts are underway relative to better construction of the combat boot and running shoes. Clearly, this may be a potentially powerful intervention needing well-designed research to determine effectiveness of shock-absorbing insoles for both an exercise shoe and military boot applications.

3. Recommendation. The JSPTIPWG found mixed evidence that shock-absorbing insoles can reduce injuries; the JSPTIPWG concludes that the balance of benefits and cost is too close to justify a general recommendation for all Service members. Insoles may be appropriate for older running shoes, military combat boots, or high-risk populations only. The work group cannot make a general recommendation for or against the use of shock-absorbing insoles for the prevention of injuries in the general Service member population. Therefore, the work group recommends further research on shock-absorbing insoles as a prevention strategy taking into account specific footwear, age of footwear, and select populations.

4. Classification Matrix. Table 26 contains the classification matrix of literature search results.

Table 26. Classification Matrix of Literature Search Results: Wear Shock-Absorbing Insoles

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	10									6	3	19
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year***	**Author/ Year***	
	Larsen		+	8						Dixon 2003	Rome/2005	
	Mundermann	M	+	7						Windel 1999	Jones/2002	
	Pfeffer	M	+	8						Johnson 1988	Thacker/2002	
	Williams		X	7						Nigg 1998		
	Sherman		X	5						House 2004		
	Fauno		+	8						Bensel/1983		
	Schwellnus		+	8								
	Gardner	M	X	7								
	Milgrom		+	8								
	Smith		+	5								

*See references that follow for full citation.

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Dixon SJ, Waterworth C, Smith CV, House CM. Biomechanical analysis of running in military boots with new and degraded insoles. Med Sci Sports Exerc 2003 Mar;35(3):472-9.

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Schwellnus MP, Jordaan G, Noakes TD. Prevention of common overuse injuries by the use of shock absorbing insoles. A prospective study. Am J Sports Med 1990 Nov-Dec; 18(6):636-41.

Sherman RA, Karstetter KW, May H, Woerman AL. Prevention of lower limb pain in soldiers using shock-absorbing orthotic inserts. J Am Podiatr Med Assoc 1996 Mar; 86(3):117-22.

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Thacker SB, Gilchrist J, Stroup DF, Kimsey CD. The prevention of shin splints in sports: a systematic review of literature. Medicine & Science in Sports & Exercise. 34(1): 32-40, 2002.

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Windle CM, Gregory SM, Dixon SJ. The shock attenuation characteristics of four different insoles when worn in a military boot during running and marching. Gait Posture. 1999 Mar; 9(1):31-7.

M. <u>Wear Running Shoes Based on Individual Foot Shape (Insufficient Evidence to Support)</u>.

1. Introduction. The purpose of this review was to identify the strength of evidence for wearing running shoes based on individual foot type. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: running shoes, running injuries, prescription.

b. Total number of hits resulting from the search: 2,203.

c. Total number of studies that meet the inclusion criteria: 10.

2. Discussion. Some believe that running injuries might be reduced by matching specific running shoes to particular foot characteristics such as foot shape, height of the longitudinal arch, and foot/ankle flexibility (subtalar mobility). Running shoe manufacturers market their running shoes in three general categories: “stability” shoes, “cushioned” shoes, or “motion-control” shoes. According to manufacturers, “stability” shoes are recommended for runners with normal arches, “cushioned” shoes for high-longitudinal arches and rigid feet, and “motion-control” shoes for low-longitudinal arches and flexible (hypermobile) feet. Army, Navy, and Air Force post and base exchanges and military clothing sales stores have adopted this nomenclature with a color-coded system: white for stability, blue for cushioned, and red for motion control. Effectiveness of shoe prescription according to this system has been tentatively supported by a single Army study that found injury rates to be reduced from 37 to 19 injuries/1000 Soldiers/month after shoes were prescribed post-wide on the basis of a static (standing, not moving) imprint of the foot (foot imprint on a lighted plexiglass box or an imprint of a wet foot on paper). However, this study suffered from a number of confounding variables, making it difficult to evaluate this intervention. Therefore, further prospective prevention trials are needed before conclusions are drawn regarding the effectiveness of a customized shoe prescription based on a static foot imprint. "One large prospective study was just completed prior to this publication (Knapik 2008) which demonstrated that prescribing running shoes on the basis of the plantar foot surface had no significant influence on injury risk in basic combat trainees. Similar studies are being analyzed in the Air Force and Marine Corps."

3. Recommendation. The popular practice of fitting the foot with a running shoe that is purported to be appropriate for a particular foot type (as measured by a static imprint of the foot) to prevent foot and lower extremity injury has not been conclusively demonstrated to prevent injuries. Therefore, the JSPTIPWG recommends that this specific research question be addressed and compared with other dynamic (movement) methods of foot measurement for running shoe type.

4. Classification Matrix. Table 27 contains the classification matrix of literature search results.

Table 27. Classification Matrix of Literature Search Results: Wear Running Shoes Based on Individual Foot Shape

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	1				1			0	1	5	2	10
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year***	**Author/ Year***	**Author/ Year***	
	Knapik/2008		+	Not scored	Taunton et al/2003	+/-	8		Burgess & Ryan/1985	Nigg & Segesser/1988	Dziados et al/1988	
										Cook et al./1985	Thacker/2002	
										Cook, Kester, & Brunet/1985		
										Miles et al/2003		
										Clowers et al/2004		

*See references that follow for full citation.

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Burgess I, Ryan MD. Bilateral fatigue fractures of the distal fibulae caused by a change of running shoes. Med J Australia 1985;143(7):304-305.

Clowers KG, Zhang S, Wortley M, Kohstall C. Longitudinal perception about cushioning, fit, and comfort of a running shoe over 400 miles. Med & Sci in Sports & Exerc 20004;36(5)Supplement, S267.

Cook SD, Kester MA, Brunet ME. Shock absorption characteristics of running shoes. Amer J Sports Med 1985;13(4):248-253.

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Knapik JJ, Swedler, D, Grier T, Hauret KG, Williams K, Bullock SH, Darakjy S, Lester M, Tobler S, Clemmons N, Brown J, Jones BH. Injury Risk and Prescribing Athletic Shoes on the Basis of the Shape of the Plantar Foot Surface in Basic Combat Training. USACHPPM Report No. 12-MA-05SB-08. 2008

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N. Wrap Ankle With Athletic Tape Prior to High-Risk Activity (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for the use of athletic tape to prevent ankle sprain injuries. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: taping, ankle injury, risk factor, sprain, ankle sprain, ankle.

b. Total number of hits resulting from the search: 140.

c. Total number of studies that meet the inclusion criteria: 13.

2. Discussion. The taping of ankles and other joints is a common practice in high school and college athletic training rooms presumably for the prevention of joint ligament sprains in those with previous injury as well as for those without history of previous injury. However, most studies of athletic taping have focused on the intermediate outcomes of injury such as performance, motion, swelling, proprioception, etc. A recent study comparing taping to bracing of the ankle to prevent ankle injuries in 83 high school athletes revealed no benefit of one over the other in terms of injuries prevented. However, savings in time and cost are substantial when using the ankle brace. Furthermore, safely and effectively taping the ankle requires the availability of a skilled operator, making ankle taping a highly impractical intervention to be implemented in a basic training environment, or in any military unit for that matter.

3. Recommendation. Evidence that ankle taping is an effective injury prevention strategy is lacking; therefore, the JSPTIPWG cannot recommend for or against ankle taping for the prevention of ankle sprain injuries. Since implementation of this particular intervention in the military is very likely impractical, the work group recommends that research addressing feasibility and practicality be conducted, including possibly targeting specific military populations where the need for ankle support may be great enough to merit taping (provided there is a skilled operator available for such an intervention).

4. Classification Matrix. Table 28 contains the classification matrix of literature search results.

Table 28. Classification Matrix of Literature Search Results: Wrap Ankle with Athletic Tape Prior to High-Risk Activity

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	1				8			2		0	2	13
Literature Reviews	**Author/ Year***	**M**	**+/- /x**	**Score**	**Author/ Year††**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year†**	
	Mickel/2006		x	5	Milgrom/1991	+	5	Verhagen/2004			Beynnon/2002	
					Baumhauer/ 1995	+	4	Leanderson/1993			Thacker/1999	
					McGuine/2000	+	5					
					Beynnon/2002	+	5					
					Willems/2005	+	7					
					Mei-Dan/2005	+	5					
					Giza/2003							
					Jensen/1998							

5. References. The risk factor/cause references, as well as studies of descriptive epidemiology and systematic reviews that discuss ankle sprain prevention, are included again here from the ankle bracing reference list.

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O. Run on Improved Surfaces That Minimize Injury Risk (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for determining the best running surface that minimizes injuries while running. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: running surface and injury, running surface, surface, terrain and injury, running injuries.

b. Total number of hits resulting from the search: 2,345.

c. Total number of studies that meet the inclusion criteria: 20.

2. Discussion. Given that there is strong evidence showing that higher running mileage is a risk factor for increased injury rates, one intervention suggests improving the surface upon which individuals run in order to reduce the impact on the musculoskeletal system. Out of the number of risk factor studies that looked at the association of injuries and different running surfaces (cement, asphalt, linoleum, soft surfaces, etc.), all either showed an increased injury incidence or no effect upon the injury rate. To date, there have been no prospective randomized trials performed that specifically address the effect of one running surface compared to another relative to injury risk in military or civilian runners.

3. Recommendation. Evidence of the effectiveness of certain running surfaces on injury risk is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined. The JSPTIPWG, therefore, concludes that the evidence is insufficient to recommend for or against any particular running surface for the prevention of injuries. The work group recommends that this specific research question be addressed.

4. Classification Matrix. Table 29 contains the classification matrix of literature search results.

Table 29. Classification Matrix of Literature Search Results: Run on Improved Surfaces That Minimize Injury Risk

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	0				10					7	3	20
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year†**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year†**	**Author/ Year†**	
					Ferretti/ 1984	+ (cement or linoleum)	4			Tillman et al/1998	Thacker et al/2002	
					Wen/1997	+ (concrete or asphalt	7			Dixon et al/2000	Bennell et al/1999	
					Macera/ 1989	X/+ (concrete; women only)	8			Creagh, Reilly, & Lees/1998	Hreljac/ 2004	
					Marti/1988	X	5			Feehery RV/1986		
					Brunet/ 1990	X	3			Ferris, Liang, & Farley/1999		
					Shwayhat/ 1994	+ soft surfaces)	9			Kerdok et al/2002		
					Jacobs/ 1986	X	3			Milgrom et al/2003		
					Walters/ 1989	X	8					
					Taunton/ 2003	X	9					
					Pope/2002	- (rubber matt) + (gravel)	8					

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P. Improve Obstacle-Course Landing Surfaces (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for improved obstacle-course landing surfaces relative to the prevention of injuries. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: unknown (reviewer did not provide terms).

b. Total number of hits resulting from the search: unknown.

c. Total number of studies that meet the inclusion criteria: 7.

2. Discussion. The safety of our troops while on obstacle courses is of importance since oftentimes they are being tasked to perform challenging movements and lifts, sometimes while fatigued, carrying equipment, and in inclement weather. Common landing surfaces for obstacle courses include dirt and loose-fill materials such as wood chips, wood fibers (mulch), pea gravel, shredded rubber, and sand. Risk factor studies on the injury prevention capacity of

these surfaces performed to date were done mainly under laboratory conditions simulating children's playground areas without any epidemiological data. No prospective study has been performed on children's playground surfaces or military obstacle-course landing surfaces to determine prevention efficacy. Risk factor studies, however, consistently rate shredded rubber as the top performer in terms of absorbing impact or shock attenuation from falls and are associated with the lowest rate of injury in children. One study demonstrated that the risk for injury sustained on rubberized surfaces is one-half that of wood chips. In another study where depth of fill was standardized, there was very little difference in the shock-absorbing capacity among sand, wood fibers, and wood chips, while pea gravel ranked last in the list of shock-absorbing materials for landing surfaces.

3. Recommendation. The JSPTIPWG found at least fair risk factor evidence that shredded rubber material attenuates shock better than other materials and is associated with fewer civilian playground injuries in children, but the evidence that shredded rubber on military obstacle-course landing surfaces prevents injury is lacking. Therefore, the JSPTIPWG concludes that the evidence is insufficient to recommend for or against use of this material on military obstacle-course landing surfaces to prevent injuries. The work group strongly recommends that this specific research question be addressed.

4. Classification Matrix. Table 30 contains the classification matrix of literature search results.

Table 30. Classification Matrix of Literature Search Results: Improve Obstacle-Course Landing Surfaces

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	0				2			0	0	5	0	7
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
					Laforest/2001	+	Not scored			Lewis LM. 1993		
					Mott/1997	+	Not scored			Gunatiliaka AH 2004		
										Bertocci GE 2004		
										Mack MG 2000		
										Arampatzis/2004		

*See references that follow for full citation.

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Q. Adjust Training Loads by Seasonal Variations (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for adjusting physical or military training loads (depending upon the season of the year or climatic changes) relative to injury risk. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: musculoskeletal injury and seasonal variation, change, injury rates.

b. Total number of hits resulting from the search: 11.

c. Total number of studies that meet the inclusion criteria: 6.

2. Discussion. Seasonal variations of injury rates appear to occur in rugby players, other elite athletes, and Army basic training recruits. The overall injury rates are increased during the spring and summer months, and lower rates are associated with the fall and winter months. Since these results are consistent while controlling for other injury risk factors, the fact that there are higher environmental temperatures during the summer is hypothesized as the reason for increased risk of injury. Unintended consequences for implementing a recommendation to reduce training load during warmer climatic conditions have not been studied.

3. Recommendation. Evidence for the effectiveness of seasonally adjusting physical training load is weak, and the balance of benefits and harms cannot be determined. The JSPTIPWG, therefore, concludes that the evidence is insufficient to recommend seasonal adjustments of training load to prevent musculoskeletal injuries. The work group recommends that investigations be conducted to conclusively evaluate the association between environmental temperature and overall musculoskeletal injury incidence and to evaluate the unintended consequences to military units of adjusting physical training according to thermal environmental conditions.

4. Classification Matrix. Table 31 contains the classification matrix of literature search results.

Table 31. Classification Matrix of Literature Search Results: Adjust Training Loads by Seasonal Variations

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found					3			3				6
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year***	**+/- /x**	**Score**	**Author/ Year***	**Author/ Year**	**Author/ Year**	**Author/ Year**	
					Phillips/1998	+	6	Koutedakis, Y /1998				
					Knapik/2002	+	9	Breaux, C /1990				
					Jones SB/2008	+	Not scored	Grimm, D /1999				

*See references that follow for full citation.

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R. <u>Encourage Smoking Cessation Programs to Prevent Musculoskeletal Injuries (Insufficient Evidence to Support)</u>.

1. Introduction. The purpose of this review was to identify the strength of evidence for smoking cessation programs as an injury prevention intervention. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: smoking, smoking cessation, athletic injuries, injury.

b. Total number of hits resulting from the search: 50.

c. Total number of studies that meet the inclusion criteria: 12.

2. Discussion. Cigarette smoking is an independent risk factor among Army infantry Soldiers and Navy shipboard personnel. As a matter of fact, there is a dose response association with injuries and the amount of cigarettes smoked per day. One observational cohort study of Army recruits demonstrated that those individuals with a history of smoking prior to entry into basic training were 1.5 times more likely than nonsmokers to sustain a musculoskeletal injury (most strongly associated with overuse injuries than with acute injuries). Hence, logic dictates that if a smoker quits smoking, his risk of sustaining a musculoskeletal injury would

decrease over time. Some studies recommend the inclusion of smoking cessation as a part of an integrated community-based injury prevention program. While a logical recommendation, the effect of smoking cessation on injury risk has not yet been demonstrated nor has it been determined at what point smokers who have quit are at a risk similar to those who have never smoked.

3. Recommendation. Smoking has been identified as a strong risk factor for musculoskeletal injury. There is sufficient retrospective evidence that quitters have an injury rate that is greater than nonsmokers but less than smokers, suggesting that quitters can reduce their injury risk. In the absence of convincing observational studies, the JSPTIPWG concludes that the evidence is insufficient to recommend for or against smoking cessation programs for the purpose of preventing injuries. However, there are many other well-documented benefits of smoking cessation. The work group strongly recommends that the association between smoking cessation and decreased musculoskeletal injury risk be assessed through large-scale observational studies at a minimum.

4. Classification Matrix. Table 32 contains the classification matrix of literature search results.

Table 32. Classification Matrix of Literature Search Results: Encourage Smoking Cessation Programs to Prevent Musculoskeletal Injuries

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	0				5			1	1	4	1	12
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year***	**+/-/x**	**Score**	**Author/ Year***	**Author/ Year***	**Author/ Year***	**Author/ Year***	
					Lappe/2001	+	8	Reynolds/2000	Gilchrist/ 2000	Burse/1982	Dyer/1986	
					Altarac/2000	+	8			Scoughton/ 1973		
					Leistikow/1998	+	5			Du Bois/1998		
					Conway/1986	+	7			Breidenbach/ 1976		
					Jones/1999	+	8					

*See references that follow for full citation.

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S. Educate Service Members on Safe Lifting Techniques (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for education in safe lifting techniques to prevent injuries. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: safe lifting, lifting technique and training, lifting and skill acquisition, injury prevention and lifting, regression and lifting, back injury prevention and exercise or training and efficacy, dose-response and back injury and prevention, flexibility, back school.

b. Total number of hits resulting from the search: 631.

c. Total number of studies that meet the inclusion criteria: 35.

2. Discussion.

a. Injuries to the low back are the number one reason for outpatient visits across all military treatment facilities. A “back school” is a common strategy generally used with those who are recovering from a low back strain or sprain. Studies in this category were inconsistent regarding how "back school" was defined, and the exercise and lifting techniques were defined differently for each study. For example, even if all the studies identified agreed that "exercise" as an intervention prevented low back pain, it would be difficult to make a general conclusion to that effect because the studies combined different types of exercise (i.e., static stretching, partial curl-ups, isolated lumbar extension, etc). This made it difficult to draw any conclusion based on the evidence as to which type of exercise intervention truly prevented low back pain. Back schools also differed regarding time frame. Some ranged from simple instructions and demonstrations of duration under 1 hour to schools involving a commitment of 5 days.

b. Research rarely examines education in isolation. Most studies examine the effects of multiple interventions where education in safe lifting techniques or back school were components. Many studies show a strong relationship between improved intermediate outcomes (process measures) of low back pain (e.g., spinal mechanics or lifting technique, improved functional capacity, perceived life quality, and return-to-work rates) and back school education courses. The literature suggests that back schools prevent recurrences of low back pain in those with a history of injury. This would seem to benefit most everyone since it is estimated that nearly 80 percent of the population has at one time sustained a non-specific low back injury. However, studies differentiate between non-specific low back pain symptoms of 0-6 months and from 6-12 months. There is moderate evidence suggesting that back schools, in an occupational setting, reduce pain and improve function and return-to-work status, in the short and intermediate term, compared to exercises, manipulation, myofascial therapy, advice, placebo or waiting list controls, for patients with chronic and recurrent low back pain. The literature does not conclusively demonstrate primary prevention efficacy of teaching safe lifting techniques to reduce musculoskeletal injury risk in healthy (noninjured) individuals.

c. Studies suggest differences in job categories should be taken into account when designing educational programs for preventing low back pain. Additionally, observing employees and providing advice to employees while they are performing their usual duties may be an essential component of low back pain prevention. While some back school interventions may be helpful in preventing recurrences of low back pain, there is a lack of controlled trials examining broad-based multidimensional programs. There is a need for clear definitions of back schools, high methodological quality outcome studies, and evaluation of back school cost-effectiveness. Perhaps a breakdown of non-specific low back pain into subdiagnoses would facilitate better understanding regarding who benefits most from safe lifting technique education.

3. Recommendation. The JSPTIPWG concludes that the evidence is insufficient to recommend for or against safe lifting technique education for the prevention of injuries in healthy individuals as an isolated intervention. Evidence that isolated safe lifting technique education for healthy individuals effectively reduces injury or minimizes injury risk is lacking or of poor quality. Safe lifting technique education may be an effective adjunct to multi-intervention injury prevention programs. The work group recommends higher quality research to determine the influence of safe lifting technique training on injury risk as a primary prevention measure as well as a secondary prevention measure among those who have been diagnosed with nonspecific low back pain.

4. Classification Matrix. Table 33 contains the classification matrix of literature search results.

Table 33. Classification Matrix of Literature Search Results: Educate Service Members on Safe Lifting Techniques

References Found/ Literature Reviews	Categories of Study Types											Total
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	11				1			0	0	14	9	35
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year***	**Author/ Year***	
	Porteau-Cassard L/99		+	5	Snook SH / 78	x	1			Gagon M /03	Maier-Riehle, B/01	
	Larsen, K/02	M	+	8						Lariviere, C/02	DelGuercio, AM/93	
	Daltroy, LH/97	M	x	7						Heiss, DG/02	Gatty, CM/03	
	Schenk, RJ/96	M	+	6						Lindbeck, L/01	Linton, SJ/01	
	Weber, M/96	M	x	4						Van Dieen, JH/99	Karas, BE/96	
	Indahl, A/98	M	+	7						Wrigley, AT/05	Straker, LM/03	
	Fanello, S/99	M	+	1						Kingma, I/04	Heymans, MW & van Tulder /04	
	Penttinen, J/02	M	+	5						Wilson, MG/99	Myers, AH/99	
	Vinh, DT/03	M	X	3						Lynch, RM/00	Straker LM /02	
	Helmhout, PH/04	M	X	6						Cedraschi, C/96		
	Heymans, MW/04 & de Vet HC/04	M	x	6						Hagen KB/93		
										Cady LD/79		
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*See references that follow for full citation.

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T. Apply Ice to Injuries Early to Prevent Reinjury ((Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for the practice of applying ice to musculoskeletal injuries to avoid re-injury or to speed return to activity. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: ice, cold, cryotherapy and athletic injury, soft tissue injury, injury, leg injury, knee injury, ankle injury, ice packs, cryotherapy, athletic injury.

b. Total number of hits resulting from the search: 1,494.

c. Total number of studies that meet the inclusion criteria: 24.

2. Discussion.

a. Cryotherapy is the topical application of ice for treatment of acute musculoskeletal injuries. When applied intermittently after injury, ice reduces many of the adverse conditions related to the inflammatory or reactive phase of an acute injury (i.e., pain, prolonged immobilization, and reduced range of motion), all of which may extend recovery time. Studies demonstrate that ice will reduce swelling, inflammation, and pain. Ice placed directly over the injured tissue limits the amount of fluids going into the injured area and slows nerve conduction velocity, both of which serve to decrease pain and improve function. Ice is especially effective in the first 24 to 72 hours after injury onset.

b. Despite the long history of using cryotherapy to control swelling and pain, there are very few randomized, controlled studies providing evidence to substantiate the effect of cryotherapy alone on measures of secondary prevention of injury (reinjury), return to sport participation, return to full activity, or return to full military duty. Several studies have analyzed cryotherapy combined with other therapeutic modalities (i.e., compression, immobilization, elevation, electrical stimulation, etc). Despite the general acceptance of cryotherapy as an effective intervention, evidence on which to base these conclusions is limited. The review of the literature for the effect of cryotherapy alone on return-to-sport-participation metrics shows that cryotherapy may have a positive effect. However, the relatively poor quality of the studies reviewed is of concern.

3. Recommendation. While cryotherapy has been helpful as a treatment modality affecting swelling, pain, range of motion, etc., the JSPTIPWG concludes that the evidence is insufficient to recommend for or against the use of cryotherapy for secondary prevention of injury (or reinjury) or to speed return to activity. The work group recommends that randomized, controlled clinical studies be conducted to assess the efficacy of the application of ice after injury as an injury prevention measure.

4. Classification Matrix. Table 34 contains the classification matrix of literature search results.

Table 34. Classification Matrix of Literature Search Results: Apply Ice to Injuries Early to Prevent Reinjury

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	13								2		9	24
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year***	**Author/ Year**	**Author/ Year***	
	Yanagisawa/ 2003		+	6					Hayden/ 1964		Swenson/1996	
	Yanagisawa/ 2003		+	4					Grant/1964		MacAuley/2001	
	Wilkerson/1993	M	x	7							Thompson/2003	
	Cote/1998		+	7							MacAuley/2001	
	Hocutt/1982		+	4							McMaster/1977	
	Eston/1999		+	5							Bleakley/2004	
	Howatson/2003		x	5							Hubbarb/2004	
	Yackzan/1984		x	5							Hubbard 2004	
	Sloan/1989	M	+	6							Ogilvie-Harris/1995	
	Basur/1976†	M	+	Not scored								
	Isabell/1992†		x	Not scored								
	Laba/1989†			Not scored								
	Airaksinen/2004		+	6								

*See references that follow for full citation

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U. Take Oral Contraceptives to Decrease Injury (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for the use of oral contraceptives to reduce injury. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: BCP and Injury, knee stability, knee injury, sex hormones and ACL, contraceptives and ACL, stress fractures

b. Total number of hits resulting from the search: 367.

c. Total number of studies that meet the inclusion criteria: 19.

2. Discussion.

a. Women are 4 to 8 times more likely to sustain a serious knee injury than their male counterparts, and some epidemiological evidence suggests a protective effect of postmenopausal estrogen therapy relative to the risk of osteoporotic fractures. The female sex hormones estrogen and progesterone have potential effects on the exercise capacity and performance through numerous mechanisms. These hormones fluctuate radically during the menstrual cycle and are reported to increase ligamentous laxity and decrease neuromuscular performance and, thus, are a possible cause of decreases in both passive and active knee stability in female athletes. Some studies have found an association between increased ligamentous laxity and changes in serum levels of these hormones. Since estrogen and progesterone are present in most oral contraceptives, it is theorized that use of oral contraceptives may be advantageous for female athletes as they may provide a stable and controllable hormonal balance conducive for training and competition.

b. One study demonstrated a statistically significant decrease in anterior translation of the tibia in users of oral contraceptives as compared to nonusers. A more recent study sought to determine if the use of oral contraceptives affects the rate of noncontact ACL injury and ankle sprains in collegiate basketball and soccer athletes. There was no difference in the rate of injuries between those athletes using hormonal therapy and those athletes not using hormonal therapy. Despite some suggestion that oral contraceptives may improve the ligamentous integrity of the joints, more research is needed before this intervention can be demonstrated as an effective injury prevention strategy for women.

3. Recommendation. The JSPTIPWG concludes that the evidence is insufficient to recommend for or against the use of oral contraceptives to prevent injuries in women. The work group recommends that this specific research question be addressed through detailed observational studies.

4. Classification Matrix. Table 35 contains the classification matrix of literature search results.

Table 35. Classification Matrix of Literature Search Results: Take Oral Contraceptives to Decrease Injury

References Found/ Literature Reviews	Categories of Study Types											Total
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	1				9			1	0	2	6	19
Literature Reviews	**Author/ Year***	**M**	**+/- /x**	**Score**	**Author/ Year***	**+/- /x**	**Score**	**Author/ Year***	**Author/ Year**	**Author/ Year***	**Author/ Year***	
	Lee, CY 2004	M	-	7	Uhorchak, JM / 2003	+	5	Gwinn, DE 2000		Lovering, RM 2005	Dugan, SA 2005	
					Piasecki, DP / 2003	-	7			Martineau/2004	Ireland, ML 2002	
					Medrano, D / 2003	+	7				Hewett, TE 2001	
					Romani, W / 2003	-	7				Lebrun, CM 2001	
					Slaughterbeck JR / 2002	+	8				Toth, AP 2001	
					Arendt, AT / 2002	+	7				Slaughterbeck/ 2001	
					Brooke-Wavell, K / 2001	-	8					
					Karageanes, SJ / 2000	x	8					
					Agel/2006	x						

*See references that follow for full citation.

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V. Standardize the Unit Reconditioning Program After Rehabilitation (Insufficient Evidence to Support).

1. Introduction. The purpose of this review was to identify the strength of evidence for a standardized reconditioning program following rehabilitation to reduce risk of reinjury. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: standardized injury rehabilitation/reconditioning, injury reconditioning, injury rehabilitation.

b. Total number of hits resulting from the search: 339.

c. Total number of studies that meet the inclusion criteria: 3.

2. Discussion.

a. Rehabilitation involves a functional progression through a systematic program of physical reconditioning addressing joint flexibility, muscular strength, muscular endurance, muscular speed, integrated and coordinated movement (skill patterns), and cardiovascular endurance. Certainly healthcare providers need to properly diagnose a Service member prior to beginning any rehabilitation; also, constant monitoring of the Service member's progress during rehabilitation is necessary so that the demands of the therapeutic regimen can be adjusted according to the patient's progress. A gradual restoration to the demands of full active-duty tasks of the Service member is achieved by progressively loading the injured body part while maintaining other aspects of fitness. There is a point at which a Service member is well enough to be out from under the direction of a healthcare provider, but reinitiating physical training with his or her military unit would provide an uncontrolled (and perhaps harmful) amount of stress on the recovering injury. It is at this point where Service members need a transition program from patient status to full military duty status.

b. A review of literature revealed the value of rehabilitation in hastening a return to sport or activity for specific injuries. However, there are no studies in the literature to date that look specifically at the effect of group intermediate reconditioning training programs on the rate of return to sports, military duty, or the incidence of reinjury. Perhaps more could be understood regarding this effect by looking at studies that address the prevention of reinjury relative to specific injuries. More research in military populations is needed to further elucidate the effect of a transitional program on return to full military duty and reinjury rates for recovering Service members.

3. Recommendation. The JSPTIPWG concludes that the evidence is insufficient to recommend for or against a standardized unit reconditioning program for the prevention of reinjury. While substantial evidence exists for the benefits of rehabilitation for specific injuries, evidence that a standardized reconditioning program for groups is effective is lacking. Therefore, the work group recommends that a standardized injury reconditioning program to prevent reinjury be developed and evaluated for its effectiveness in the prevention of injuries in group military training.

4. Classification Matrix. Table 36 contains the classification matrix of literature search results.

Table 36. Classification Matrix of Literature Search Results: Standardize the Unit Reconditioning Program After Rehabilitation

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	0				0			0	0	0	3	3
Literature Reviews	**Author/ Year**	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year***	
											Genuario, S /90	
											Thompson, T /90	
											Knight, K /85	

*See references that follow for full citation.

5. References.

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W. <u>Predict Injury Risk Through Use of an Injury Risk Index (Insufficient Evidence to Support)</u>.

1. Introduction. The purpose of this review was to identify if an injury risk index exists in the literature that would predict the risk of sustaining an injury in military recruits. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: predicting musculoskeletal injury, musculoskeletal injury screening.

b. Total number of hits resulting from the search: 1,589.

c. Total number of studies that meet the inclusion criteria: 14.

2. Discussion.

a. The Framingham Risk Index (Pinsky, et al. 1985) continues to be a helpful tool that provides a quick assessment of an individuals risk for sustaining a cardiac event. A number of the most significant risk factors are calculated together to determine a level of risk. This index serves to alert someone of their level of risk and to give them guidance on how to reduce that risk. Such a risk index could be helpful with regard to preventing musculoskeletal injury in someone who exhibits a high risk for injury.

b. A number of studies have identified risk factors for injury, and some use individual risk factors as screens for further action. For example, it is understood that low physical fitness (measured by a timed run) is a significant risk factor for basic training injuries. Some preconditioning programs have been developed to gradually improve the physical fitness of those less fit, which has been shown to reduce injuries and attrition in Army BCT. Two studies in the literature independently looked at balance scores from a one-legged stance test as a predictor of ankle sprains in healthy individuals. Each of these studies confirmed that a positive score on a single-leg stance test was predictive of ankle injury. Another study on 350 Australian recruits used a physical exam screening of feet (looking for pes cavus and pes planus) together with a history of previous injury. This multivariate risk factor screening did not have the predictive power seen in those screenings that focused only on one risk factor. Given that there are several known risk factors for musculoskeletal injury, such a risk index could alert individuals, healthcare providers, and military commanders of the potentially negative outcomes of military training allowing intervention where appropriate to reduce injury and attrition risk. No such risk index predicting musculoskeletal injury exists in the literature.

3. Recommendation. The JSPTIPWG recommends exploring the development of an injury risk index. Detailed statistical modeling techniques could be used to develop a multivariate injury risk index, utilizing known risk factors for musculoskeletal injury, for the purpose of identifying those at greatest risk and then targeting interventions to reduce that risk. The work group did not find any composite musculoskeletal injury risk index in the literature. However, the work group did find at least fair evidence that certain tests are predictive of specific injuries and that screening for risk factors may allow for interventions that reduce the overall risk.

4. Classification Matrix. Table 37 contains the classification matrix of literature search results.

Table 37. Classification Matrix of Literature Search Results: Predict Injury Risk Through Use of an Injury Risk Index

References Found/ Literature Reviews	**Categories of Study Types**											**Total**
	Intervention + = positive effect, pre-identified risk - = negative effect, no predictable risk x = neither predictable nor unpredictable M = multiple intervention study				**Risk Factor/Cause** + = positive effect, reduces rate - = negative effect, decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
No. of Refs Found	6				5					3		14
Literature Reviews	**Author/ Year***	**M**	**+/- /x**	**Score**	**Author/ Year***	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year***	**Author/ Year**	
	Knapik, 2004a		+	8	Shaffer, 1999	+	8			Knapik, 2003		
	Knapik, 2001		+	7	Kaufman, 1999	+	8			Knapik, 2004b		
	Knapik, 2004c	M	+	8	Uhorhcak, 2003	+	8			Kraus, 2004		
	McGuine, 2000		+	Not scored	Canham-Chervak, 2000	+	8					
	Trojian, 2006		+	Not scored	Hier, 1997	+	6					
	Rudzki, 1997		x	Not scored								

*See references that follow for full citation.

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X. INTERVENTIONS WITHOUT A COMPLETED REVIEW (*INTERVENTIONS THAT REQUIRE A SYSTEMATIC LITERATURE REVIEW, WORK GROUP DISCUSSION, AND OBJECTIVE ASSESSMENT*).

A. Provide Pre-Basic Training Fitness Assessment and Fitness Programs for the Least Fit (Incomplete Review).

1. Introduction.

a. This intervention was listed but not accomplished. However, during a literature review of another intervention (screening), the authors of this report could not ignore the strength of evidence for this intervention. Therefore, references are provided but no quality analysis has been performed, and a complete and focused literature review was not performed.

b. The purpose of this review was to identify the strength of evidence for implementing a fitness program prior to entering into the Service as a means of preventing injury while undergoing basic training. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

2. Discussion. The work group did not review the literature on pre-accession fitness programs during the initial work. However, in light of more recently published articles, the editors could not ignore the strength of the evidence supporting fitness programs for those who are of low fitness before entering basic training. One key study demonstrated that participation in a pre-BCT fitness assessment program (FAP) and PT program significantly reduced attrition during the basic training cycle. Another key study evaluated the effectiveness of the FAP by examining fitness, injury, and training outcomes. Recruits who had failed a basic initial physical fitness test and then trained in the FAP and entered basic training after passing

the test were evaluated against a group who failed the initial test but entered directly into basic training without any pre-BCT fitness conditioning. Attrition and injury rates were significantly lower for low-fit trainees who participated in a preconditioning program prior to starting basic training. Final physical fitness test scores at the end of basic training were also higher for those who were involved in a pre-BCT fitness program. This program evaluation showed that low-fit recruits who preconditioned before basic training had reduced attrition and tended to have lower injury risk, compared with recruits of similar low fitness who did not precondition.

3. Recommendation. Despite recent studies showing pre-BCT fitness assessments and PT programs to be effective in lowering basic training injuries, there has been no systematic review and assessment of literature quality to make a determination on the effectiveness of this intervention for injury prevention; therefore the JSPTIPWG concludes that the evidence is insufficient to recommend for or against this intervention. The work group recommends a complete systematic review and quality assessment of literature on preconditioning programs of aerobic and anaerobic exercise for new very low-fit recruits who do not meet a minimum standard of fitness prior to entry into basic training.

B. Individualize Physical Training Versus Training as a Group or Unit (Incomplete Review).

1. Introduction. This intervention was listed and reviewed; however, a quality analysis was not completed. The purpose of this review was to assess the strength of evidence for individualized PT versus group or unit PT to avoid injury. This is not to be confused with performing exercise in ability groups—a prevention strategy covered in the first recommendation. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

a. Search terms: group, mass, individual, exercise, physical training.

b. Total number of hits resulting from the search: 361.

c. Total number of studies that meet the inclusion criteria: 7.

2. Discussion. It is theorized that those who are required to do PT as a group have higher injury rates than those who do PT individually. The reasoning behind this theory is that with individual training, the training is specific to the needs of the individual. This intervention was not assessed for the quality of the science. However, despite the outcome, it is highly unlikely that solely individualized training would be implemented in a basic training environment for reasons such as motivation, military discipline, and a development of unit esprit de corps that PT performed in groups or units provides. References are provided; however, there was no assessment as to the results of the studies, the quality of the research, group discussion, or consensus regarding these studies.

3. Recommendation. The JSPTIPWG cannot recommend for or against the use of individualized PT in place of training as a group or military unit since a review of the literature and a quality analysis are incomplete. The work group recommends a literature review and quality analysis be conducted on individualized PT versus group PT as they relate to their effect on injury rates.

4. References.

Carrel AL, Clark RR, Peterson SE, Nemeth BA, Sullivan J, Allen DB. Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: a randomized, controlled study. Arch Pediatr Adolesc Med 2005 Oct;159(10):963-8.

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Moe EL, Elliot DL, Goldberg L, Kuehl KS, Stevens VJ, Breger RK, DeFrancesco CL, Ernst D, Duncan T, Dulacki K, Dolen S. Promoting healthy lifestyles: alternative models' effects (PHLAME). Health Educ Res 2002 Oct;17(5):586-96.

C. Wear Knee Braces (Incomplete Review).

1. Introduction. The purpose of this review was to identify the strength of evidence for the use of knee braces to prevent knee sprains. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

2. Discussion. A potentially promising study of a knee brace with a silicone ring to surround the patella showed that brace wearers were only 35 percent as likely as nonwearers to develop retropatellar pain syndrome during an intense 8-week progressive running program. Given the large prevalence of retropatellar pain syndrome among Service members, this intervention warrants additional scrutiny. However, given that only a single study has demonstrated this preventive benefit, these results must be considered preliminary until validated by additional research. References from an expedited review are provided but no assessment as to the results of the studies, quality of the research, group discussion, or consensus regarding these studies.

3. Recommendation. The JSPTIPWG cannot recommend for or against the prophylactic use of knee braces for the prevention of injuries since a review of the literature and a quality analysis are incomplete. The work group recommends a literature review and quality analysis be conducted on the influence of knee brace use on the prevention of injuries.

4. References.

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D. Wear Forearm or Elbow Straps (Incomplete Review).

1. Introduction. The purpose of this review was to identify the strength of evidence for the use of forearm or elbow straps to prevent medial or lateral epicondylitis (elbow tendonitis). Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

2. Discussion. The use of a forearm or elbow strap and, more recently, the development of a dynamic extensor brace for the treatment and secondary prevention of lateral and medial epicondylitis have shown some promise by decreasing the tension moment of flexor and extensor tendons on the epicondyles of the elbow. The expedited review of this intervention revealed that neither of these devices, or anything similar, has been tested in prophylaxis or as a preventive device. Further research is needed to establish the efficacy of these devices targeted at those at highest risk of sustaining lateral or medial epicondylitis or epicondylalgia (elbow pain).

3. Recommendation. The JSPTIPWG cannot recommend for or against the prophylactic use of forearm or elbow straps for the prevention of injuries since a review of the literature and a quality analysis are incomplete. The work group recommends a literature review and quality analysis be conducted on the influence of forearm or elbow straps relative to the prevention of injuries.

E. Utilize Allied Health Professional in a Pre-MTF Care Setting (Incomplete Review).

1. Introduction. The purpose of this review would have been to identify the strength of evidence for the use of allied health professionals (e.g., physical therapists, occupational therapists, athletic trainers, etc.) in care settings before Service members seek care or are referred to MTFs. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below. A literature review was not completed.

2. Discussion. Better access to health care is desirable, especially in the military. The question as to whether or not improved access to musculoskeletal evaluation and treatment hastens a Service member's return to full military duty and reduces the risk of reinjury has yet to be determined. It is unknown whether or not the presence of an allied health professional has a primary prevention effect on injuries in the units they serve. Some programs show some evidence with regard to reduced attrition. A few of the Services have assigned active-duty physical therapists and/or civilian athletic trainers to Brigade Combat Teams and Special Operations units. These programs deserve greater scrutiny to provide sound scientific evidence to prove both their effectiveness in reducing injury (not just better access to care) and applicability to other Services (including the business case supporting their use).

3. Recommendation. The JSPTIPWG cannot recommend for or against the utilization of allied health professionals in a pre-MTF setting to prevent injury, prevent reinjury, or hasten a return to full military duty since a review of the literature and a quality analysis are incomplete. The work group recommends a review of the scientific literature and program evaluation and business case analysis of the following types of programs to determine efficacy of primary and secondary injury prevention and DOD-wide applicability:

a. Programs that bring a full range of sports medicine care in closer proximity to trainees.

b. Programs that utilize athletic trainers as organic unit assets.

c. Programs that deploy physical therapists with Brigade Combat Teams and Special Operations units.

F. Accommodate for Psychosocial Issues Related to Injury (Incomplete Review).

1. Introduction. The purpose of this review would have been to identify the strength of evidence for the impact of psychosocial factors (such as depression, anxiety, job stress, job satisfaction, etc.) on the prevention of injuries. Reasons for pursuing this theory and a summary of salient points that lead to the final recommendation are presented in the discussion below.

2. Discussion. Psychosocial issues are likely a larger contributor to the military's high injury rates than first thought. The influence of peers, leaders, and the organizational climate may well influence whether a Service member is at higher or lower risk for musculoskeletal injury. Depression, anxiety, job stress, and job satisfaction all may play a part in the prevention of injury, prevention of reinjury and recovery. Interventions designed to influence these psychosocial issues may, in fact, reduce injury risk.

3. Recommendation. The JSPTIPWG recommends that a review of various psychosocial issues related to injury (such as depression, anxiety, job stress, job satisfaction, etc.) be performed and further research be conducted (as appropriate) to clearly identify what strategies may impact the reduction of musculoskeletal injury risk.

XI. CONCLUSIONS.

A. Of the 40 PT-related injury prevention strategies reviewed in the scientific literature by the JSPTIPWG, 3 were determined to be critical components of a successful injury prevention program and not interventions in and of themselves. Therefore, rather than viewing these components as interventions, the JSPTIPWG agreed to classify them as "essential elements" that are necessary for the successful implementation of any injury prevention strategy. Because of lack of convincing scientific evidence for most of the strategies identified, the work group deemed it prudent to add 1 more essential element to the list (research and program evaluation), bringing the list of essential elements to 4 and the total intervention strategies considered to 37. The essential elements of an injury prevention program are:

1. Education of Service members, especially leaders, in injury prevention principles and strategies.

2. Enforcement of injury prevention policies and programs.

3. Unit injury surveillance reporting.

4. Investment of greater resources in research and program evaluation of training-related injury prevention interventions.

B. Of the 37 interventions, 6 were neither reviewed nor discussed by the work group. There are currently no JSPTIPWG recommendations for these interventions except that they be reviewed and discussed in a systematic manner. The remaining 31 interventions were categorized into 3 levels representing the strength of recommendation: recommended, not recommended, and insufficient evidence to recommend or not recommend. Six interventions (20 percent) had strong enough evidence to become JSPTIPWG recommendations. This was an unexpectedly low number, given that the majority of the interventions proposed had been proven effective, or so thought some members of the JSPTIPWG. Leaders should implement these recommendations and monitor injury rates and physical fitness to ensure recommended strategies are having the intended effect. Two interventions (6 percent) were not recommended due to evidence of ineffectiveness or harm: Leaders should discourage the use of back braces, harnesses, or support belts and advise against the use of anti-inflammatory medication prior to exercise in their units.

C. What stands out as a singularly important outcome of this work group effort is the significant number of interventions for which there is still insufficient evidence to support recommending the interventions as injury prevention strategies to the military Services at this time. Twenty-three (74 percent) of the interventions reviewed in the scientific literature cannot be recommended because of lack of evidence, poor quality evidence, conflicting evidence, or evidence of harm. Leaders should carefully weigh the benefits and costs of implementing any of these 23 unproven strategies in their units in order to conserve resources and maximize training time. For example, it would not be prudent to waste precious PT time with group stretching given that it has no proven injury prevention efficacy.

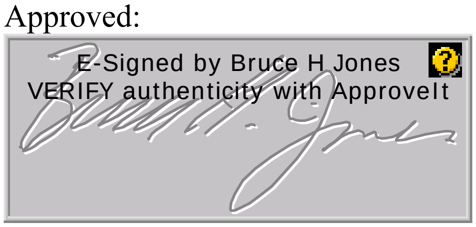
D. The lack of scientific evidence found for most injury prevention strategies supports the work group decision to add the fourth essential element (greater investment of resources in research and program evaluation of training-related injury prevention interventions) for successful injury prevention programs. Without further research and program evaluation of injury prevention strategies in military populations (and in comparable civilian populations), the rate of PT-related injuries will continue to be a burden on the Services and a health threat to Force readiness. Preventing injuries will have a significant effect on military operational readiness by decreasing entry-level attrition and separation due to injury. This technical report identifies 29 injury prevention strategies that have yet to be evaluated (n=6) or that lack sufficient scientific evidence (n=23) to support Quad-Service recommendations. Injury researchers interested in studying the prevention of PT-related injuries in the military should start with this list.

E. The systematic process of evaluating interventions enabled the JSPTIPWG to build Quad-Service consensus around those injury prevention strategies that had enough scientific evidence to support a recommendation. The use of guidelines that required a sufficient level of scientific evidence before making any recommendation was key to prioritizing the recommendations. While the initial effort of the work group sought to elucidate the proven strategies to reduce injuries in the basic training environment, the principles behind the six recommended interventions can be broadly and inexpensively applied to operational training environments among the Services with similar results.

XII. POINT OF CONTACT. The point of contact at USACHPPM is LTC Steven H. Bullock, Program Manager, Health Promotion Policy. LTC Bullock can be reached at DSN 584-7007, commercial 410-436-7007, or by electronic mail at steven.h.bullock@us.army.mil.

STEVEN H. BULLOCK
LTC, SP
Program Manager
Health Promotion Policy

Approved:



BRUCE H. JONES, MD, MPH
Program Manager
Injury Prevention Program

Appendix A

References

This appendix contains a listing of process references used in this report. (References for each topic of discussion are found in paragraphs VI through X.)

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Appendix B. Secretary of Defense Memorandum on Reducing Preventable Accidents

THE SECRETARY OF DEFENSE
1000 DEFENSE PENTAGON
WASHINGTON, DC 20301-1000

May 19, 2003

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
DIRECTOR, DEFENSE RESEARCH AND ENGINEERING
ASSISTANT SECRETARIES OF DEFENSE
GENERAL COUNSEL OF THE DEPARTMENT OF DEFENSE
INSPECTOR GENERAL OF THE DEPARTMENT OF DEFENSE
DIRECTOR, OPERATIONAL TEST AND EVALUATION
ASSISTANTS TO THE SECRETARY OF DEFENSE
DIRECTOR, ADMINISTRATION AND MANAGEMENT
DIRECTOR, FORCE TRANSFORMATION
DIRECTOR, NET ASSESSMENT
DIRECTOR, PROGRAM ANALYSIS AND EVALUATION
DIRECTORS OF THE DEFENSE AGENCIES
DIRECTORS OF THE DOD FIELD ACTIVITIES

SUBJECT: Reducing Preventable Accidents

World-class organizations do not tolerate preventable accidents. Our accident rates have increased recently, and we need to turn this situation around. I challenge all of you to reduce the number of mishaps and accident rates by at least 50% in the next two years. These goals are achievable, and will directly increase our operational readiness. We owe no less to the men and women who defend our Nation.

I have asked the Under Secretary of Defense for Personnel and Readiness to lead a department-wide effort to focus our accident reduction effort. I intend to be updated on our progress routinely. The USD(P&R) will provide detailed instructions in separate correspondence.

U06916-03

Appendix C. JSPTIPWG Charter

DEPARTMENT OF THE ARMY
Office of the Deputy Chief of Staff, G-3
400 Army Pentagon
Washington, DC 20310-0400

SEP 16 2004

REPLY TO
ATTENTION OF:

DAMO-TR

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Joint Services Physical Training Injury Prevention Work Group

In July of 2003, the Deputy Secretary of Defense chartered the Defense Safety Oversight Council (DSOC) to provide governance on DoD-wide efforts to reduce preventable injuries and mishaps. The DSOC is chaired by the Under Secretary of Defense for Personnel and Readiness, who in turn has chartered nine task forces to develop recommendations for policies, programs, and investments to reduce preventable injuries and accidents. I am the Chair of one of these task forces - the Military Training Task Force. In fulfillment of our mission to reduce military training injuries and accidents, we are establishing a Joint Services Physical Training Injury Prevention Work Group. The purpose of this Work Group is twofold: (1) to evaluate military physical training injury prevention programs, policies, and research for cross-Service recommendations to reduce physical training related injuries in and beyond Initial Entry Training; and (2) to evaluate military footwear type, fitting, and replacement policy and practices to reduce injuries related to inappropriate, improperly fitted or worn footwear.

I am writing you to request your participation on the Joint Services Physical Training Injury Prevention Work Group (please see the attached proposed Work Group roster). The Work Group will be co-chaired by Dr. Bruce Jones and MAJ(P) Steve Bullock of the US Army Center for Health Promotion and Preventive Medicine. We anticipate our first meeting will be held in October 2004 and subsequent meetings by video teleconference at 4-8 week intervals as needed.

Request you inform Dr. Jones (410-436-1008, bruce.jones@apg.amedd.army.mil) or MAJ(P) Bullock (410-436-7007, steven.bullock@apg.amedd.army.mil) of your availability to participate in the Joint Services Physical Training Injury Prevention Work Group. I thank you for your consideration of this request and hope you will be able to provide us your expertise in preventing Service Member injuries.

Jim B. Gunlicks
Chairman, Defense Safety Oversight Council
Military Training Task Force

Appendix D. USACHPPM-JHCIRP Work Group Process for Prioritizing Injury Prevention Programs and Policies

1. Assemble injury and safety experts.

- 14 participants in one-day workshop
- 8 Army, 6 non-Army
- Variety of disciplines: clinicians, epidemiologists, researchers, policymakers

2. Review existing Army injury data.

- Medical surveillance data on deaths, disabilities, hospitalizations, and outpatient visits, comparing injuries to all other diagnoses
- Cause of injury information collected during U.S. Army field studies and research projects
- Cause of injury information collected by the U.S. Army Combat Readiness/Safety Center

3. Review existing criteria (initial criteria developed at CDC's National Center for Injury Prevention and Control).

- Consistent with mission
- Magnitude of problem
- High costs of problem
- Size of population
- Degree of public concern
- Preventable problem
- Modifiable risk factors
- Proven prevention
- Public health and health infrastructure
- Adequacy of resources
- Benefits greater than costs
- Evaluation capability

4. Brainstorm additional criteria (additional criteria added by the work group).

- Cause(s) are identifiable
- Prevention strategies can be designed
- Authority to implement the program or policy is held or obtainable by the implementing organization(s)
- Program or policy will not undermine essential missions
- Accountability and responsibility for implementation exists or can be established

5. Organize criteria (grouped into five main criteria).

- CONSISTENT WITH MISSION
- IMPORTANCE OF PROBLEM to force health and readiness
- PREVENTABILITY of problem
- FEASIBILITY of program or policy
- EVALUATION of program or policy

6. Assign scoring scheme and format score sheet. (See Table E-1.)

10 pts. – Importance
10 pts. – Preventability
10 pts. – Feasibility
5 pts. – Evaluation potential
35 pts. – TOTAL

7. Use criteria to evaluate and prioritize 25 causes of Army unintentional injury hospitalization. (See Table E-2).

Appendix E. USACHPPM-JHCIRP Criteria for Prioritizing Injury Programs and Policies and 25 Causes of Unintentional Injury Hospitalization Prioritized by the USACHPPM-JHCIRP Work Group

Table E-1. USACHPPM-JHCIRP Criteria for Prioritizing Injury Programs and Policies

Criterion	Preliminary Rating	Final Score
A. PROGRAM OR POLICY IS CONSISTENT WITH MISSION	[ ] YES [ ] NO	If YES – Continue with scoring. If NO – Stop here.
B. IMPORTANCE OF PROBLEM TO FORCE HEALTH & READINESS *Considerations*: 1. Magnitude and severity of problem (consider its effect on personnel readiness) 2. Cost of the problem (consider training, property, and personnel costs) 3. Size and/or vulnerability of population at risk 4. Degree of concern (consider command concern, public concern, visibility of problem)	1. [ ] Low [ ] Medium [ ] High 2. [ ] Low [ ] Medium [ ] High 3. [ ] Low [ ] Medium [ ] High 4. [ ] Low [ ] Medium [ ] High	(10 points; 1=low, 10=high)
C. PREVENTABILITY OF PROBLEM (10 points) *Considerations*: 1. Cause(s) are identifiable. 2. Risk factors are modifiable. 3. Proven prevention strategies exist. 4. Prevention strategies can be designed.	1. [ ] Low [ ] Medium [ ] High 2. [ ] Low [ ] Medium [ ] High 3. [ ] Low [ ] Medium [ ] High 4. [ ] Low [ ] Medium [ ] High	(10 points; 1=low, 10=high)
D. FEASIBILITY OF PROGRAM OR POLICY (10 points) *Considerations*: 1. Existence of infrastructure to support implementation of the program or policy (consider medical staff and facilities, safety staff and resources, cadre availability). 2. Adequacy of funding to support implementation. 3. Authority to implement the program or policy is held or obtainable by the implementing organization(s). 4. Program or policy will not undermine essential missions. 5. Political and cultural acceptability of program or policy. 6. Accountability and responsibility for implementation exists or can be established.	1. [ ] Low [ ] Medium [ ] High 2. [ ] Low [ ] Medium [ ] High 3. [ ] Low [ ] Medium [ ] High 4. [ ] Low [ ] Medium [ ] High 5. [ ] Low [ ] Medium [ ] High 6. [ ] Low [ ] Medium [ ] High	(10 points; 1=low, 10=high)
E. EVALUATION OF PROGRAM OR POLICY (5 points) *Considerations*: 1. Ability to evaluate effects of program or policy exists (consider if a metric is possible). 2. Benefits of program or policy outweigh the costs of implementation.	1. [ ] Low [ ] Medium [ ] High 2. [ ] Low [ ] Medium [ ] High	(5 points; 1=low, 5=high)
TOTAL SCORE		

Table E-2. Twenty-Five Causes of Unintentional Injury Hospitalization* Prioritized by the USACHPPM-JHCIRP Work Group

1. Accidents with own instruments of war	14. Machinery/tools
2. Athletics/sports	15. Marching/drilling
3. Complications of medical/surgical procedures	16. Military air transport accidents
4. Cut/pierced by object	17. Military vehicle accidents
5. Drowning/submersion	18. Nonmilitary air transport accidents
6. Excessive cold	19. Other environmental
7. Excessive heat	20. Physical training (e.g., running, calisthenics)
8. Falls/jumps	21. Poisoning
9. Fighting	22. POV accidents
10. Guns, explosives, and related devices	23. Twisting/turning/slipping
11. Hanging/suffocation	24. Unconventional weapons injury (chemical and biological weapons, terrorism)
12. Late effects of injury	
13. Lifting/pushing/pulling	25. Water transport

*Alphabetical list compiled from the Atlas of Injuries in the United States Armed Forces.

Appendix F. JSPTIPWG Members

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Army Research Laboratory, Human Research and Engineering Directorate

Appendix G. Criteria for Determining Studies to Include or Exclude When Evaluating the Scientific Evidence

Table G-1. Inclusion/Exclusion Criteria

	Study Type	Definition
INCLUDED STUDIES *Original research studies + reviews of original research = scientific evidence.*	**Injury research studies with injury outcome(s)**	Original research studies that present the methods, results, and conclusions of an original scientific investigation and include injury as measured outcome. Intervention studies, risk factor/cause studies, descriptive epidemiology studies, and case series are included in this category if injury is a measured outcome. All of these studies should be categorized into the Intervention, Risk Factor/Cause, Descriptive Epidemiology, or Case Series columns of the Classification Matrix.
	Other research studies with non-injury outcome(s)	These are original research studies (e.g., field, epidemiological, lab, or biomechanical) related to your topic that *do not measure injury*, but rather measure *intermediate* outcomes (e.g., a stretching study measuring flexibility, a PT program measuring improvements in fitness, biomechanical studies examining shock absorbency of footwear). All of these studies should be classified as Other Research Studies in the Classification Matrix.
	Reviews of injury research	Review studies that describe the results of original scientific investigations and include injury as a measured outcome. All of these studies should be categorized into the Reviews column of the Classification Matrix.
EXCLUDED STUDIES	**Research studies on a different topic**	Studies presenting original scientific investigation that were culled from the initial search, but are not directly relevant to your topic. All of these studies will be excluded from the Classification Matrix.
	Non-research studies	Studies that do not describe original scientific investigation(s) or do not review original research. Examples include editorials, letters, opinion papers, and educational articles. All of these studies will be excluded from the Classification Matrix.

Appendix H. Study Definitions

Table H-1. Study Glossary

Study Type	Definition
Injury Intervention Studies	Studies specifically examining interventions compared to controls where injury is the primary outcome (e.g., randomized trials, convenience sample comparisons of two cohorts, historical controls—pre and post studies of the same population, etc.). These studies include a numerator and denominator.
Injury Risk Factor/ Cause Studies (Analytic Epidemiology)	These studies look at the incidence, rates, risks (percentages), or prevalence of injuries in different groups compared to each other (for example, a study that uses a cohort of individuals to look at the association of injuries with different degrees of exposure, such as the amount of running or marching, or different levels of factors, such as fitness or percent body fat). These studies include a numerator and denominator and can be prospective or retrospective cohort studies, case-control studies, cross-sectional studies, or surveys.
Descriptive Injury Epidemiology Studies	These studies look only at risks and rates of injuries in a single group without reference to comparison groups or levels of risk factors or exposures (e.g., rates of injuries associated with running, marching, wearing of boots, etc.). These studies include a numerator and denominator.
Injury Case Series	These studies look only at cases or series of cases of injuries but do not have a denominator. These may provide a distribution of causes or risk factors among the injured only. They may also provide a distribution of types of injuries associated with a type of activity or setting. Comparisons to other populations are not possible.
Other Research Studies	These are original research studies (e.g., field, epidemiological, lab, or biomechanical) related to the topic that *do not measure injury*, but rather measure *intermediate* outcomes (e.g., a stretching study measuring flexibility, a PT program measuring improvements in fitness, biomechanical studies examining shock absorbency of footwear).
Injury Review Studies	These reviews should include only reviews of studies relating to a particular injury problem or intervention and MUST have injuries as one of the outcomes considered in the review.

Appendix I. Template for Conducting an Online Literature Search

PURPOSE: Identify all literature (research and non-research) related to your topic from the three identified search engines.

Conduct an online literature search.

- Limit your search to human studies only, no earlier than 1970, in the English language.
- Refer to the criteria in Appendix G to determine the studies to include or exclude.

a. PubMed (Medline) Search Engine: www.ncbi.nlm.nih.gov/entrez/query.fcgi

Date of search:	
Search terms used:	
Number of both included and excluded studies resulting from search:	
Number of included studies only:	Number of excluded studies only:

b. DTIC Search Engine: www.dtic.mil/dtic/find_a_doc.html

Date of search:	
Search terms used:	
Number of both included and excluded studies resulting from search:	
Number of included studies only:	Number of excluded studies only:

c. Cochrane Search Engine: www.cochrane.org/reviews/index.htm

Date of search:	
Search terms used:	
Number of both included and excluded studies resulting from search:	
Number of included studies only:	Number of excluded studies only:

d. Other search engine: ____

Date of search:	
Search terms used:	
Number of both included and excluded studies resulting from search:	
Number of included studies only:	Number of excluded studies only:

e. Other search engine: ____

Date of search:	
Search terms used:	
Number of both included and excluded studies resulting from search:	
Number of included studies only:	Number of excluded studies only:

Appendix J. Template for Creating a Bibliography of the Studies That Meet the Inclusion Criteria

Create a bibliography of the studies that meet the inclusion criteria.

- Studies listed here meet the criteria and study definitions provided in appendices A and B.
- Insert rows as needed.

PURPOSE – Create a compete list of all studies meeting the inclusion criteria and likely to be useful for prevention.

<u>SAMPLE</u> **Full Study Citation *and* Web Link for Abstract or Full Study**	Jones, B.H. and J.J. Knapik. "Physical training and exercise-related injuries. Surveillance, research and injury prevention in military populations." *Sports Med.* 27:111-125, 1999. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=10091275&dopt=Abstract
Full Study Citation *and* Web Link for Abstract or Full Study	
Full Study Citation *and* Web Link for Abstract or Full Study	
Full Study Citation *and* Web Link for Abstract or Full Study	
Full Study Citation *and* Web Link for Abstract or Full Study	

Appendix K. Classification Matrix of Literature Search Results

Table K-1. Sample of Classification Matrix

References Found/ Literature Reviews		Categories of Study Types											Total
		Intervention + = positive effect, reduces injuries - = negative effect, increases injuries x = no effect on injuries M = multiple intervention study				**Risk Factor/Cause** + = increases rate - = decreases rate x = no effect on injuries			**Descriptive Epidemiology**	**Case Series**	**Other Research Studies (non-injury outcome)**	**Reviews**	
SAMPLE	**No. of Refs Found[a]**	2				1			0	1	0	0	4
SAMPLE	**Literature Reviews**	**Author/ Year**	**M**	**+/-/x**	**Score[b]**	**Author/ Year**	**+/- /x**	**Score[c]**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
SAMPLE		Stasinopoulis, S/ 2003	M	+	8	Thomas, R / 1999	x	5		Smith, J / 2001			
SAMPLE		Taft, R / 1998		+	6								
No. of Refs Found[a]													
Literature Reviews													

Notes:

[a] The "No. of Refs Found" indicates the number of studies that met the search and inclusion criteria from appendices G and H. You must insert a "0" (zero) if you searched but you found no directly relevant studies.

[b] Use Intervention Studies Quality Scoring Form to determine score.

[c] Use Risk Factor/Cause of Injury Studies Quality Scoring Form to determine score.

Appendix L. JSPTIPWG Intervention Studies Quality Scoring Form

Author/Year/Title of Intervention Study: **Date of Review:**	
Problem and Sample	**Score**
1. Is there a clear statement of research question or hypothesis? If yes, score 1.	
2. Is there a source of subjects or sample described (e.g., inclusion criteria listed)? If yes, score 1.	
3. Is there a clear description of intervention? If yes, score 1.	
Study Design and Methodology	
4. Is it a randomized controlled trial? If yes, score 2.	
5. Is it an observational study with data on relevant confounders? If yes, score 1.	
6. Is there collected data on important covariates used in an analysis? If yes, score 1.	
Data Presentation and Statistical Analysis	
7. Are statistical methods clearing described? If yes, score 1.	
8. Are confidence intervals or P-values used? If yes, score 1.	
9. Are multivariate methods in analysis (e.g., regression) used? If yes, score 1.	
10. TOTAL SCORE – Maximum score possible is 10 (*transfer total to the Classification Matrix*).	

Appendix M. JSPTIPWG Risk Factor/Cause of Injury Studies (Analytic Epidemiology) Quality Scoring Form*

Author/Year/Title of Risk Factor/Cause Study:	
Date of Review: **Name of Reviewer:**	
Problem and Sample	**Score**
1. Is there a clear statement of research question or hypothesis? If yes, score 1.	
2. Is it stated that a power or sample size calculation was done? If yes, score 1.	
3. Is the source of subjects or sample described (e.g., inclusion and exclusion criteria listed)? If yes, score 1.	
4. Is the measurement of exposures/risk factors and outcomes clearly described? If criterion is fully met, score 2; if partially met, score 1.	
Study Design and Methodology	
5. Is this a prospective cohort study? If yes, score 2. ***or*** Is it a retrospective cohort or case control study or other appropriate design? If yes, score 1.	
6. Is data on relevant confounders provided and controlled for appropriately? If criterion is fully met, score 2; if partially met, score 1.	
7. Is there data collected on important covariates used it an analysis? If yes, score 1.	
Data Presentation and Statistical Analysis	
8. Are statistical methods clearly described and appropriate? If yes, score 1.	
9. Are incidences (rates), risks (percentages), or odds of injury reported appropriately? If yes, score 1.	
10. Are confidence intervals or P-val used appropriately? If yes, score 1.	
11. Are multivariate methods in analysis (e.g., regression) used appropriately? If yes, score 1.	
12. Are demographic variables and associated risks/rates described appropriately? If yes, score 1.	
13. TOTAL SCORE – Maximum score possible is 15	
14. TOTAL SCORE CORRECTED to 10-point scale = points from line 13 x .667 (*transfer total to the Classification Matrix*).	

*****Significant contributions to content and design of this form made by the following JSPTIPWG members: LtCol Vincent Fonseca, Dr. Julie Gilchrist, and Dr. Stephen Marshall.

Appendix N. USPSTF Ratings, Strength of Recommendations, and Quality of Evidence*

Table N-1. Format for Revised Recommendations and USPSTF Ratings

Color Code	Recommendations
Green	Strongly recommends __________ for the prevention of injuries. The JSPTIPWG found *good* evidence that ____ reduces injuries and concludes that benefits substantially outweigh harms. *or* Recommends __________ for the prevention of injuries. The JSPTIPWG found at least *fair* evidence that ____ reduces injuries and concludes that benefits outweigh harms.
Amber	We make no recommendation for or against __________ for the prevention of injuries. The JSPTIPWG found at least fair evidence that ____ can reduce injuries • but concludes that the balance of benefits and harms is too close to justify a general recommendation for all Services and /or • [but] may be appropriate for individual Services or high-risk individuals.
Red	Recommends against ___________ for the prevention of injuries. The JSPTIPWG found at least fair evidence that ______ is ineffective or that harms outweigh benefits.
Gray	Conclude that the evidence is insufficient to recommend for or against __________ for the prevention of injuries. Evidence that ________ is effective is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined. Therefore, the work group recommends further research on the following: ____.

USPSTF Ratings: Strength of Recommendations and Quality of Evidence

The USPSTF grades its recommendations according to one of five classifications (A, B, C, D, I) reflecting the strength of evidence and magnitude of net benefit (benefits minus harms).

A. The USPSTF strongly recommends that clinicians provide [the service] to eligible patients. *The USPSTF found good evidence that [the service] improves important health outcomes and concludes that benefits substantially outweigh harms*.

B. The USPSTF recommends that clinicians provide [this service] to eligible patients. *The USPSTF found at least fair evidence that [the service] improves important health outcomes and concludes that benefits outweigh harms*.

C. The USPSTF makes no recommendation for or against routine provision of [the service]. *The USPSTF found at least fair evidence that [the service] can improve health outcomes but concludes that the balance of benefits and harms is too close to justify a general recommendation*.

D. The USPSTF recommends against routinely providing [the service] to asymptomatic patients. *The USPSTF found at least fair evidence that [the service] is ineffective or that harms outweigh benefits*.

I. The USPSTF concludes that the evidence is insufficient to recommend for or against routinely providing [the service]. *Evidence that the [service] is effective is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined*.

Quality of Evidence - The USPSTF grades the quality of the overall evidence for a service on a 3-point scale (good, fair, poor):

Good: Evidence includes consistent results from well-designed, well-conducted studies in representative populations that directly assess effects on health outcomes.

Fair: Evidence is sufficient to determine effects on health outcomes, but the strength of the evidence is limited by the number, quality, or consistency of the individual studies, generalizability to routine practice, or indirect nature of the evidence on health outcomes.

Poor: Evidence is insufficient to assess the effects on health outcomes because of limited number or power of studies, important flaws in their design or conduct, gaps in the chain of evidence, or lack of information on important health outcomes.

*Adapted from the U.S. Preventive Services Task Force (USPSTF 2000-2003).

Appendix O. JSPTIPWG Criteria for Ranking PT Injury Interventions

Intervention Name: _________________ Intervention No. ______

Purpose: This score sheet is a tool that provides a systematic means of rating an injury prevention intervention and objectively comparing total scores of competing interventions.

How to use this score sheet: Complete a score sheet for each intervention under consideration. First, decide on a *preliminary rating* (1 = low, 5 = high) for each criterion. Then assign a *final score* for each criterion using the formula presented. Adding the final scores will provide a *total score*. The maximum total score is 100.

Criterion*	Total points possible*	Preliminary score	Final score (preliminary score/5 X total points possible)
1. Strength of the evidence (quality of science)	20	1 2 3 4 5 Low High	___ X 20 = 5
2. Magnitude of Net Effect ▪ Size of health benefit ▪ Size of population affected	20	1 2 3 4 5 Low High	___ X 20 = 5
3. Practicality ▪ Feasible ▪ Start-up cost ▪ Acceptable ▪ Existing infrastructure	20	1 2 3 4 5 Low High	___ X 20 = 5
4. Timeliness of reduction ▪ Implementation time ▪ Result time	10	1 2 3 4 5 Low High	___ X 10 = 5
5. Sustainability ▪ Effort to keep going ▪ Maintenance cost ▪ Training	10	1 2 3 4 5 Low High	___ X 10 = 5
6. Measurable outcomes ▪ Measurable reductions	10	1 2 3 4 5 Low High	___ X 10 = 5
7. Collateral benefit (e.g.: ▪ Increase readiness ▪ Decrease attrition ▪ Decrease in other health problem, etc.	10	1 2 3 4 5 Low High	___ X 10 = 5
TOTAL SCORE	100		

*Criteria and total points adapted from Defense Safety Oversight Council Criteria, 2004.

Date of Review:______________ Name of Reviewer: ________________________________

Appendix P. JSPTIPWG Initial List of PT-Related Injury Prevention Interventions by Category

I. Exercise/ Training Programs (as they relates to injury)

1. Running volume (intensity, duration, frequency, overload)
2. Fitness level (ability groups)
3. Other types of training (strength, cross-training, job specific)
4. Preventives (warm-up/cool-down, proprioception, stretching)
5. Technique (stride length, short-to-tall formation)
6. Progression/Overload with increased fitness (standardization, preconditioning, remedial)
7. Recovery period (training and testing)
8. Elimination of harmful exercise/ avoidance of high-risk exercise (deep knee bends, mule kick, sit-ups, etc.)
9. Exercise program management (separating weighing and fitness testing)

II. Equipment & Environment

10. Footwear (shoes, insoles, socks)
11. Joint support (bracing and taping)
12. Mouthguards, helmets, pads, and reflective material
13. Running and landing surfaces (obstacle course)
14. Environmental temperature

III. Education

15. Injury prevention
16. Health behavior (alcohol, smoking, other)
17. Technique (running form, safe lifting)
18. Healthcare provider (profile writing training)
19. Self-treatment

IV. Nutrition, Supplements, and Hydration

V. Medication and Medical Care

20. Medications
21. Rehabilitation
22. Early intervention

VI. Leadership/ Accountability Issues

23. Responsibility for injury rates
24. Focus on PT pass performance
25. Psychosocial issues

VII. Surveillance & Evaluation

26. Command injury visibility
27. Screening: Injury Risk Index

Appendix Q. Quality Scoring Form Used for Manuscripts Variables Score*

Experimental design
Statement of research question (prior hypothesis) 4
Source of sample 5
Inclusion/exclusion criteria 6
Randomization 10
Examiner/analyst blinding 4
Selection bias addressed 2
Information bias addressed 2
Description of intervention 7
Comparison of participants with eligible decliners 3
Comparison of participants with dropouts 3
Independent validation of data 1
Power calculations (sample size requirements) 3
Clear method to evaluate outcome variable defined 3
Appropriateness of method 3
Addressed possible confounders (1 point each)
Age
Sex
Skill level
Conditioning
Prior lower extremity injury
Sport
Competition versus practice
Playing surface
Medical supervision
Shoes
Taping or bracing
Education
Appropriateness of method of adjustment 4
Data presentation and statistical analysis
Description of tests 6
Use of relative risk or odds ratio 2
Use of confidence intervals or P values 3
Multivariate techniques 4
Regression coefficients (if relevant) 3
Presentation of data (2 points each)
Demographic data
Confounders
Comparability groups
Collinearity
Multiple testing
Total possible 100

*Thacker, et al. 1999