Joint Services Physical Training Injury Prevention Work Group

Interventions Evaluated to Make Recommendations for Physical Training-Related Injury Prevention

A Supplement to the Military Training Task Force White Paper: A Process for Setting Military Injury Prevention Priorities and Making Evidence-Based Recommendations for Interventions

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CONTENTS

Chapter 1

Introduction

Section I. Background

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 (Jones et al. 1999; Jones and Amoroso 2000). Training-related (overuse) 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 limited duty assignement (Jones et al. 1999; Jones et al. 2000). Conservative estimates of time Servicemembers are given physical activity restrictions are upwards of 25 million limited duty days per year for all three Services combined. These Servicemembers are unable to perform their full duties and as a consequence many are unable to deploy. Most of the overuse injuries sustained in a military environment come from the cumulative effect of physical training, particularly for basic military trainees. More serious injuries result from accidents than any other cause (i.e., illness, intentional injuries, hostile action), even in combat (Writer and DeFraites 2000; Jones and Amoroso 2000; Hauret et al. 2004). As a consequence of knowledge about the magnitude of the injury problem for the U.S. Military, the Secretary of Defense mandated in 2003 that rates of accidents and injuries must be significantly reduced (see Appendix A).

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 chartered nine task forces to develop recommendations for policies, programs, and other investments to reduce preventable injuries and accidents. Military Training Task Force (MTTF) was chartered to support the Secretary of Defense's accident and injury prevention mandate with focus in the realm of interventions that relate to aspects of military training.

In support of the DSOC mission and due to the significant contribution physical training makes toward the injury problem, the Chairman of the MTTF chartered the Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG) in 2005 (see Appendix B). The original purpose of the work group was two-fold: (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 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 current body of scientific literature and deserved its own thorough evaluation and careful scientific review.

A Systematic Approach to Setting injury Prevention Priorities Adapted to Identifying Successful Prevention Strategies

The 1988 Institute of Medicine (IOM) report, *The Future of Public Health*, identified ad hoc public health decision-making as a common obstacle to successful program and policy development and implementation. 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)

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).

A test set of criteria which would enable an unbiased, objective determination of Service-wide priorities was developed by a group of 14 civilian and military injury experts (Appendix C) from the US Army Center for Health Promotion and Preventive Medicine and Johns Hopkins Center for Injury Research and Policy (see process at Appendix D). The process clearly identified the largest and most sever health problems for the Army (see criteria categories and causes of unintentional injury hospitalization at Appendix E). Scores ascribed to different causes of injury ranged from a low of 91 to a high of 308. 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

The JSPTWIP work group adapted the criteria and applied a systematic approach to identify existing scientific evidence of intervention effectiveness for the prevention of physical training-related injuries and prioritized them into levels of strength of recommendation. The process for making these recommendations is fully explained in the August 2005 Military Training Task Force (MTTF) White Paper, "A Model Process for Setting Military Injury Prevention Priorities and Making Evidence-Based Recommendations for Interventions." The process serves three additional purposes for the JSPTIP work group:

- Establishes the evidence base for making recommendations to prevent injuries in the most efficient, cost-effective manner possible,
- Prioritizes the implementation of programs and policies for prevention, and
- Substantiates the need for further research into interventions or programs likely to reduce injuries.

Section II. Intervention Selection

The JSPTIPWG consisted of 20 civilian and military fitness and injury expert members and 8 consultants/subject matter experts from safety, health, and academia (see Appendix F for list of participants).

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

- Establishing inclusion and exclusion criteria when evaluating scientific evidence (Appendix G),
- Clearly identifying the definitions of study types to ensure consistency among reviewers (Appendix H),
- Conducting literature searches to identify scientific reports relevant to physical training-related injury prevention—using Medline, DTIC, Cochrane, and other pertinent search engines—for studies related to physical training and exercise- related injury prevention interventions, (Appendix I),
- Culling studies from identified literature that did not meet specific inclusion criteria,
- Documenting known physical training-related injury prevention interventions studies in full bibliography (Appendix J) and categorizing them in a matrix (Appendix K)
- Evaluating the scientific quality of the intervention and risk factor studies that met the criteria (Appendices L and M)
- Assessing the overall strength of the evidence for each intervention and "grading" each intervention using a rating scheme adapted from the United States Preventive Services Task Force (USPSTF) (Appendix N),
- Developing criteria to objectively score and rank recommended interventions (Appendix O), and
- Applying those criteria to produce a prioritized list of recommended physical training-related injury prevention interventions (Summary, Chapter 20).

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.

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)

The teleconference discussions expanded this original list of 27 interventions to 49 interventions shown in Table 1-1.

Table 1-1. Intervention Expansion

Category	Sub Category	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, Swiss 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

Category	Sub Category	Intervention
	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
	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, situps)
	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 (are there shoe tests that can demonstrate ~500 miles of wear?)
	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	Joint bracing (especially with history

Category	Sub Category	Intervention
	Support	of previous injury – ankle, knee, etc)
	29. Joint Support	Ankle taping
	30. Equipment	Mouth guards, 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. Health Care Provider Education	Health care 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
Medication & Medical Care	41. Medications	Pre exercise loading anti-inflammatory medication
	42. Medications	BCP use increases knee stability (potentially reducing risk of 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., SMART clinics)

Category	Sub Category	Intervention
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 (a 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) BMI Foot arch height Knee Q-angle Injury history (especially ankle)

Each of the 49 intervention topics was assigned to individual JSPTIPWG members who conducted literature searches and reviewed and rated studies related to each intervention. The literature review process was carefully detailed in five steps which were scheduled to be completed before our first face to face meeting:

Step 1: Conduct 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).

Step 2: Create a bibiliography of the studies that met the inclusion criteria (Appendix J)

Step 3: Score the quality of each intervention and risk factor study using two standardized quality scoring forms (Appendix L and M) adapted by sub-work group members from Steven Thacker's Quality Scoring Form Used for Manuscripts Variables Score (Appendix Q).

Step 4: Complete classification matrix of the literature search. Contributors were asked to document the references into one of six classifications 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 K):

- Intervention Studies (injury outcomes)
- Analytic Risk Factor or Cause Studies (injury outcomes)
- Descriptive Epidemiology Studies (injury outcomes)
- Clinical Case Series Studies (injury outcomes)
- Other Research (non-injury outcomes)
- Reviews

Step 5: Confirm or modify a JSPTIPWG recommendation using a format adapted from the United States Preventive Services Task Force.

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%) of the 35 topics; no intervention studies had been found in the literature for 12 (34%) of the topics.

Meeting Objectives

Apply systematic, objective criteria to:

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

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

- 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?
- How do rates of injury during basic training established using centralized medical surveillance data (Defense Medical Surveillance System - DMSS) compare with rates observed in more focal studies and from other surveillance systems?
- What recommendations have previous expert panels made?
- What specific recommendations have been made most frequently by past panels?
- What have been the greatest successes of past panels?
- What has limited dissemination or implementation of previous recommendations?
- What lessons can our group learn from previous panels?
- What can we learn from previous successful and unsuccessful military intervention trials?
- How would we apply our rating scales to examples of military intervention studies reporting positive and negative results?

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:

- What injury prevention strategies or problems have been the subject of the most research?
    - What is the total number of studies identified by our literature searches using the search terms chosen?
    - How many peer reviewed papers and tech reports did our preliminary searches identify?
- For which interventions/prevention strategies have intervention studies been conducted?
    - How many?
    - What were the average scores for the intervention studies your search identified?
    - What interventions should we recommend for implementation now?
    - Are there any interventions we should not recommend at this time?
- How many risk factor or cause of injury studies did our 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?
- 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 our positions?
- What can we learn from the preliminary literature searches we have done?
    - How can we improve the process?
    - Which prevention strategies should we focus on for further review?
- What could we do to improve the intervention quality rating process?
    - Should we design a separate scoring system/card for risk factor/cause of injury studies?

- Once the quality of research has been established how do we objectively rank the priority for implementing prevention strategies?
  - Can we apply the Defense Safety Oversight Council criteria?
  - Would it be preferable to use the CHPPM criteria?
  - What about the U.S. Preventive Services Task Force criteria?

The briefings described the available studies and rated the quality of each. In that way, all 20 JSPTIPWG members had an opportunity to see and comment on the quality review scores. After reviewing all of the intervention topics on which literature searches had been completed, the JSPTIPWG assessed the strength of the evidence for those topics for which intervention studies were found. The group agreed that the best criterion for objectively ranking the priority for implementing strategies was an adaptation of the USPSTF guidelines (Appendix R). Interventions were categorized as:

- Strongly Recommended
- Recommended
- No Recommendation For or Against (due to a close balance of benefits/harms)
- Recommend Against Use (due to evidence of ineffectiveness or harm)
- Insufficient Evidence to Make a Recommendation (recommend further research)

The strongly recommended interventions were then prioritized using the refined USACHPPM-JHCIRP set of criteria which 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 this criterion (Appendix O):

- Strength of the Evidence (20 pts)
  - Quality of the science
- Magnitude of the Effect (20 pts)
  - Size of health benefit
  - Size of population affected
- Practicality (20 pts)
  - Feasible
  - Start up cost
  - Acceptable
  - Existing infrastructure
- Timeliness of Reduction in Injury Rates (10 pts)
  - Implementation time
  - Result Time
- Sustainability (10 pts)
  - Effort to keep going
  - Maintenance cost
  - Training
- Measurable Outcomes (10 pts)
  - Measurable reductions
- Collateral Benefits (10 pts)
  - Increase readiness

- Decrease attrition
- Decrease in other health problem, etc.

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). Mean scores and rankings of injury interventions for the first meeting only are listed in Table 20-2 of Summary Chapter 20.

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 agreement on the outstanding tasks yet to be completed. The following questions and issues formed the framework for discussions during the day:

- How would you list and categorize our recommendations?
- What DOD or Service policies or guidelines support our recommendations for preventive action?
- For those recommendations/guidelines that are applicable to all four Services what do we need to do to make/describe/express their applicability across the Services?
  - For example, how to we establish ability group cut points and speeds and amounts of running for the different Services?
  - Do we need Service specific tables of these or could we set a common standard?
- What immediate recommendations for action should we make in what order of priority?
- How can we use the work we have already done to make more solid recommendations?
- What work remains to be done to add value to our current effort and to refine and add to our recommendations so that we can publish the results in a peer reviewed journal (like the American Journal of Preventive Medicine supplement published on military injuries in 2000 or the "Atlas of Injuries in U.S. Armed Forces" published in Military Medicine in 1999)?

As discussed within the White Paper: A Model Process For Setting Military Injury Prevention Priorities and making Evidence-Based Recommendations For Interventions, August 2005, public health decisions must often consider all available scientific evidence, not just randomized controlled trials (RCT). 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. Studies considered for further review included research studies with injury and non-injury outcome(s) and reviews of injury research.

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.

The results of the working group's efforts are detailed in chapters 2-19 of this report and summarized in Chapter 20. Within the chapters, each intervention is presented in four sections followed by a flow chart illustration of the review process:

- Section I introduces and discusses the intervention.
- Section II states the working group's final recommendation.
- Section III presents the classification matrix of literature search results.
- Section IV provides the reference list of included studies meeting the working group's criteria.
- A flow chart illustration shows how some interventions may have been combined, split, and not reviewed, and tracks the evolution from initial to final recommendations.

Chapter 2

Preventing Overtraining
(Multiple Interventions)

The following interventions are covered in this chapter:

- Intervention 1 - Reduction in Running Frequency, Duration, and Distance
- Intervention 2 - Reinitiating Exercise at Lower Intensity Levels for the Detrained (at what point of detraining should one revert to lighter training loads?)
- Intervention 3 - No PT on Days When Exhaustive Military Training Occurs
- Intervention 4 - Increase Marching While Decreasing Running
- Intervention 5 - Run in Ability Groups by Time, Not Distance
- Intervention 14 - Standardized and Graduated/Progressive Exercise (Including Running) Program
- Intervention 19 - Discontinue or Modify Use of PT As Corrective Tool
- Intervention 20 - Eliminate Extra PT Sessions for the Least Fit Individuals
- Intervention 21 - Determine the Ideal and Absolute Minimum Recovery Period Between Maximal Effort Fitness Tests

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

Flow charts illustrating the working group's review of these interventions are shown in Figures 2-1 and 2-2 at the end of this chapter.

Preventing Overtraining
(Combination of Interventions 1, 3, 4, 5, 14, 19, 20, and 21)

- Reduction in Running Frequency, Duration, and Distance (1)
- No PT on Days When Exhaustive Military Training Occurs (3)
- Increase Marching While Decreasing Running (4)
- Run in Ability Groups by Time, Not Distance (5)
- Standardized and Graduated/Progressive Exercise (Including Running) Program (14)
- Discontinue or Modify Use of PT As Corrective Tool (19)
- Eliminate Extra PT Sessions for the Least Fit Individuals (20)
- Determine the Ideal and Absolute Minimum Recovery Period Between Maximal Effort Fitness Tests (21)

I. Introduction and Discussion

Introduction

Interventions 1, 3, 4, 5, 14, 19, 20, and 21 all have the ultimate objective of reducing the overtraining effect on the musculoskeletal system. Additionally, the literature review revealed that these interventions often occurred simultaneously in the research methods. Therefore, these four interventions were considered together in the recommendation to reduce overtraining.

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 summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Daniel W. Trone:

- Search terms: exercise, running, fitness, injuries, and volume
- Total number of hits resulting from the search: 286
- Total number of studies that meet the inclusion criteria: 50

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 physical training-related injuries. About 80 percent of these injuries are in the lower extremities and are of the overuse type—a condition brought about by physical training volume overload (generally excessive running). 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 convey the key principle of the prevention of overtraining. The effect of running mileage, duration, frequency, intensity, and progression on overtraining is discussed. Other interventions related to the prevention of overtraining are discussed and added to this recommendation: avoiding combinations of strenuous military and physical training, standardizing a gradually progressive running program, utilization of ability groups, avoidance of remedial programs that overtrain the least fit Servicemembers, more use of interval training and less use of long/slow distance runs, and allowing adequate musculoskeletal recovery.

- ***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 Servicemembers. This intervention has been tested experimentally among recruits in 12-week Marine Corps boot camp. The table 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 reduction in running distance was associated with a 53 percent reduction in stress fracture incidence and only slightly (3 percent) slower run times. Thus, reducing running mileage reduced stress fracture incidence with minimal effects 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. In a study of Army BCT, one battalion running a total of 17 miles plus an undetermined amount of interval training had lower injury rates and similar improvements in 2-mile run times compared to a battalion that ran a total distance of 38 miles. Another study 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. 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 U.S. Army Training and Doctrine Command (TRADOC) Standardized Physical Training Program for BCT was implemented in April 2004. Studies conducted prior to implementation showed that this program reduced injuries by 21 percent compared to a traditional BCT PT program. The TRADOC program incorporates less running mileage and a greater variety of exercises.

Table 2-1. Mileage, stress fracture incidence, and 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 (n/100)	Final 3-mile run times (min)
1136	55	3.7	20.3
1117	41	2.7	20.7
1097	33	1.7	20.9

- ***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 known 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) or estimated 2-mile run times. The table below indicates that running duration of 45 minutes versus 30 minutes increases the injury incidence (percent of subjects injured) by 125 percent (over 2 times) with only a 5 percent increase in maximal oxygen uptake (or an estimated 18 seconds faster on a 2-mile run). The next table indicates that a running frequency of 5 times per week versus 3 times per week increases the injury incidence by 225 percent (over 3 times) with only a 35 percent increase in maximal oxygen uptake (or an estimated 36 seconds faster on a 2-mile run). The bottom line is that the amount of running can be dramatically reduced to prevent injuries without significantly decreasing the cardiorespiratory endurance of Soldiers. 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.

Table 2-2. Running duration, injuries, and cardiovascular endurance*

Duration (min/day)	Injury incidence (percent)	Change in CV endurance (percent maximal oxygen uptake)	Estimated change in 2-mile run time (minutes)
0	0	-.7	- :06
15	22	8.7	1:12
30	24	16.1	2:00
45	54	16.9	2:18
From 30 to 45 min/day	125% increase	5% greater	:18 faster

*Training: running 3 days/week, 85-90% MHR
Adapted from Pollock ML, Gettman LR, Milesis CA, Bah MD, Durstine L, Johnson RB. Effects of frequency and duration of training on attrition and incidence of injury. *Med Sci Sports.* Spring 1977;9(1):31-36.

Table 2-3. Running frequency, injuries, and cardiovascular endurance*

Frequency (days/week)	Injury Incidence (percent)	Change in CV Endurance (percent maximal oxygen uptake)	Estimated change in 2-mile run time (minutes)
0	0	-3.4	- :30
1	0	8.3	1:06
3	12	12.9	1:48
5	39	17.4	2:24
From 3 to 5 days/wk	225% increase	35% greater	:36 faster

*Training: running 30 min, 85-90% MHR
Adapted from Pollock ML, Gettman LR, Milesis CA, Bah MD, Durstine L, Johnson RB. Effects of frequency and duration of training on attrition and incidence of injury. *Med Sci Sports.* Spring 1977;9(1):31-36.

- ***Exercise intensity and progression.*** The minimum threshold for PT required to achieve desired training effects has been less well characterized for Servicemembers. 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. Recommended minimum duration and frequency are 20 minutes, 2 to 3 times per week for individuals with initially low cardiorespiratory fitness levels. Recommended progression is gradual with small-increment increases in training stimulus over 4 to 6 months (table below). 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.

Table 2-4. Example of aerobic training program progression for healthy, initially untrained adults

Program stage	Week	Exercise frequency (sessions/week)	Exercise intensity (%HR max*)	Exercise duration** (minutes)
Initial Stage	1	2	55-60	15-20
	2	2	55-60	20-25
	3	3	60-70	20-25
	4	3	60-70	25-30
Improvement Stage	5-7	3-4	70-75	25-30
	8-10	3-4	70-75	25-30
	11-13	3-4	75-80	25-30
	14-16	3-5	75-80	25-30
Maintenance Stage	17+	3-5	75-85	25-30

*HR max = 220 - age.
**Although the limit of 30 minutes for novice exercisers is prudent to reduce injuries, most people who are conditioned after months of consistent exercise may be able to tolerate 30 to 45 minute exercise sessions without problems.
Adapted from Franklin B, ed. *ACSM's Guidelines for Exercise Testing and Prescription.* 6 ed. Philadelphia: Lippincott Williams & Wilkins; 2000.

- ***Combinations of strenuous military and physical training.*** Commanders at all levels should actively avoid combinations of physical and military training that exceed physiologic thresholds of overtraining that result in higher injury rates and do not improve 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.

- ***Standardized gradual progressive run program.*** Military research also shows 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. Following a standardized, gradual, systematic progression of running distance and speed beginning with lower mileage and intensity, especially for those just starting a physical training program (e.g., new recruits, changing units, or returning to PT after time off for an injury or leave).

- ***Ability groups.*** Physical training injury prevention programs that target those Servicemembers at the highest risk of injury (those of average or below average fitness) ensure that the running mileage for the least fit Servicemembers is appropriate for their fitness level. The use of initial fitness test performance (run times) to place Servicemembers in ability groups of similar fitness levels provide each Servicemember with a more appropriate level of physiological stimulus to enhance fitness and minimize injury risk. (Running by time, not distance, allows the least fit to run shorter distances than the most fit, thus accommodating low and high fitness groups simultaneously). Formation running is contrary to training in ability groups as it overtrains the least fit and provides an inadequate training effect for the most fit.

- ***Remedial programs.*** Least fit Servicemembers are two to three times more likely to be injured as their more fit counterparts, especially in the recruit training environment. In order to reduce injuries and attrition rates while maximizing physical performance requires that the core of any physical training program be targeted directly at these Servicemembers of average and below average fitness levels. Servicemembers of below average fitness who overreach their physical capability have an increased risk of overtraining characterized by increased injuries, fatigue and depression and decreased motivation and physical performance. Avoiding remedial physical training programs that require the least fit Servicemembers, especially recruits, to do more training than fit Servicemembers significantly 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.)

- ***Punitive training.*** The common practice of utilizing physical training 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. Punitive PT is counterproductive from the physical performance and injury perspective. The end result will likely be reduced readiness because of an increased injury risk and decreased physical performance. Other methods to discipline new recruits should be sought after or the amount and type of physical demands placed on a new recruit should be limited, standardized, and finite.

- ***Interval training.*** Interval training is one of the best methods of reducing total running mileage while most efficiently increasing cardiovascular fitness. From a performance perspective, substantial evidence exists that interval training results in more rapid improvements in running speed and endurance than long-slow sustained running, and these improvements are achieved with many fewer total miles run. 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. Replacing some distance runs with higher intensity, shorter distance runs (e.g., interval training activities like repeated sprints, Fartlek training, and last-man-up, etc.) increase speed and stamina more rapidly than distance running while limiting total miles run.

- ***Recovery.*** Balance the body's need for a physiologic training overload with the need for recovery and rebuilding by coordinating military and physical training to:
    - Avoid exhaustive military or physical training (e.g., obstacle courses, long road marches with heavy loads, longer runs, maximal-effort physical fitness testing, etc.) on the same or successive days.

- Allow adequate recovery time between administrations of maximal effort physical fitness tests (ideally 3-5 days for Servicemembers in operational units) to prevent overtraining and increase the likelihood of improved physical performance.
- Alternate training days that emphasize lower body weight-bearing physical activity with training days focused on upper body conditioning.
- 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.

II. Recommendation: Interventions 1, 3, 4, and 5

The JSPTIPWG strongly recommends the de-emphasis of distance running during physical training to prevent overtraining. Overtraining (caused largely by excessive distance running) results in higher injury rates, lowered physical performance, decreased motivation, and attrition. Good evidence was found that physical training programs, especially in initial military training, that reduce distance running miles and incorporate the following elements prevent overtraining and reduce injury rates while maintaining or improving physical fitness.

- Commanders at all levels should actively avoid combinations of physical and military training that exceed physiologic thresholds of overtraining that result in higher injury rates and do not improve 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.

- Other ways to achieve this objective include the following recommendations:
  - Follow a standardized, gradual, systematic progression of running distance and speed beginning with lower mileage and intensity, especially for those just starting a physical training program (e.g., new recruits, changing units, or returning to PT after time off for an injury or leave).
  - Structure physical training injury prevention programs to target those Servicemembers at the highest risk of injury (those of average or below average fitness) by ensuring that the running mileage for the least fit Servicemembers is appropriate for their fitness level.
    - Use fitness test performance (run times) to place Servicemembers in ability groups of similar fitness levels that provide each Servicemember with a more appropriate level of physiological stimulus to enhance fitness and minimize injury risk. (Running by time, not distance, allows the least fit to run shorter distances than the most fit, thus accommodating low and high fitness groups simultaneously.)
    - Avoid remedial physical training programs that require the least fit Servicemembers, especially recruits, to do more training than fit Servicemembers since it significantly increases 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.)

    - Limit formation running as it overtrains the least fit and provides an inadequate training effect for the most fit.
  - Replace some distance runs with higher intensity, shorter distance runs (e.g., interval training activities like repeated sprints, Fartlek training, and last-man-up, etc.) that increase speed and stamina more rapidly than distance running while limiting total miles run.
  - Vary the body's need for a physiologic training overload with the need for recovery and rebuilding by coordinating military and physical training to:
    - Avoid exhaustive military or physical training (e.g., obstacle courses, long road marches with heavy loads, longer runs, maximal-effort physical fitness testing, etc.) on the same or successive days.
    - Allow adequate recovery time between administrations of maximal effort physical fitness tests (ideally 3-5 days for Servicemembers in operational units) to prevent overtraining and increase the likelihood of improved physical performance.
    - Alternate training days that emphasize lower body weight-bearing physical activity with training days focused on upper body conditioning.
    - 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.

III. Classification Matrix: Interventions 1, 3, 4, 5, 14, 19, 20, and 21

The Classification Matrix of Literature Search Results is shown in Table 2-5.

Table 2-5. Classification Matrix of Literature Search Results: Interventions 1, 3, 4, 5, 14, 19, 20, and 21

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	
No. of Refs Found	8				7			0	0	0	35†	50
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					
	Knapik 2003 (military)	M	+	8	Koplan 1982 (civilian)	+	5.3					
	Rudzki 1999 (military)	M	+	5	Marti 1988 (civilian)	+	7.3					
	Pope 1999 (military)	M	+	5	Macera 1989 (civilian)	+	9.3					
	Pollock 1977 (civilian)	M	+	4	Sullivan 1984 (civilian)	+	1.3					
	Rudzki 1997-II (military)		+	8	Jacobs 1986 (civilian)	+	6.0					
	Rudzki 1997-I (military)		+	8	Brunet 1990 (civilian)	+	2.0					
	Pester 1992 (military)	M	+	1								

*See references that follow for full citation.
†Contributor lists certain number but no specific references are identified.

IV. References: Interventions 1, 3, 4, 5, 14, 19, 20, and 21

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Reinitiating Exercise at Lower Intensity Levels for the Detrained (Intervention 2)

I. Introduction and Discussion

Introduction

This intervention is also related to overtraining but could not be included within the interventions 1, 3, 4, and 5 due to the lack of direct evidence for injury prevention.

The purpose of this review was to identify the strength of evidence for identifying the point of detraining at which it would be recommended to revert a trainee to lighter training loads to avoid injury. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by CDR Lanny L. Boswell, PT, PhD, OCS and LTC Steven Bullock:

- Search terms: reinitiating exercise in military, reinitiating exercise, and detraining
- Total number of hits resulting from the search: 106
- Total number of studies that meet the inclusion criteria: 3

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 within just 2 weeks of stopping intense physical training (Coyle) and a return to pretraining cardiorespiratory fitness after as short a period of time as 10 weeks (Fringer). 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 (Graves). Even though no studies have been performed that address the risk of injury on reinitiating exercise after periods of detraining, it would be prudent to reinitiate activity and rebuild fitness gradually for trainees who miss more than 1 week of PT (such as those returning from Exodus, new-starts to units, or those coming off limited duty). Expecting trainees to immediately return to the running volume achieved before training was interrupted overloads their capacity inasmuch as some detraining has occurred.

II. Recommendation: Intervention 2

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 the exact point of detraining that requires exercise reinitiation at lower levels. The JSPTIPWG recommends further research into how much detraining requires a lower level of intensity and duration of exercise to prevent injury.

III. Classification Matrix: Intervention 2

The Classification Matrix of Literature Search Results is shown in Table 2-6.

Table 2-6. Classification Matrix of Literature Search Results: Intervention 2

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**	
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.

IV. References: Intervention 2

1. 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.

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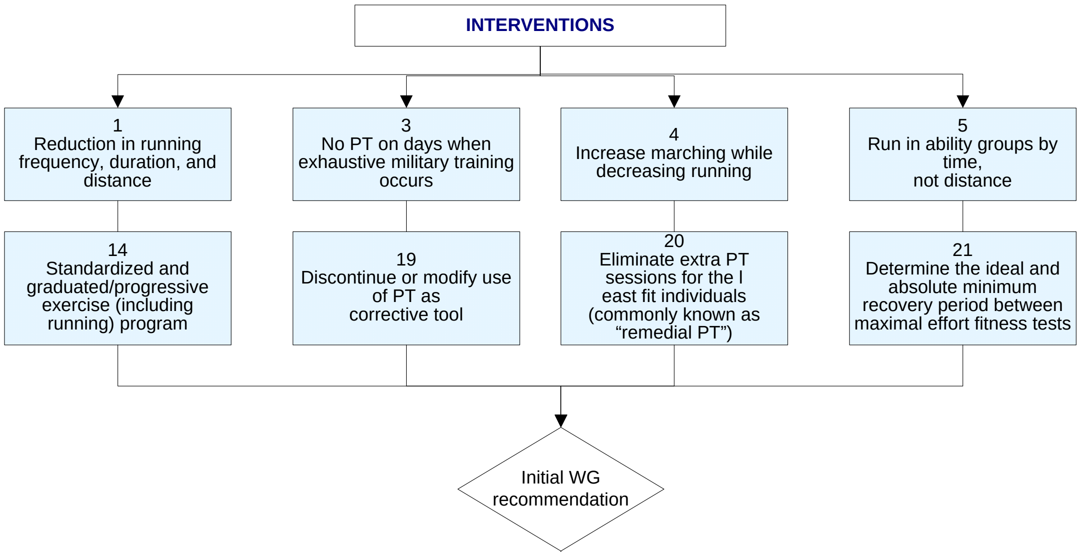
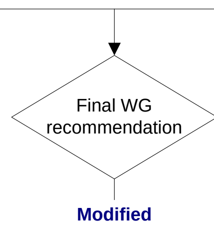
Figure 2-1. Review Process: Interventions 1, 3, 4, 5, 14, 19, 20, and 21



Overtraining

Recommend use of initial fitness levels to develop a run program that emphasizes ability groups and intensity (interval training) to achieve Service-specific cardiorespiratory fitness standards. There is good evidence that programs that incorporate the following control the volume of running and thereby reduce injuries:

- Limit total run frequency and duration (mileage) for those individuals with lower fitness levels.
- Standardize a gradual, systematic run progression.
- Recognize that physiological thresholds exist above which increases in duration and frequency do not result in commensurate increases in cardiorespiratory fitness, but do result in higher injury rates, particularly for people with average and below-average fitness levels.
- Consider total time on the feet (e.g., marching, travel time, administrative movements, drill and ceremony) in determination of run program.
- Consider near-maximal or exhaustive military training as the equivalent of a strenuous PT session.

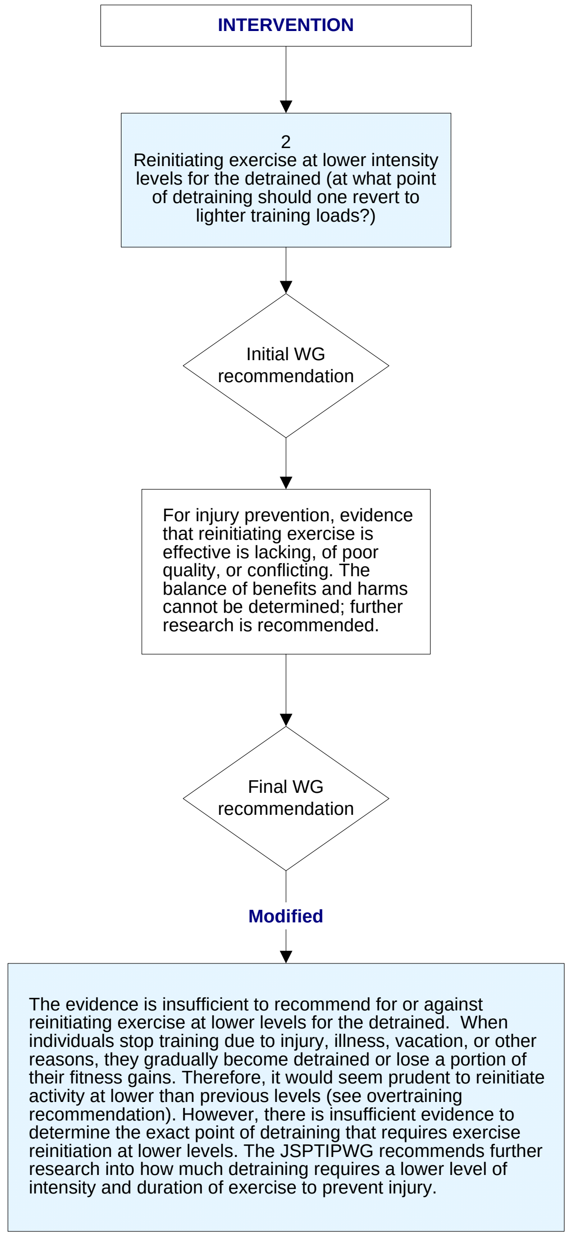


The JSPTIPWG strongly recommends the de-emphasis of distance running during physical training to prevent overtraining. Overtraining (caused largely by excessive distance running) results in higher injury rates, lowered physical performance, decreased motivation, and attrition. Good evidence was found that physical training programs, especially in initial military training, that reduce distance running miles and incorporate the following elements prevent overtraining and reduce injury rates while maintaining or improving physical fitness.

Commanders at all levels should actively avoid combinations of physical and military training that exceed physiologic thresholds of overtraining that result in higher injury rates and do not improve 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. Other ways to achieve this objective include the following recommendations.

- Follow a standardized, gradual, systematic progression of running distance and speed beginning with lower mileage and intensity, especially for those just starting a physical training program (e.g., new recruits, changing units, or returning to PT after time off for an injury or leave).
- Structure physical training injury prevention programs to target those Servicemembers at the highest risk of injury (those of average or below average fitness) by ensuring that the running mileage for the least fit Servicemembers is appropriate for their fitness level: run in ability groups, avoid additional remedial physical training programs, and limit formation running.
- Replace some distance runs with higher intensity, shorter distance runs (e.g., interval training activities like repeated sprints, Fartlek training, and last-man-up, etc.) that increase speed and stamina more rapidly than distance running while limiting total miles run.
- Vary the body's need for a physiologic training overload with the need for recovery and rebuilding by coordinating military and physical training to deconflict military and physical training schedules, allow adequate recovery time, alternate training days, and minimize weight-bearing stress on lower body.

Figure 2-2. Review Process: Intervention 2



Chapter 3

Targeted Muscle Strengthening and Job Specific Strength Training (Interventions 6 and 7)

The following interventions are covered in this chapter:

- Intervention 6 - Targeted Muscle Strengthening (Pre-injury)
- Intervention 7 - Job Specific Strength Training - Align Conditioning with Readiness Physical Demands

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 3-1 at the end of this chapter.

Isolated Muscle Strength Training
(Combination of Interventions 6 and 7)

Intervention 6 - Targeted Muscle Strengthening (Pre-injury)
Intervention 7 - Job Specific Strength Training (Aligning Conditioning with Physical Demands of Readiness)

I. Introduction and Discussion

Introduction

Interventions 6 and 7 each have the ultimate objective of reducing injuries through the application of strength training. They are similar enough in concept that they were combined for purposes of this review. Therefore, these two interventions were considered together in the recommendation.

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 summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Marilyn A. Sharp and Timothy L. Bockleman:

- 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
- Total number of hits resulting from the search: 319
- Total number of studies that meet the inclusion criteria: 11

Discussion

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 desired function or related specifically 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 in the same idea.

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 in the strip mining industry, firefighters, and men's college soccer players nor does therapeutic exercise appear to 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.

II. Recommendation: Interventions 6 and 7

The JSPTIPWG recommends specific muscle group strengthening for rehabilitation of injury to aid in recovery where appropriate and prevent injury recurrence. The WG found good evidence that targeted muscle strengthening provides recovery in the treatment of injuries and fair evidence to suggest that isolated muscle strengthening of the low back may prevent injuries in the low back. The WG concludes that more research on the precise series or combinations of strengthening exercise in the military population is necessary.

III. Classification Matrix: Interventions 6 and 7

The Classification Matrix of Literature Search Results is shown in Table 3-1.

Table 3-1. Classification Matrix of Literature Search Results: Interventions 6 and 7

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		
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		
	Hewitt†	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.
†Reviewer did not provide full citation in references.

IV. References: Interventions 6 and 7

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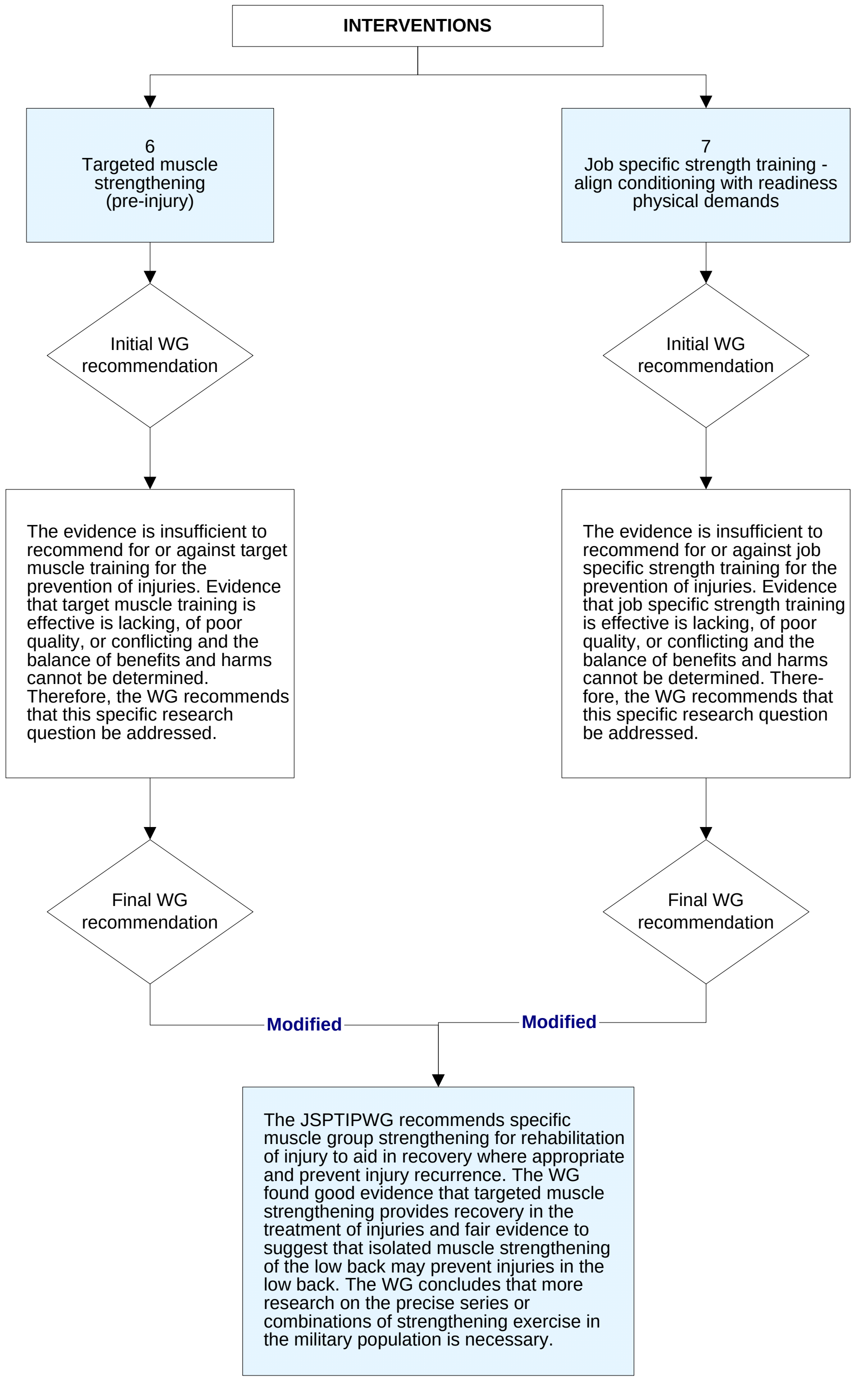
9. Von Restorff W. Physical fitness of young women: carrying simulated patients. Ergonomics 2000 Jun;43(6):728-43.

Figure 3-1. Review Process: Interventions 6 and 7



Chapter 4

Pre-exercise Warm-up and Post-exercise Cool-down
(Intervention 9)

The following intervention is covered in this chapter:

- Intervention 9 - Preventives/Stretching (Warm-up/Cool-down; Pre-exercise Stretching; Post-exercise Stretching; Targeted Risk Groups - e.g., Low Flexibility Groups)

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 4-1 at the end of this chapter.

Pre-exercise Warm-up and Post-exercise Cool-down (Intervention 9)

I. Introduction and Discussion

Introduction

Although pre-exercise stretching often occurs during warm-up to or cool-down from exercise, a warm-up or cool-down does not have to include stretching. This section only deals with the process of "warming" or "cooling" the body as a preparation for or following more intense activity. Stretching itself as an intervention is discussed in Chapter 5.

The purpose of this review was to establish if warming up the body with low intensity exercise is influential in reducing musculoskeletal injuries during follow-on activity. Additionally, the purpose of this review was to establish if evidence exists to support the notion that cooling down after exercise is somehow protective against musculoskeletal injury. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by LTC Steven Bullock:

- Search terms: warm-up, injury prevention, neuromuscular or proprioception
- Total number of hits resulting from the search: 1035
- Total number of studies that meet the inclusion criteria: 13

Discussion

Initially the JSPTIPWG focused on the stretching component of a warm-up when making the recommendation found in Ch 5. However, a more thorough review beyond the initial meeting revealed good evidence that a warm-up was beneficial in minimizing musculoskeletal injury when it includes neuromuscular and proprioceptive activities. Since the scientific evidence is clear that pre-exercise stretching is not protective against injuries (see Ch 5), one should not expect stretching exercises during warm-up to prevent physical training-related injuries during activity. A prospective cluster randomized controlled trial demonstrated that warm-up exercises specifically designed for a single sport (team handball) significantly reduced musculoskeletal injuries in youth aged 15-17. Risk for all injuries combined and also for lower limb injuries in athletes who performed the task-specific warm-up exercises was only about half of the injury risk for control athletes who did their usual training. A separate cohort study of female soccer players aged 14-18 showed a 74% - 88% reduction in anterior cruciate ligament tears among players performing soccer-specific warm-up exercises over a 2-year follow up, compared to age- and skill-matched control athletes.

During the process of editing this report, several more research studies have appeared in the literature that lend support to neuromuscular and proprioceptive performance programs that prevent contact and non-contact lower extremity injuries, particularly ankle injuries. In many studies these programs have been conducted as a matter of warm-up exercises, generally mimicking those activities in which will be engaged to greater intensity during follow-on activity. Warm-up programs that consist of plyometric jumping, sport-specific agility drills, cutting, and balance training on a wobble board or foam balance mat improve the awareness and control of the knees and ankles during activity and prevent injury. No similar research has yet been conducted using this intervention with Servicemembers.

No review of literature was performed on cool-down and injury prevention.

II. Recommendation: Intervention 9

- **Pre-exercise Warm-up Including Neuromuscular Activities.** The JSPTIPWG strongly recommends the inclusion of neuromuscular and proprioceptive performance activities as the core of any warm-up activity. The WG found good evidence that a structured program of task-specific, dynamic warm-up activities prior to more intense physical training or sport participation prevents injury. For example, brisk walking or light jogging before running; before sport participation, exercises and agility drills to improve awareness and control of major joints by throwing, cutting, plyometric jumping, landing, and exercise to improve neuromuscular control, balance, and strength. Stretching exercises are not a necessary component of the warm-up (see Chapter 4).

- **Post-exercise Cool-down.** The JSPTIPWG recommends a literature review be conducted on the use of cool-down activities for the prevention of injuries.

III. Classification Matrix: Intervention 9

The Classification Matrix of Literature Search Results is shown in Table 4-1.

Table 4-1. Classification Matrix of Literature Search Results: Intervention 9

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**	
No. of Refs Found	10										3	13
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year***	
	VanMechelen/ 1993		-	4							Quinn/2000	
	Stasinopoulos/ 2004		+	5								
	Verhagen/2004		+	7							Handoll/2001	
	Mandelaum/ 2005		+	7							Thacker/2004	
	Garrick/2005		+	8								
	Olsen/2005		+	8								
	McGuine/2006		+	9								
	Emery/2007		+	7								
	Mohammadi/ 2007		+	8								
	McHugh/2007		+	6								

*See references that follow for full citation.

IV. References: Intervention 9

1. Quinn K, Parker P, de Bie R, Rowe B, Handoll H. Interventions for preventing ankle ligament injuries. Cochrane Database Syst Rev. 2000;(2):CD000018.

2. Handoll HH, Rowe BH, Quinn KM, de Bie R. Interventions for preventing ankle ligament injuries. Cochrane Database Syst Rev. 2001;(3)CD000018.

3. Stasinpoulos D. Comparison of three preventive methods in order to reduce the incidence of ankle inversion sprains among female volleyball players. BR J Sports Med. 2004 Apr;38(2):182-5.

4. Verhagen E, van der Beek A, Twisk J, Bouter L, Bahr R, van Mechelen W. The effect of a proprioceptive balance board training program for the prevention of ankle sprains: a prospective controlled trail. Am J Sports Med. 2004 Sep;32(6):1385-93. Epub 2004 Jul 20.

5. Mandelbaum BR, Silvers HJ, Watanabe DS, Knarr JF, Thomas SD, Griffin LY, Kirkendall DT, Garrett W Jr. Effectiveness of a neuromuscular and proprioceptive training program in preventing anterior cruciate ligament injuries in female athletes: 2-year follow-up. Am J Sports Med. 2005 Jul;33(7):1003-10. Epub 2005 May11.

6. Garrick JG, Requa R. Structured exercises to prevent lower limb injuries in young handball players. Clin J Sports Med. 2005 Sep;15(5):398.

7. Olsen OE, Myklebust G, Engebretsen L, Holmes I, Bahr R. Exercises to prevent lower limb injuries in youth sports: cluster randomized controlled trail. BMJ. 2005 Feb 26;330(7489):449. Epub 2005 Feb 7.

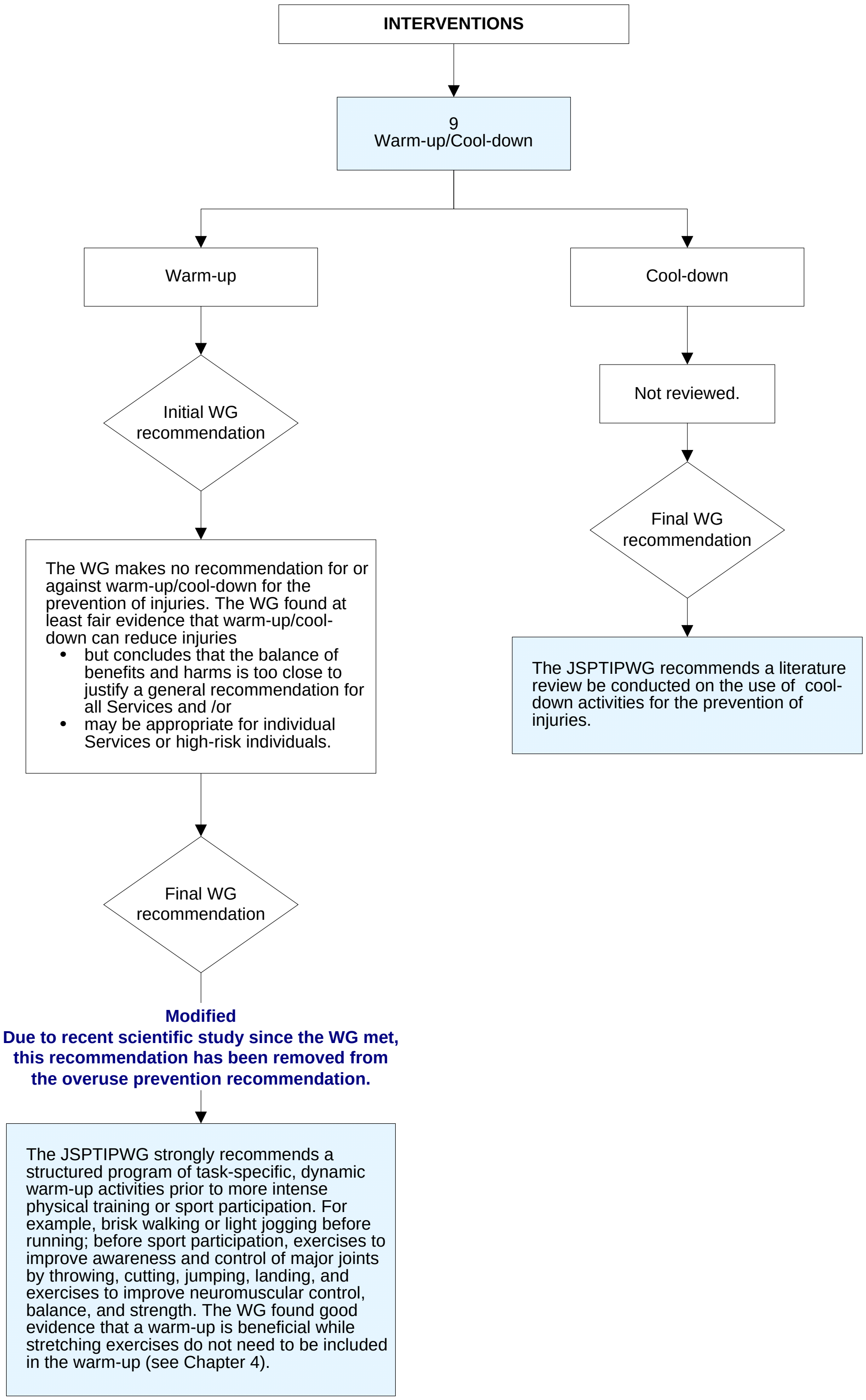
8. McGuine TA, Keene JS. The effect of a balance training program on the risk of ankle sprains in high school athletes. Am J Sports Med. 2006 Jul;34(7):1103-11. Epub 2006 Feb 13.

9. Emery CA, Rose MS, McAllister JR, Meeuwisse WH. A prevention strategy to reduce the incidence of injury in high school basketball: a cluster randomized controlled trial. Clin J Sport Med. 2007 Jan;17(1):17-24

10. Mohammadi F. Comparison of 3 Preventive Methods to Reduce the Recurrence of Ankle Inversion Sprains in Male Soccer Players. AM J Sports Med. 2007 Mar 22; [Epub ahead of print].

11. McHugh MP, Tyler TF, Mirabella MR, Mullaney MJ, Nicholas SJ. The Effectiveness of a Balance Training Intervention in Reducing the Incidence of Noncontact Ankle Sprains in High School Football Players. Am J Sports Med. 2007 Mar 29;[Epub ahead of print].

Figure 4-1. Review Process: Intervention 9



Chapter 5

Pre- and Post-Exercise Stretching and Multi-axial Proprioceptive Training
(Interventions 10-11)

The following interventions are covered in this chapter:

- Intervention 10 - Pre- and Post-Exercise Stretching
- Intervention 11 - Multi-axial and Proprioceptive Training: Training on Non-stable Platforms

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 5-1 at the end of this chapter.

Pre- and Post-Exercise Stretching
(Intervention 10)

I. Introduction and Discussion

Introduction
A member of the JSPTIPWG is one the world's foremost authority on stretching. The work group relied upon her already very extensive review and meta-analysis to assess the evidence for the effectiveness of stretching as a tool to prevent injuries in sports. The methods for this review were carried out previous to the work group meeting to a level that exceeded that performed for other potential interventions. The complete reference list is best reviewed by referring to the Thacker (2004) article at the reference list.

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 summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Julie Gilchrist, MD:
- Search terms: stretching, injury prevention
- Total number of hits resulting from the search: 1
- Total number of studies that meet the inclusion criteria: 1

Discussion
For many years sports medicine professionals have recommended stretching prior to physical activity as a method for reducing the risk of injury. However, it was not until recently that the effectiveness of this intervention was tested. Studies performed to date generally show that stretching prior to or both prior to and after PT does not reduce the risk of injury. There simply is not sufficient evidence to endorse routine stretching before or after exercise to prevent injury among competitive or recreational athletes or Servicemembers. The few studies that did show an effect of stretching on injuries suffered from serious design flaws. However, studies failing to show stretching reduced injuries also suffer from limitations. Studies to date have not specifically targeted individuals with limited motion. Because epidemiological data indicate that both extremes of flexibility (too much or too little) are associated with increased injury rates, future stretching studies need to selectively target individuals with tight muscles and tendons to see whether stretching can reduce injuries for these Soldiers.

II. Recommendation: Intervention 10

- **Pre-Exercise Stretching.** The JSPTIPWG does not recommend pre-exercise stretching as a component of exercise warm-up. The WG found good evidence that pre-exercise stretching is ineffective as an injury prevention intervention during follow on activity. Studies to date have not specifically targeted individuals with limited motion. Because epidemiological data indicate that both extremes of flexibility (too much or too little) are associated with increased injury rates, the WG recommends research on selective targeting of individuals with limited range of motion to determine the effect of stretching on this select population.

- **Post-Exercise Stretching.** The evidence is insufficient to recommend for or against post-exercise stretching for the prevention of injuries. Evidence that stretching after exercise as an intervention for injury prevention is lacking. The JSPTIPWG recommends further research on the effect of stretching targeted only at those with very low flexibility on injury rates.

Further research, especially well-conducted randomized controlled trials, is urgently needed to determine the proper role of stretching in sports.

III. Classification Matrix: Intervention 10

The Classification Matrix of Literature Search Results is shown in Table 5-1.

Table 5-1. Classification Matrix of Literature Search Results: Intervention 10

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**	
No. of Refs Found											1	1
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year***	
											Thacker/2004	

*See references that follow for full citation.

IV. Reference: Intervention 10

Thacker SB, Gilchrist J, Stroup DF, Kimsey CD Jr. The impact of stretching on sports injury risk: a systematic review of the literature. Med Sci Sports Exerc 2004 Mar;36(3):371-8.

Multi-axial and Proprioceptive Training: Training on Non-stable Platforms (Intervention 11)

I. Introduction and Discussion

Introduction

This intervention was assigned to a work group member but was not completed but remains a potentially effective technique for the prevention of musculoskeletal injuries in theory. While the editor includes references from the literature to support the theory, no formal review of the literature or analysis to evaluate the quality of evidence has been performed.

The purpose of this review was to identify the strength of evidence supporting multiaxial training on non-stable platforms to improve body awareness, strength, reaction time, and proprioception (body position sense). Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

A literature review was not performed. However, the editor provided six relevant references.

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 a randomized controlled trial. Some limited 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. No research has yet been conducted using this intervention with Soldiers.

The same study from warm-up used, as the main focus of the warm up, exercises that were designed to improve awareness and control of knees and ankles during standing, running, cutting, jumping, and landing. The program consisted of exercises and partner-perturbation with an inflatable ball, wobble board, and balance mat. (TB: A prospective cluster randomized controlled trial demonstrated that warm-up exercises specifically designed for a single-sport (team handball) significantly reduced musculoskeletal injuries in youth aged 15-17. Risk for all injuries combined and also for lower limb injuries in athletes who performed the task-specific warm-up exercises over a 2-year follow up, compared to age- and skill-matched control athletes. No similar research has yet been conducted using this intervention with Soldiers.)

Recent effectiveness of a neuromuscular and proprioceptive training program in competitive female youth soccer players in decreasing anterior cruciate ligament injuries has been demonstrated in 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% reduction in anterior cruciate ligament tears. However, since this program was a combination of interventions, the contribution the proprioceptive activities had on the overall reduction of injuries is difficult to determine. Further studies utilizing proprioceptive training drills in Servicemember populations are recommended.

II. Recommendation: Intervention 11

Not reviewed.

III. Classification Matrix: Intervention 11

The Classification Matrix of Literature Search Results not completed.

IV. References: Intervention 11

1. Caraffa A, Cerulli G, Projetti M, Aisa G, Rizzo A. Prevention of anterior cruciate ligament injuries in soccer. A prospective controlled study of proprioceptive training. Knee Surg Sports Traumatol Arthrosc 1996;4(1):19-21.

2. Mandelbaum BR, Silvers HJ, Watanabe DS, Knarr JF, Thomas SD, Griffin LY, Kirkendall DT, Garrett W Jr. Effectiveness of a neuromouscular and proprioceptive training program in preventing anterior cruciate ligament injuries in female athletes: 2-year follow-up. Am J Sports Med. 2005 Jul;33(7):1003-10.

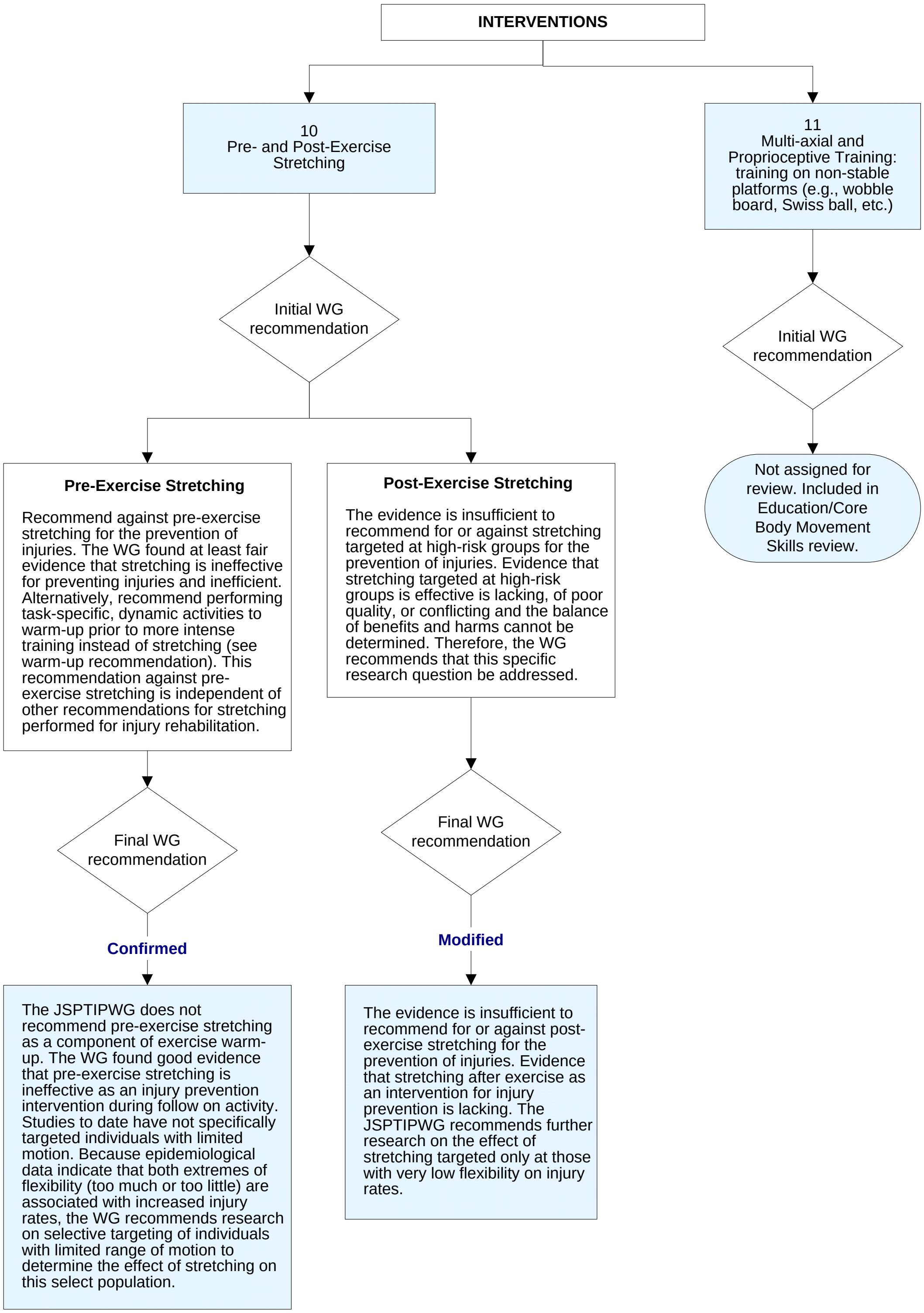
3. Olsen OE, Myklebust G, Engebretsen L, Holme I, Bahr R. Exercises to prevent lower limb injuries in youth sports: cluster randomized controlled trial. BMJ 2005 Feb 26;330(7489):449.

4. Sheth P, Yu B, Laskowski ER, An KN. Ankle disk training influences reaction times of selected muscles in a simulated ankle sprain. Am J Sports Med. 1997 Jul-Aug;25(4):538-43.

5. Tropp H, Askling C, Gillquist J. Prevention of ankle sprains. Am J Sports Med 1985 13(4):259-262.

6. Wedderkopp N, Kaltoft M, Holm R, Froberg K. Comparison of two intervention programmes in young female players in European handball--with and without ankle disc. Scand J Med Sci Sports 2003 Dec;13(6):371-5.

Figure 5-1. Review Process: Interventions 10 and 11



Chapter 6

Technique Training
(Interventions 12-13)

The following interventions are covered in this chapter:

- Intervention 12 - Place Shorter Servicemembers in Front of Formations to Set Running Pace
- Intervention 13 - Run and March at Own Stride Length

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 6-1 at the end of this chapter.

Place Shorter Servicemembers in Front of Formations to Set Running Pace (Intervention 12)

I. Introduction and Discussion

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

The literature review was provided by Keith G. Hauret:

- Search terms: stride length, step length, run, walk, march, injury and musculoskeletal injury or soft-tissue injury, stress fractures, shin splints
- Total number of hits resulting from the search: 56
- Total number of studies that meet the inclusion criteria: 3

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 to order trainees by their physical height by placing the shorter stature trainees at the front of marching or running platoons would reduce injury. While this appears to make sense to shorten the stride to one that is most comfortable for the shortest trainees, it ignores the impact of the taller trainees who are striding much shorter than is comfortable for them. A recent descriptive study reports reaffirms that Navy recruits who are the shortest and lightest have higher rates of pelvic stress fractures. However, no prospective randomized intervention trial has yet to be performed to definitively test this hypothesis and the impact this intervention may have on taller trainees.

II. Recommendation: Intervention 12

The evidence is insufficient to recommend for or against placing the shorter Servicemembers in the front of a marching formation and those who are taller to the rear for the prevention of injuries. Evidence that placing Servicemembers in ranks from front to back by their physical height as an intervention strategy to prevent lower extremity injuries is weak. Therefore, the JSPTIPWG recommends that this specific research question be addressed.

III. Classification Matrix: Intervention 12

The Classification Matrix of Literature Search Results is shown in Table 6-1.

Table 6-1. Classification Matrix of Literature Search Results: Intervention 12

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**	
No. of Refs Found	3											3
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
	Kelly	M	+	4								
	Reinker		+	2								
	Ozburn		+	1								

*See references that follow for full citation.

IV. References: Intervention 12

1. 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.

2. Ozburn MS, Nichols JW. Pubic ramus and adductor insertion stress fractures in female basic trainees. Mil Med 1081;146:332-334.

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

Run and March at Own Stride Length
(Intervention 13)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the prevention evidence for allowing Servicemembers to walk or run at a pace that is comfortable for them as apposed to marching or running in cadence (to the beat of a caller). Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Keith G. Hauret:

- Search terms: stride length, step length, run, walk, march, injury and musculoskeletal injury or soft-tissue injury, stress fractures, shin splints
- Total number of hits resulting from the search: 56
- Total number of studies that meet the inclusion criteria: 8

Discussion

Allowing an open stride or allowing trainees to walk or run at a stride that is comfortable for them (instead of marching in step) would seem to be the logical answer to reducing pelvic stress fractures in the shortest trainees while not adversely impacting the stride of the taller trainees. An Australian study demonstrated a significant reduction (11.2% to .6%) in pelvic stress fractures in female recruits by using just such an intervention. However, while this study was well designed, controlled and analyzed, the open stride was coupled with a number of other interventions making it difficult to assess the contribution of open stride length alone. A British study later 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 most recent British study confirms that understriding may cause more soreness than a preferred stride length.

II. Recommendation: Intervention 13

The evidence is insufficient to recommend for or against allowing Servicemembers to march at their own stride length for the prevention of injuries. Evidence that stride length manipulation as an intervention for lower extremity injuries is lacking or of poor quality. Therefore, the JSPTIPWG recommends that this specific research question be addressed.

III. Classification Matrix: Intervention 13

The Classification Matrix of Literature Search Results is shown in Table 6-2.

Table 6-2. Classification Matrix of Literature Search Results: Intervention 13

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**	
No. of Refs Found	3									5		8
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year***	**Author/ Year**	
	Pope	M	+	7						Cavanagh/ 1987		
	Hill		+	2						Cavanagh/ 1982		
	Rowlands		+	5						Elliott/ 1979		
										McNeill/ 2002		
										Vaughn/ 1994		

*See references that follow for full citation.

IV. References: Intervention 13

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

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

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

4. 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.

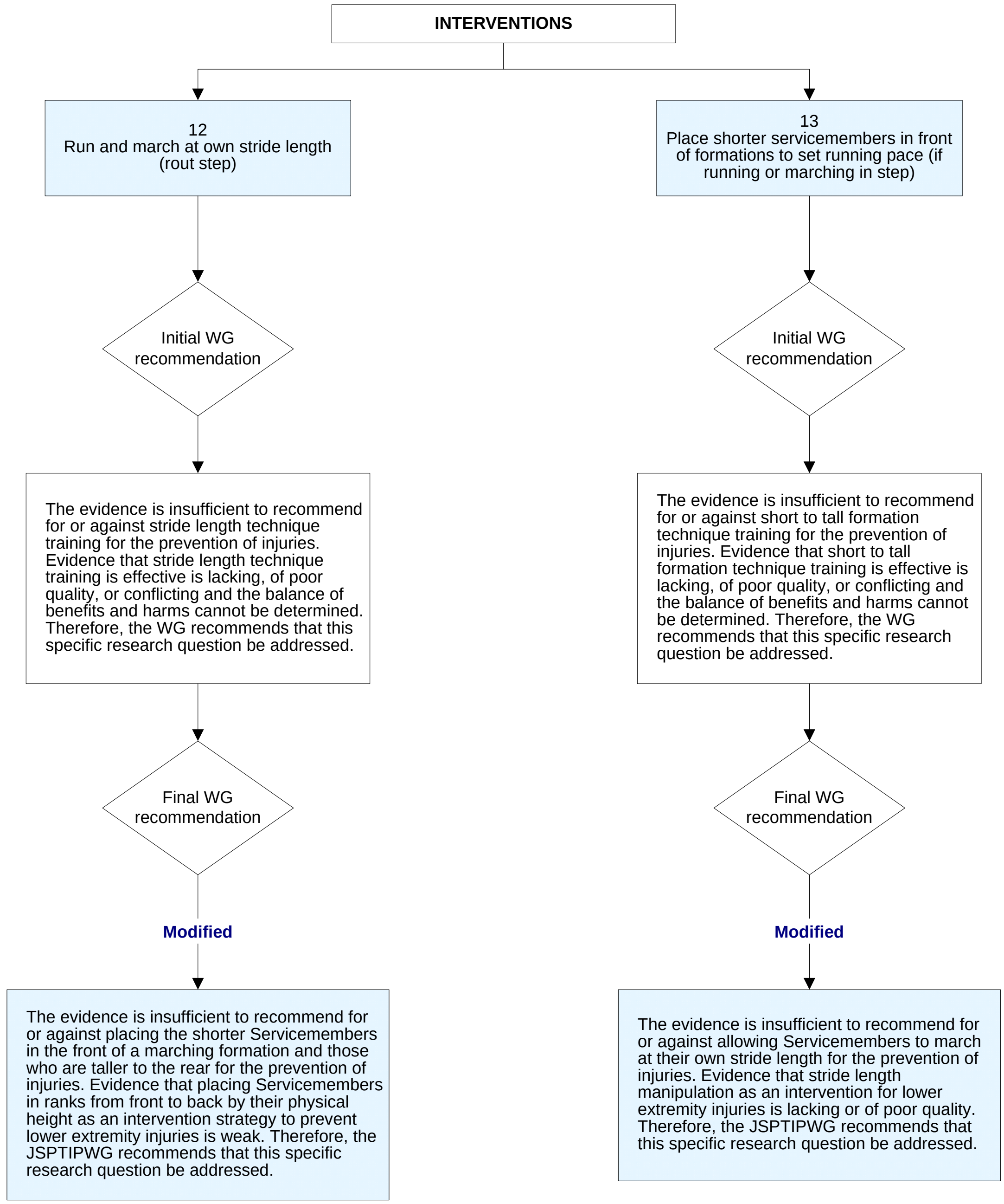
5. McNeill AR. Energetics and optimization of human walking and running: the 2000 Raymond Pearl memorial lecture. Am J Hum Biol 2002;14:641-8.

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

7. 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.

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

Figure 6-1. Review Process: Interventions 12 and 13



Chapter 7

Progression/Overload with Increased Fitness
(Interventions 14-18)

The following interventions are covered in this chapter:

- Intervention 14 - Standardized and Graduated/Progressive Exercise (Including Running) Program
- Intervention 15 - Standardized Graduated Hiking Program
- Intervention 16 - Introduction of Flak Vests in BCT: Increases in Load-Bearing Equipment
- Intervention 17 - Pre-accession Fitness Program
- Intervention 18 - Does Mass or Individual Training in Like Units Affect Injury Rates?

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 7-1 at the end of this chapter.

Standardized and Graduated/Progressive Exercise (Including Running) Program (intervention 14)

I. Introduction and Discussion

A standardized and carefully graduated exercise program limits stressors to the musculoskeletal system until the body can respond with increasing strength to withstand greater stressors. Since this is reducing the risk of overtraining, this intervention is considered and included within the Overtraining recommendation.

Standardized Graduated Hiking Program
(Intervention 15)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the strength of evidence for a standardized graduated 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 summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Jim Larsen:

- Search terms: walking and fitness, military load carriage (no useful results with "hiking" or "marching")
- Total number of hits resulting from the search: 788
- Total number of studies that meet the inclusion criteria: 32

Discussion

When searching for the term "hiking" in the literature, one finds references to recreational cross-country 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 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.

II. Recommendation: Intervention 15

The evidence is insufficient to recommend for or against a standardized graduated hiking program for the prevention of injuries. Evidence that a standardized graduated hiking program is effective is lacking. Therefore, the JSPTIPWG recommends that this specific research question be addressed if the mission so dictates.

III. Classification Matrix: Intervention 15

The Classification Matrix of Literature Search Results is shown in Table 7-1.

Table 7-1. Classification Matrix of Literature Search Results: Intervention 15

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**	
No. of Refs Found	32*											32
Literature Reviews	**Author/ Year†**	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
	Knapik											
	Law			6								

*Contributor lists certain number but no specific references are identified.
†See references that follow for full citation.

IV. References: Intervention 15

1. Abe D, Yanagawa K, Niihata S. Effects of load carriage, load position, and walking speed on energy cost of walking. Appl Ergon 2004 Jul;35(4):329-35.

2. Asikainen TM, Miilunpalo S, Oja P, Rinne M, Pasanen M, Uusi-Rasi K, Vuori I. Randomised, controlled walking trials in postmenopausal women: the minimum dose to improve aerobic fitness? Br J Sports Med 2002 Jun;36(3):189-94.

3. Bar-Khama Amos, Shoenfeld Yehuda, Shuman Eric. The Israeli fitness strategy: a complete diet and exercise program based on the training system of the Israeli Defense Forces, 1980.

4. Bastien GJ, Willems PA, Schepens B, Heglund NC. Effect of load and speed on the energetic cost of human walking. Eur J Appl Physiol 2005 May;94(1-2):76-83.

5. Bunc V, Dlouha R, Kohoutek M. Use of walking in the evaluation of aerobic fitness. Cas Lek Cesk 1992 Sep 10;131(17):530-3.

6. Cooper KH. A means of assessing maximal oxygen intake. Correlation between field and treadmill testing. JAMA 1968 Jan 15;203(3):201-4.

7. De Wild GM, Peeters MP, Hoefnagels WH, Oeseburg B, Binkhorst RA. Relative exercise intensity of long-distance marching (120 km in 4 days) in 153 subjects aged 69-87 years. Eur J Appl Physiol Occup Physiol 1997;76(6):510-6.

8. Gefen A. Biomechanical analysis of fatigue-related foot injury mechanisms in athletes and recruits during intensive marching. Med Biol Eng Comput 2002 May;40(3):302-10.

9. Johnson RF, Knapik JJ, Merullo DJ. Symptoms during load carrying: effects of mass and load distribution during a 20-km road march. Percept Mot Skills 1995 Aug;81(1):331-8.

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21. Paillard T, Lafont C, Costes-Salon MC, Riviere D, Dupui P. Effects of brisk walking on static and dynamic balance, locomotion, body composition, and aerobic capacity in ageing healthy active men. Int J Sports Med 2004 Oct;25(7):539-46.

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Introduction of Flak Vests in BCT: Increases in Load-Bearing Equipment (Intervention 16)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the strength of evidence for introducing flak vests or other load bearing equipment as a training aid in basic combat training to prevent future injuries. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Kelly W. Williams:

- Search terms: body armor, bulletproof vests, protective equipment, flak vests, stress fractures, injuries
- Total number of hits resulting from the search: 978
- Total number of studies that meet the inclusion criteria: 14

Discussion

The introduction of increased load carriage through the use of military flak vests/body armor or back packs have been suggested as a method of physical training by increasing physiologic loads. The theory is to create both an anaerobic and aerobic stimulus that would prevent injuries while simultaneously provide realistic training for the combat warrior who will expect to be subjected to such loads in deployed environments. There is a dearth in the literature on this topic, especially as it relates to the prevention of injuries in trainees in basic military training.

II. Recommendation: Intervention 16

The evidence is insufficient to recommend for or against introduction of flak vests in BCT/ increases in load-bearing equipment for the prevention of injuries. Evidence that introduction of flak vests in BCT/increases in load-bearing equipment is effective is lacking. Therefore, the JSPTIPWG recommends that this specific research question be addressed.

III. Classification Matrix: Intervention 16

The Classification Matrix of Literature Search Results is shown in Table 7-2.

Table 7-2. Classification Matrix of Literature Search Results: Intervention 16

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**	
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†		+	6	Burton et al/96	+	2.67			Cline, Coast, & Arnall/1999		
	Rudzki†		+	6						Muza, Banderet, & Forte/1996		
	Rudzki†		+	6						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		

*See references that follow for full citation.
†Contributor did not include citation in references.

IV. References: Intervention 16

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Pre-accession Fitness Program
(Intervention 17)

I. Introduction and Discussion

Introduction

This intervention was assigned to a work group member but it was not completed. However, during a literature review of another intervention (screening) the editors could not ignore the strength of evidence for this intervention. Therefore, references are provided but no quality analysis has been performed and a literature review was not performed.

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

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 upon basic training. One key study demonstrated that fitness assessment program (FAP) participation (where Army basic training candidates physically trained until they passed a basic fitness test before entering basic training) 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 failed a basic initial physical fitness test, 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-accession fitness conditioning. Attrition and injury rates were significantly higher for low-fit trainees who were not involved in a pre-conditioning 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-accession 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.

II. Recommendation: Intervention 17

The JSPTIPWG recommends a preconditioning program 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. The WG found at least fair evidence that pre-accession fitness programs reduce injuries and attrition for low-fit recruits and have the added benefit of improved physical fitness scores at the end of the basic training cycle.

III. Classification Matrix: Intervention 17

The Classification Matrix of Literature Search Results not completed.

IV. References: Intervention 17

These references are from Intervention 49: Predicting Injury Risk Through Use of an Injury Risk Index (Screening).

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4. 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.

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11. Uhorchak JM, Scoville CR, Williams G, Arciero RA, St Pierre P, Taylor DC. Risk factors associated with non-contact ACL injury: a prospective 4-year evaluation of 859 West Point cadets. Am J Sports Med 2003;31(6):831-842.

Mass vs. Individual Training
(Intervention 18)

I. Introduction and Discussion

Introduction
This intervention was assigned and reviewed, however contributor did not provide quality analysis nor classify studies on matrix.

The purpose of this review was to assess the strength of evidence for individual physical training versus mass physical training to avoid injury. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Valerie J. Rice, PhD, CPE, OTR/L:

- Search terms: group, mass, individual, exercise, physical training
- Total number of hits resulting from the search: 361
- Total number of studies that meet the inclusion criteria: 7

Discussion
It is theorized that those who are required to do physical training as a group have higher injury rates than those who do physical training individually. The reasoning behind this theory is that with individual training, the training is specific to the needs of the individual and one avoids the inflexibility of en mass training. This intervention was not reviewed. However, despite the outcome, it is highly unlikely that individualized training would be implemented in a basic training environment for multiple reasons; chief among them are motivation, military discipline, and a development of unit esprit de corps that en mass physical training provides.

II. Recommendation: Intervention 18

The JSPTIPWG recommends a literature review and quality analysis be conducted on mass or individual training in like units to affect injury rates.

III. Classification Matrix: Intervention 18

The Classification Matrix of Literature Search Results not completed. References provided without analysis.

IV. References: Intervention 18

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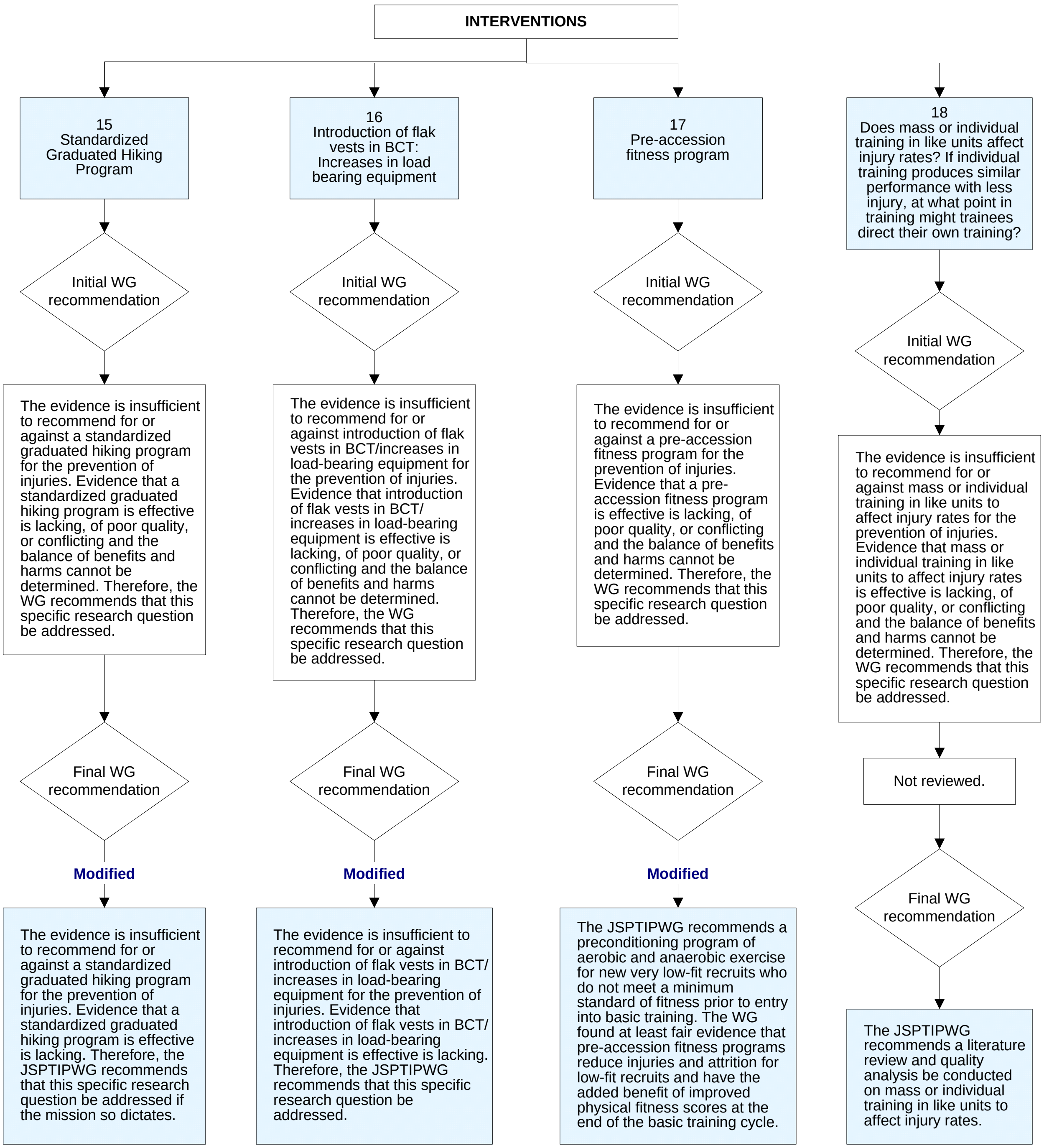
Figure 7-1. Review Process: Interventions 15, 16, 17, and 18



Chapter 8

Progression/Overload – Remedial Exercise
(Interventions 19-20)

The following interventions are covered in this chapter:

- Intervention 19 - Discontinue or Modify Use of PT as Corrective Tool
- Intervention 20 - Eliminate Extra PT Sessions for the Least Fit Individuals

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 8-1 at the end of this chapter.

Discontinue or Modify Use of PT as Corrective Tool
Eliminate Extra PT Sessions for the Least Fit Individuals
(Interventions 19 and 20)

I. Introduction and Discussion

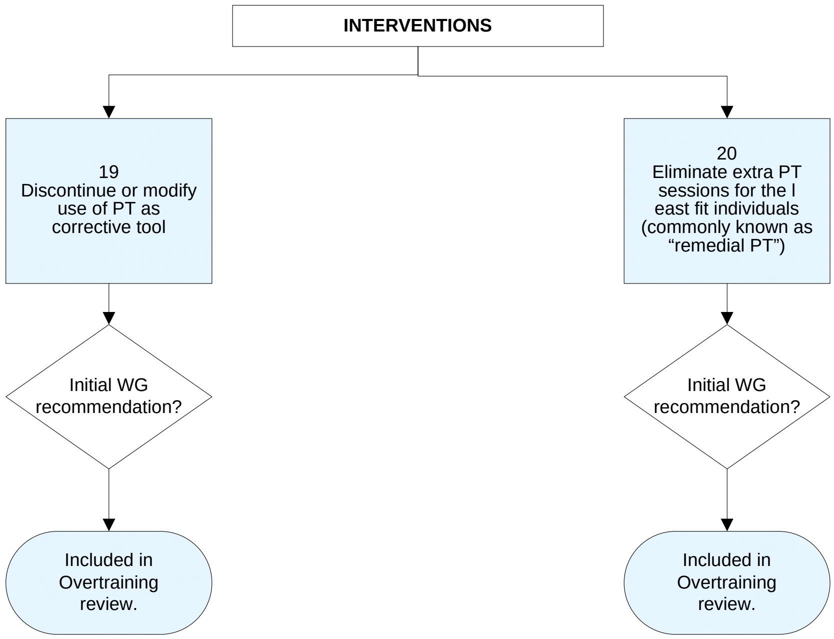
Introduction

The common practice of utilizing physical training 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. Punitive PT is counterproductive from the physical performance and injury perspective. Other methods to discipline new recruits should be sought after or the amount and type of physical demands placed on a new recruit should be limited, standardized, and finite.

Extra PT sessions (also know as remedial PT) increase the volume of exercise being demanded of the least fit individuals. Since low fitness is a significant risk factor for injury, placing these kinds of demands on the lease fit is counterproductive.

Each of these training errors contributes to the overtraining of specific individuals and, therefore, each is included within the Overtraining recommendations.

Figure 8-1. Review Process: Interventions 19 and 20



Chapter 9

Recovery, Avoidance, and Exercise Program Management
(Interventions 21-23)

The following interventions are covered in this chapter:

- Intervention 21 - Determine the Ideal and Absolute Minimum Recovery Period Between Maximal Effort Fitness Tests
- Intervention 22 - Avoidance of “Harmful” Exercises
- Intervention 23 - Would Injury Rates and Performance be Affected if Body Weight was Assessed at a Time Other than a Maximal Effort Physical Fitness Test?

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group’s review of these interventions is shown in Figure 9-1 at the end of this chapter.

Determine the Ideal and Absolute Minimum Recovery Period Between Maximal Effort Fitness Tests (Intervention 21)

I. Introduction and Discussion

Introduction

While the direct injury evidence for establishing a precise minimum period of recovery time between maximal effort physical fitness tests is lacking, physiologic principles of recovery of the musculoskeletal system are sound.

Originally the question is posed if there is an ideal recovery period between two maximal effort fitness tests. The larger issue is one of how much recovery must there be. In performing this review, contributors discovered that there are no studies that answer the question directly. However, when looking at the larger issue of recovery for optimizing performance while minimizing injury, one would be thinking in terms of Periodization training - the on again off again type of training. The literature discusses this as a sound way to prevent overtraining. Therefore, this principle of recovery is included the Overtraining recommendation.

Avoidance of “Harmful” Exercises
(Intervention 22)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the strength of evidence for avoiding so-called harmful exercises to avoid injury. Different texts describe certain exercises as “harmful” but do not support the statement with evidence. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by LTC Steven Bullock:

- Search terms: elimination of harmful exercise, avoidance of harmful exercise, harmful exercises in military, harmful exercises, harmful exercise & 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
- Total number of hits resulting from the search: 80
- Total number of studies that meet the inclusion criteria: 1

Discussion

There are some anecdotal reports of a few callisthenic exercises common in gymnasiums and as part of physical training programs among the Services that are suspected of either causing injury or aggravating existing injuries (such as those mentioned in the search terms above). 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 Army. A standard investigation revealed that the push-up, sit-up and run events of the Army Physical Fitness Test (APFT) do not pose a considerable acute injury risk to active duty Soldiers. Soldiers who reported previous APFT related injuries, however, were at greater risk for reporting injury during this test. 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.

II. Recommendation: Intervention 22

The evidence is insufficient to recommend for or against eliminating or avoiding any specific exercise or movement for the prevention of injuries. Evidence that eliminating or avoiding any specific exercise or movement is lacking. Therefore, the JSPTIPWG recommends that research on specific exercises or movements called into question be addressed individually.

III. Classification Matrix: Intervention 22

The Classification Matrix of Literature Search Results is shown in Table 9-2.

Table 9-2. Classification Matrix of Literature Search Results: Intervention 22

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**			
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 references that follow for full citation.

IV. References: Intervention 22

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.

Assess Body Weight and Physical Fitness on Different Days (Intervention 23)

I. Introduction and Discussion

Introduction

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

The literature review was provided by LtCol Vincent P. Fonseca, MD, MPH.

- Search terms: risk factors body composition athletic injuries/etiology physical fitness, body composition and injury and fitness
- Total number of hits resulting from the search: 114
- Total number of studies that meet the inclusion criteria: 0

Discussion

This intervention yielded no results. This question is posed because of the convenient practice of assessing body height and weight standards at the same time as administration of the physical fitness test. Typically body height and weight is assessed prior to the physical fitness test which requires maximal effort on the part of the Servicemember. Although there are no studies that demonstrate this, some suspect that there are a number of Servicemembers who are borderline overweight by Service standards and starve themselves from food and liquids for some time prior to being assessed for body weight in order to ensure that they are able to meet the standard. The Servicemember then attempts a maximal effort physical fitness test in a state of undernourishment and dehydration. A fast and convenient method of determining the prevalence of such a practice could be performed through the use of an anonymous survey.

II. Recommendation: Intervention 23

The evidence is insufficient to recommend for or against separating weigh-ins from performance tests for the prevention of injuries. Evidence that separating weigh-ins from performance tests is effective is lacking. Therefore, the JSPTIPWG recommends that this specific research question be addressed.

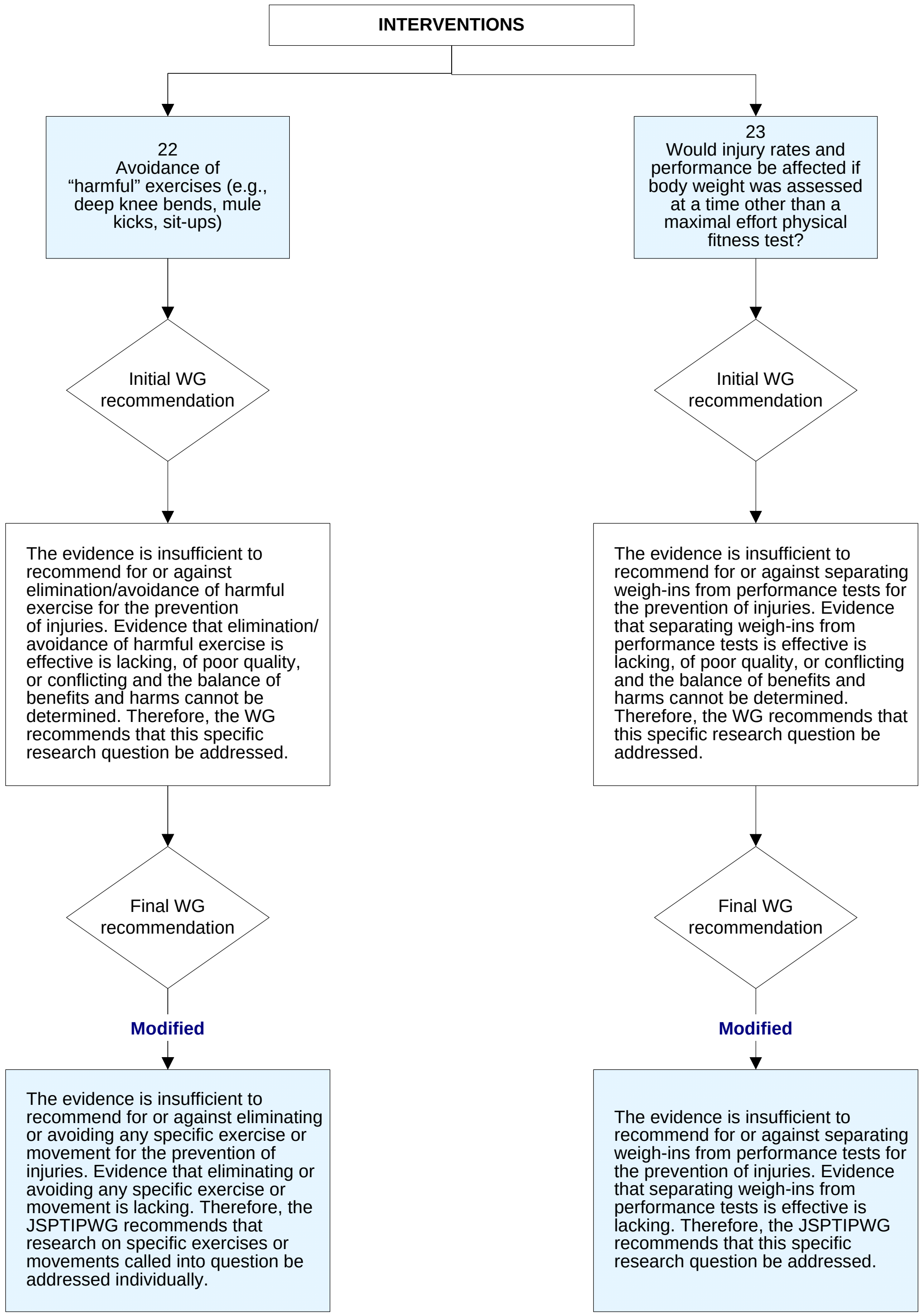
III. Classification Matrix: Intervention 23

No Classification Matrix of Literature Search Results is shown due to lack of research.

IV. References: Intervention 23

There are no references.

Figure 9-1. Review Process: Interventions 22 and 23



Chapter 10

Footwear
(Interventions 24-27)

The following interventions are covered in this chapter:

- Intervention 24 - Replace Running Shoes Every 400-600 Miles
- Intervention 25 - Shock-absorbing Insoles
- Intervention 26 - Socks and Antiperspirants to Prevent Blisters
- Intervention 27 - Individual Prescription of Running Shoe Based on Foot Type

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 10-1 at the end of this chapter.

Replacement of Running Shoes
(Intervention 24)

I. Introduction and Discussion

Introduction
The purpose of this review was to identify the strength of evidence for the practice of replacing running shoes and the exact interval at which this should be performed by Servicemembers to prevent lower extremity injuries. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Kelly W. Williams, PhD:

- Search terms: running shoes, age of shoe, running injuries, prescription, replacing shoes, shoe replacement
- Total number of hits resulting from the search: 2,203
- Total number of studies that meet the inclusion criteria: 8

Discussion
Shoes worn during physical training 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.

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 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.

II. Recommendation: Intervention 24

Shoe manufacturers and biomechanical studies on running shoes report that shoes should last between 400 and 600 miles and should therefore be replaced by that period of time. The WG concludes that the scientific evidence is insufficient to recommend for or against replacing running shoes for the prevention of injuries at that interval. Evidence that replacing running shoes at specific intervals is effective is lacking and the balance of benefits has not been determined. Therefore, the WG recommends that this specific research question be addressed.

III. Classification Matrix: Intervention 24

The Classification Matrix of Literature Search Results is shown in Table 10-1.

Table 10-1. Classification Matrix of Literature Search Results: Intervention 24

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**	
No. of Refs Found	0				1			0	1	5	1	8
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	Dziados et al/1988	
										Cook et al./1985		
										Cook, Kester, & Brunet/1985		
										Miles et al/2003		
										Clowers et al/2004		

*See references that follow for full citation.

IV. References: Intervention 24

1. 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.

2. 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 20004;36(5):Supplement, S267.

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

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

5. 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.

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7. 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.

8. 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.

Shock-absorbing Insoles
(Intervention 25)

I. Introduction and Discussion

Introduction
The purpose of this review was to identify the strength of evidence for the use of shock absorbing insoles added to the standard running shoe to reduce the risk of injury to the lower extremities. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by James E. Reading:

- Search terms: shock absorbing insoles
- Total number of hits resulting from the search: 75
- Total number of studies that meet the inclusion criteria: 16

Discussion
Studies of shock-absorbing insoles in the boots of young recruits report mixed results for reducing lower limb injuries overall but 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. Clearly, this is a potentially powerful intervention needing well-designed research to determine effectiveness of shock-absorbing insoles for both an exercise shoe and military boot applications.

II. Recommendation: Intervention 25

The JSPTIPWG makes no recommendation for or against shock-absorbing insoles for the prevention of injuries. The WG found at least fair evidence that shock-absorbing insoles can reduce injuries but concludes that the balance of benefits is too close to justify a general recommendation for all Servicemembers. Insoles may be appropriate for individual Servicemembers or high risk populations only. Therefore, the WG recommends further research on shock absorbing insoles, particularly for use in military boots as cushioning technology of running shoes is adequate.

III. Classification Matrix: Intervention 25

The Classification Matrix of Literature Search Results is shown in Table 10-2.

Table 10-2. Classification Matrix of Literature Search Results: Intervention 25

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**	
No. of Refs Found	10									5	1	16
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		
	Pfeffer	M	+	8						Johnson 1988		
	Williams		X	7						Nigg 1998		
	Sherman		X	5						House 2004		
	Fauno		+	8								
	Schwellnus		+	8								
	Gardner	M	X	7								
	Milgrom		+	8								
	Smith		+	5								

*See references that follow for full citation.

IV. References: Intervention 25

1. 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.

2. Fauno P, Kalund S, Andreasen I, Jorgensen U. Soreness in lower extremities and back is reduced by use of shock absorbing heel inserts. Int J Sports Med. 1993 Jul;14(5):288-90.

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13. 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.

14. Smith W, Walter J, Baily M. Effects of insoles in Coast Guard basic training footwear. J Am Podiatr Med Assoc 1985 Dec;75(12):644-7.

15. Williams KM, Almeida SA, Hagy J, Leone D, Luz JT, Shaffer RA. Naval Health Research Center, San Diego, CA. Performance of a shock-absorbing insole in the laboratory is not associated with a reduction of lower extremity musculoskeletal injuries Med Sci Sports and Exec. 1998; 30(5(supplement)):S269

16. 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.

Special Socks and Antiperspirants to Prevent Blister Injuries (Intervention 26)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the strength of evidence for the use of special socks and antiperspirants to prevent blister injuries on 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 potentially can cause infection and limitations in duty. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Joseph J. Knapik, ScD:

- Search terms: blister, blisters, blisters and risk factors
- Total number of hits resulting from the search: 91
- Total number of studies that meet the inclusion criteria: 17

Discussion

- **Moisture-wicking socks.** Blisters appear to be caused by friction between the skin and sock; that friction is exacerbated by moisture produced when 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 pull away moisture from the skin) worn 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 blended sock designed to assist with the wicking action while reducing friction. Thus, both experimental sock systems were successful in reducing blisters. The commercial name for the liner sock is Coolmax® (Coolmax is a registered trademark of E.I. DuPont de Nemours, Inc., Wilmington, DE) but any sock composed of polyester will probably be effective.

- **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-km foot march. Cadets performed the march on a hot day and their feet were examined for blisters before and after. 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 vs. 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.

II. Recommendation: Intervention 26

The JSPTIPWG recommends the use of moisture-wicking socks (e.g., polyester blended) to prevent blister injuries to the feet during physical training and extended foot marching. The WG found at least fair evidence that special moisture-wicking socks or antiperspirants can prevent blister injuries to the feet, especially for long distance use. The WG concludes that the benefits and harms of antiperspirant use on the foot too close to justify a general recommendation for all Services.

III. Classification Matrix: Intervention 26

The Classification Matrix of Literature Search Results is shown in Table 10-3.

Table 10-3. Classification Matrix of Literature Search Results: Intervention 26

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**	
No. of Refs Found	7				4			3*	0	0	3*	17
	Author/ Year†	**M**	**+/- /x**	**Score**	**Author/ Year‡**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
Literature Reviews	Knapik		+	7	Bush	+	5					
	Herring		+	7	Patterson	+	7					
	Herring		-	7	Knapik	+	7					
	Jagoda	M	+	8	Hoeffler	+	2					
	Knapik		+	8	Reynolds	+	8					
	Reynolds		-	7								
	Darregrand		-	7								

*Contributor lists certain number but no specific references are identified.
†Full citations for these intervention studies are not included in the references.
‡See references that follow for full citation.

IV. References: Intervention 26

1. Bush RA, Brodine SK, Shaffer RA. The association of blisters with musculoskeletal injuries in male Marine recruits. J Am Podiat Med Assoc 2000;90:194-198.

2. Hoeffler DF. Friction blisters and cellulitis in a Navy recruit population. Mil Med 1975;140: 333-337.

3. Knapik JJ, Reynolds K, Barson J. Risk factors for foot blisters during road marching: tobacco use, ethnicity, foot type, previous illness and other factors. Mil Med 1999;164:92.

4. Patterson HS, Woolley TW, Lednar WM. Foot blister risk factors in an ROTC summer camp population. Mil Med 1994;159:130-135.

5. Reynolds K, Williams J, Miller C, et al. Injuries and risk factors in an 18-day Marine winter mountain training exercise. Mil Med 2000;165:905-910.

Individual Running Shoe Prescription
(Intervention 27)

I. Introduction and Discussion

Introduction

This intervention is also related to the replacement of running shoes, therefore the search the resulted in the reference list for intervention 24 is the same for running shoe prescription.

The purpose of this review was to identify the strength of evidence for prescribing running shoes based upon foot type (determined by the shape the foot makes when contacting the ground as a surrogate for arch height and foot flexibility). Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Kelly W. Williams, PhD:

- Search terms: running shoes, age of shoe, running injuries, prescription, replacing shoes, shoe replacement
- Total number of hits resulting from the search: 2,203
- Total number of studies that meet the inclusion criteria: 8

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 a select group of their running shoes in three general categories: stability, cushioned, or motion control. 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 subjective imprint of the foot (wet test). However, this one study suffered from a number of confounding variables, making it imperative that this intervention be tested in a randomized prospective prevention trial before conclusions are drawn regarding the effectiveness of customized shoe prescription.

II. Recommendation: Intervention 27

The common practice of fitting the foot with a running shoe that is consistent with foot shape (generally based on the assumption that foot shape is a surrogate for foot arch height and foot/ankle flexibility) to prevent foot and lower extremity injury has not been definitively confirmed. The evidence that prescription running shoes are effective is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined. Therefore, the JSPTIPWG recommends that this specific research question be addressed.

III. Classification Matrix: Intervention 27

The Classification Matrix of Literature Search Results is shown in Table 10-4.

Table 10-4. Classification Matrix of Literature Search Results: Intervention 27

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**	
No. of Refs Found	0				1			0	1	5	1	8
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	Dziados et al/1988	
										Cook et al./1985		
										Cook, Kester, & Brunet/1985		
										Miles et al/2003		
										Clowers et al/2004		

*See references that follow for full citation.

IV. References: Intervention 27

1. 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.

2. 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.

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

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

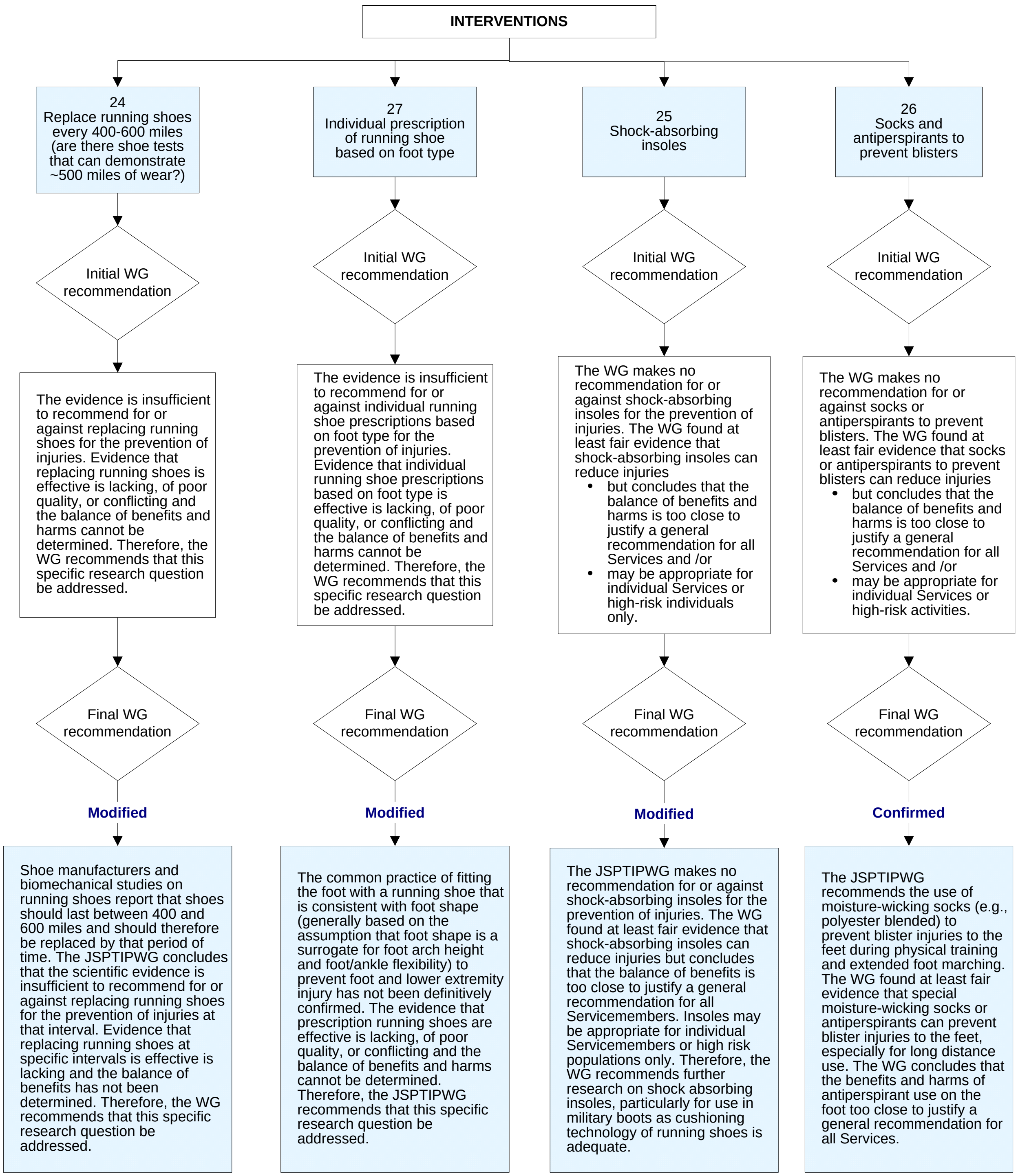
5. Gardner LI Jr, Dziados JE, Jones BH, Brundage JF, Harris JM, Sullivan R, Gill P. Prevention of lower extremity stress fractures: a controlled trial of a shock absorbent insole. Amer J of Pub Hlth 1988;78(12):1563-1567.

6. Miles KA, Smith J, Riemer E, Schaefer MP, Dahm DL, Kaufman K. Wear characteristics of common running shoes. Med & Sci in Sports & Exerc 2003;35(5):Supplement 1, S237.

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

8. 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. Brit J Sports Med 2003;37:239-244.

Figure 10-1. Review Process: Interventions 24, 25, 26, and 27



Chapter 11

External Support to the Joints
(Interventions 28-29)

The following interventions are covered in this chapter:

- Intervention 28 - Joint Bracing
- Intervention 29 - Ankle Taping

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 11-1 at the end of this chapter.

Joint Bracing
(Intervention 28)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the strength of evidence for the use of ankle braces to prevent inversion or eversion ankle sprains, knee braces to prevent knee sprains, back braces to prevent low back sprains, and elbow straps to prevent medial or lateral epicondylitis (elbow ligament strains). Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by LtCol Bruce R.Burnham, DVM, MPH; Joseph J. Knapik, ScD; Donald E. Goddard; and LTC Steven Bullock:

- Search terms: ankle injury, risk factor, cause//knee injury, risk factor, cause; ankle injury risk factor//knee injury risk factor; sprain, ankle sprain; ankle, sprain, ankle sprain
- Total number of hits resulting from the search: 952
- Total number of studies that meet the inclusion criteria: 31

Discussion

- **Ankle braces**. 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 airborne operations 30 to 60 percent of injuries involve the ankle. Well-controlled research has demonstrated that during U.S. Army 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%. 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 Soldiers with a history of previous ankle sprains.

- **Knee braces**. 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 Servicemembers, 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.

- **Back braces, harnesses, and support belts**. Back belts have been aggressively promoted as a preventive measure for back injuries by increasing the intra-abdominal pressure (IAP) which is thought to decrease compressive forces on the lumbar spine during lifting. However, the relationship between IAP and spine compressive forces has been challenged biomechanically. The abdominal activation to increase IAP would produce a flexion moment which has to be offset by extensor activity, actually creating spine compression. In addition, increasing IAP can cause a significant increase in blood pressure with potentially serious cardiovascular effects, especially in workers with latent coronary heart disease. Back belts were not shown to reduce spinal muscle activity and did not significantly reduce the rate of back injuries or lost workdays. Furthermore, the costs associated with injuries occurring with the belt were significantly higher than the costs associated with injuries without belts. Workers report perceptions of improved trunk stability with the belt; however, this often leads to worker overconfidence with the worker lifting more weight or faster than capacity. In fact, one study demonstrated a higher rate of injury for workers with belts than without belts. Studies have shown significantly increased risk and severity of injuries and lost workdays occurred when workers discontinued use of the back belt. This may be associated with muscle atrophy and weakening of associated spinal structures due to dependence on the belt support, overconfidence, or changes in lifting techniques.

  The Department of Defense does not recognize back support belts as personal protective equipment, or the use of these devices in the prevention of back injuries (see DoDI 6055.1, DoD Safety and Occupational Health Program, para E6.1.3).

- **Elbow braces**. The use of a forearm 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 cursory 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).

II. Recommendation: Intervention 28

The JSPTIPWG strongly recommends that semi-rigid ankle braces be utilized during participation in high risk physical activity. The WG found good evidence that semi-rigid ankle braces reduce re-injuries for individuals with previous moderate or severe ankle sprains and good evidence that semi-rigid ankle braces reduce ankle injuries when participating in high-risk physical activity such as airborne operations (parachuting), obstacle courses, basketball, volleyball, soccer, etc.

The JSPTIPWG concludes that the evidence is insufficient to recommend for or against the prophylactic use of knee or elbow braces for the prevention of injuries. Evidence that knee or elbow bracing is effective is lacking or of poor quality and the balance of benefits and harms cannot be determined. Therefore, the WG recommends further research on this topic.

The JSPTIPWG recommends against the use of back braces, harnesses, and support belts for the prevention of low back injuries. The WG found at least moderate to strong evidence that back belts/supports are ineffective or that the harms outweigh the benefits. Furthermore, DoD has issued policy against their use for injury prevention.

III. Classification Matrix: Intervention 28

The Classification Matrix of Literature Search Results is shown in Table 11-1.

Table 11-1. Classification Matrix of Literature Search Results: Intervention 28

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**	
No. of Refs Found	12				10			3		0	6	31
Literature Reviews	**Author/ Year***	**M**	**+/- /x**	**Score**	**Author/ Year††**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year†**	
	Sitler		+	8	Milgrom	+	5	Verhagen/2004			Beynnon/2002	
	Surve		+	7	Baumhauer	+	4	Leanderson/1993			Knapik/2003	
	Rovere		+	6	Hosea	+	3	James/1995			Thacker/1999	
	Sharpe		+	6	McGuine	+	5				Albright/1995	
	Garick		+	6	Beynnon	+	5				Nigg/1988	
	Barrett		+	7	Willems	+	7				Arendt/1995	
	Milford		+	5	Mei-Dan	+	5					
	Boyer		+	8	Giza/2003							
	Mann		+	6	Jensen/1998							
	Amoroso		+	7	Baker/2003							
	Schumader		+	6								
	Schmidt		+	6								

*Full citations for these intervention studies are not included in the references.
†See references that follow for full citation.

IV. References: Intervention 28

1. Albright JP, Saterbak A, Stokes. Use of knee braces in sport. Current recommendations. J Sports Med 1995 Nov;20(5):281-301.

2. Arendt E, Dick R. Knee injury patterns among men and women in collegiate basketball and soccer. NCAA data and review of literature. Am J Sports Med 1995 Nov-Dec;23(6):694-701.

3. Baker P, Reading I, Cooper C, Coggon D. Knee disorders in the general population and their relation to occupation. Occupational and Environmental Medicine 2003;60:794-797.

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11. Knapik JJ, Craig SC, Hauret KG, Jones BH. Risk factors for injuries during military parachuting. Aviat Space Environ Med 2003 Jul;74(7):768-74.

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13. McGuine TA, Greene JJ, Best T, Leverson G. Balance as a predictor of ankle injuries in high school basketball players. Clin J Sports Med 2000;10:239-244.

14. Mei-Dan O, Kahn G, Zeev A, Rubin A, Constantini N, Even A, Nyska M, Mann G. The medial longitudinal arch as a possible risk factor for ankle sprains: a prospective study in 83 female infantry recruits. Foot Ankle Int 2005;26:180-183.

15. Milgrom C, Shlamkovitch N, Finestone A, et al. Risk factors for lateral ankle sprains: a prospective study among military recruits. Foot Ankle 1991;12:26-30.

16. Nigg BM, Segesser B. The influence of playing surfaces on the load on the locomotor system and on football and tennis injuries. Sports Med 1988 Jun;5(6):375-85.

17. Thacker SB, Stroup DF, Branche CM, Gilchrist J, Goodman RA, Weitman EA. The prevention of ankle sprains in sports. A systematic review of the literature. Am J Sports Med 1999 Nov-Dec;27(6):753-60

18. Verhagen EA, Van der Beek AJ, Bouter LM, Bahr RM, Van Mechelen W. A one season prospective cohort study of volleyball injuries. Br J Sports Med 2004 Aug; 38(4):477-81.

19. Willems TM, Witvrouw E, Delbaere, Mahieu N, DeBourdeaudhuij I, DeClercq D. Intrinsic risk factors for inversion ankle sprains inmale subjects: a prospective study. Am J Sports Med 2005;33:415-423.

Ankle Taping
(Intervention 29)

I. Introduction and Discussion

Introduction

This intervention is similar to the ankle bracing intervention in that it is a technique to support the ankle in a very similar fashion as bracing the ankle. The search and review conducted for ankle bracing (Intervention 28) is provided again here as it is the same risk factor as for taping.

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 summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Bruce R. Burnham and Joseph J. Knapik, ScD:

- Search terms: taping; ankle injury, risk factor, cause//knee injury, risk factor, cause; ankle injury risk factor//knee injury risk factor; sprain, ankle sprain; ankle, sprain, ankle sprain
- Total number of hits resulting from the search: 952
- Total number of studies that meet the inclusion criteria: 31

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, all studies of athletic taping have focused on the intermediate outcomes of injury such as performance, motion, swelling, proprioception, etc. A recent study (Mickel, 2006) 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 knowledgeable operator, making ankle taping a highly impractical intervention to be implemented in a basic training environment, or in any military unit for that matter.

II. Recommendation: Intervention 29

The evidence is insufficient to recommend for or against ankle taping for the prevention of ankle sprain injuries. Evidence that ankle taping is effective is lacking. However, since implementation of this particular intervention in the military may be impractical, the WG recommends that this specific research question be addressed and the feasibility of implementation with only specific target groups of the military be evaluated.

III. Classification Matrix: Intervention 29

The Classification Matrix of Literature Search Results is shown in Table 11-2.

Table 11-2. Classification Matrix of Literature Search Results: Intervention 29

References Found/ Literature Reviews	Categories of Study Types: 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	Total
No. of Refs Found	12				10			3		0	6	31
	Author/ Year*	**M**	**+/- /x**	**Score**	**Author/ Year††**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year†**	
Literature Reviews	Sitler		+	8	Milgrom	+	5	Verhagen/2004			Beynnon/2002	
	Surve		+	7	Baumhauer	+	4	Leanderson/1993			Knapik/2003	
	Rovere		+	6	Hosea	+	3	James/1995			Thacker/1999	
	Sharpe		+	6	McGuine	+	5				Albright/1995	
	Garick		+	6	Beynnon	+	5				Nigg/1988	
	Barrett		+	7	Willems	+	7				Arendt/1995	
	Milford		+	5	Mei-Dan	+	5					
	Boyer		+	8	Giza/2003							
	Mann		+	6	Jensen/1998							
	Amoroso		+	7	Baker/2003							
	Schumader		+	6								
	Schmidt		+	6								
Tape specific	Mickel/2006		x	5								

*Full citations for these intervention studies are not included in the references.
†See references that follow for full citation.

IV. References: Intervention 29

1. Albright JP, Saterbak A, Stokes. Use of knee braces in sport. Current recommendations. J Sports Med 1995 Nov;20(5):281-301.

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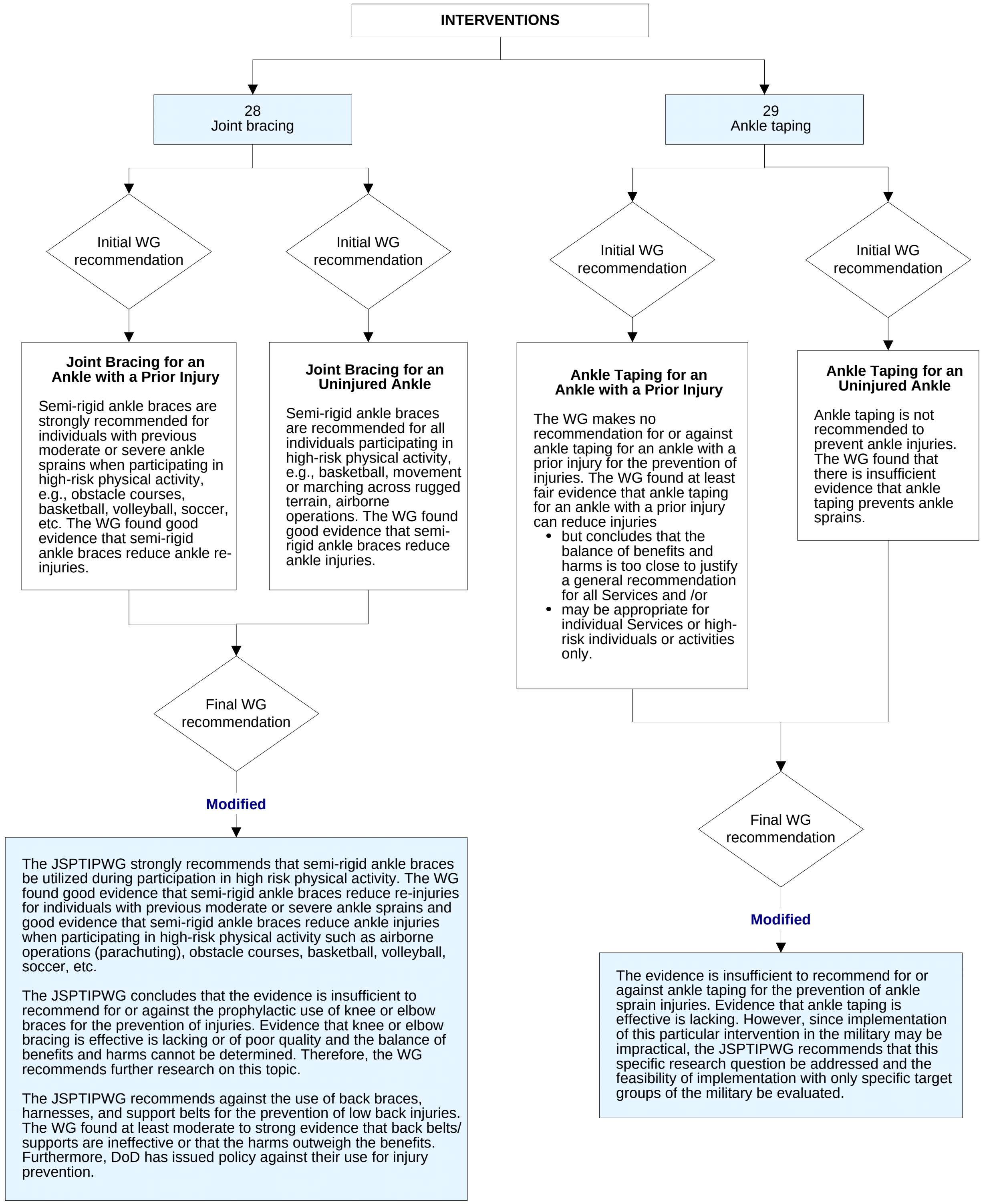
Figure 11-1. Review Process: Interventions 28 and 29



Chapter 12

Mouthguards
(Intervention 30)

The following interventions are covered in this chapter:

- Intervention 30 - Mouthguards

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 12-1 at the end of this chapter.

Mouthguards
(Intervention 30)

I. Introduction and Discussion

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 summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Joseph J. Knapik, ScD.

- Search terms: mouthguards; mouth protectors
- Total number of hits resulting from the search: 806
- Total number of studies that meet the inclusion criteria: 31

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 such 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, MO 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%. Mouthguards have also been recommended to reduce the incidence of concussions but prospective cohort investigations show little difference in concussion incidence between mouthguard users and nonusers.

II. Recommendations: Intervention 30

- **Mouthguards to Reduce Orofacial Injury.** The JSPTIPWG strongly recommends all Services provide mouthguards for all individuals participating in high-risk activities. The WG found good evidence that mouthguards reduce orofacial injuries when worn during activities with high orofacial injury risk (e.g., combatives, obstacle courses, rifle/bayonet training, etc., and contact sports such as basketball, football, etc.).

- **Mouthguards to Prevent Concussion.** The evidence is insufficient to recommend for or against mouthguards to prevent concussion injuries. Evidence that mouthguard use (for concussion injuries) is effective is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined. Therefore, the JSPTIPWG recommends that this specific research question be addressed.

III. Classification Matrix: Intervention 30

The Classification Matrix of Literature Search Results is shown in Table 12-1.

Table 12-1. Classification Matrix of Literature Search Results: Intervention 30

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**	
No. of Refs Found	19				0			14*	1*	1*	6*	31
Literature Reviews	**Author/ Year†**	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
	Maestrello-deMoya		+	3								
	deWet		+	3								
	Alexander		+	3								
	Morton		+	2								
	LaBella		+	6								
	Marshall		X	8								
	Blignaut		X	2								
	Cohen ('52)		+	2								
	Cohen ('61)		+	2								
	Cohen ('62)		+	2								
	Chapman		+	3								
	Chapman		+	3								
	McNutt		+	3								
	Heintz		+	1								
	Moon		+	3								
	BDHE		+	2								
	Davies		+	3								
	Caglar		X	3								
	Dunbar		+	2								

*Contributor lists certain number but no specific references are identified.
†See references that follow for full citation.

IV. References: Intervention 30

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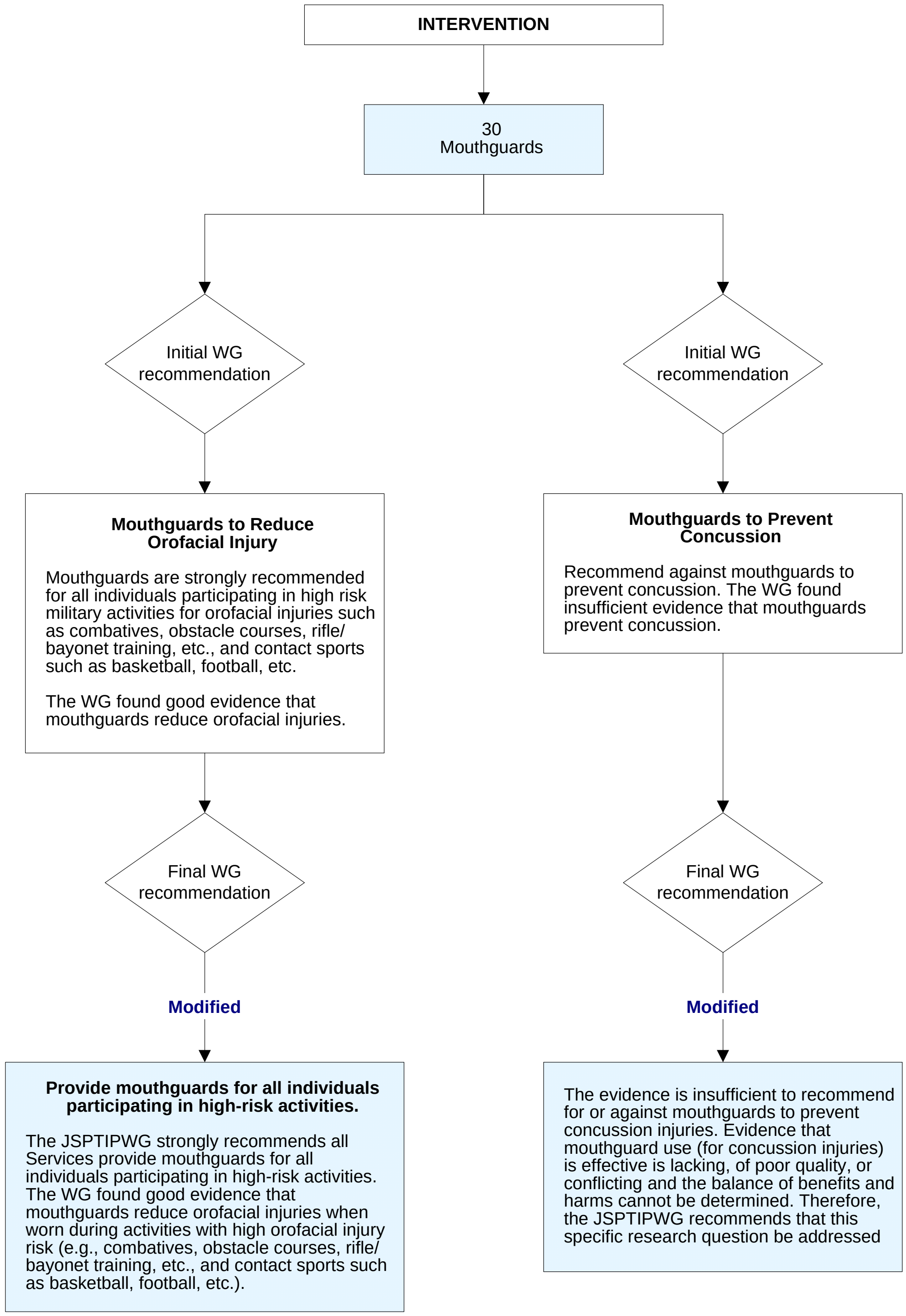
19. Morton JG, Burton JF. An evaluation of the effectiveness of mouthguards in high-school rugby players. N Z Dent J 1979;75:151-153.

Figure 12-1. Review Process: Intervention 30



Running Surfaces that Minimize Injury
(Intervention 31)

I. Introduction and Discussion

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 summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Joseph J. Knapik, ScD and Kelly W. Williams, PhD:

- Search terms: running surface and injury; running surface, surface, terrain and injury; running injuries, running surfaces, terrain; running injuries, running surfaces
- Total number of hits resulting from the search: 2,345
- Total number of studies that meet the inclusion criteria: 20

Discussion

Given that there is very strong evidence showing higher running mileage as an injury risk factor, one intervention suggested is to improve 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 on injury risk within the military or without.

II. Recommendation: Intervention 31

The JSPTIPWG concludes that the evidence is insufficient to recommend for or against any particular running surface for the prevention of injuries. 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. Therefore, the WG recommends that this specific research question be addressed.

III. Classification Matrix: Intervention 31

The Classification Matrix of Literature Search Results is shown in Table 13-1.

Table 13-1. Classification Matrix of Literature Search Results: Intervention 31

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**	
No. of Refs Found	1*				9					7	3	20
Literature Reviews	**Author/ Year**	**M**	**+/-/x**	**Score**	**Author/ Year†**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year†**	**Author/ Year†**	
	Pope	M		5	Ferretti	+ (cement or linoleum)	4			Tillman et al/1998	Thacker et al/2002	
					Wen	+ (concrete or asphalt	7			Dixon et al/2000	Bennell et al/1999	
					Macera	X/+ (concrete; women only)	8			Creagh, Reilly, & Lees/1998	Hreljac/ 2004	
					Marti	X	5			Feehery RV/1986		
					Brunet	X	3			Ferris, Liang, & Farley/1999		
					Shwayhat	+ soft surfaces)	9			Kerdok et al/2002		
					Jacobs	X	3			Milgrom et al/2003		
					Walters	X	8					
					Taunton	X	9					

*Full citation for this intervention study is not included in the references.
†See references that follow for full citation.

IV. References: Intervention 31

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9. Hreljac A. (2004). Impact and overuse injuries in runners. Med Sci Sports Exerc 36(5):845-849.

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Improved Obstacle Course Landing Areas
(Intervention 32)

I. Introduction and Discussion

Introduction

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

The literature review was provided by LtCol Brian McGuire, MS, ATC, CSCS:

- Search terms:
- Total number of hits resulting from the search:
- Total number of studies that meet the inclusion criteria: 6

Discussion

The safety of our troops while on obstacle courses is of paramount importance since often times they are being tasked to perform challenging movements and lifts, sometimes while fatigued and carrying equipment, and in inclement weather. Common landing areas 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 are 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 areas for efficacy. Risk factor studies, however, consistently rate shredded rubber as the top performer on impact-absorbing or shock attenuation from falls and are associated with the lowest rate of injury in children. One study demonstrated the risk for injury sustained on rubberized surfaces is one half that of wood chips. In another study there was very little difference between sand, wood fibers, and wood chips; while pea gravel ranked last in the list of shock absorbing materials for landing surfaces.

II. Recommendation: Intervention 32

The JSPTIPWG recommends shredded rubber material under obstacle courses for the protection of fall injuries. The WG found at least fair evidence that shredded rubber material attenuates shock the better than other materials and is associated with fewer civilian playground injuries in children. However, the evidence is insufficient to recommend for or against use of this material on military obstacle course landing areas for the prevention of injuries. Evidence that shredded rubber on military obstacle course landing areas is lacking. Therefore, the WG strongly recommends that this specific research question be addressed among Servicemembers.

III. Classification Matrix: Intervention 32

The Classification Matrix of Literature Search Results is shown in Table 13-2.

Table 13-2. Classification Matrix of Literature Search Results: Intervention 32

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**			
No. of Refs Found	0				0			2	0	4	0			6
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year**	**+/- /x**	**Score**	**Author/ Year***	**Author/ Year**	**Author/ Year***	**Author/ Year**			
								Laforest S 2001		Lewis LM. 1993				
								Mott A. 1997		Gunatiliaka AH 2004				
										Bertocci GE 2004				
										Mack MG 2000				

*See references that follow for full citation.

IV. References: Intervention 32

1. Bertocci GE, Pierce MC, Deemer E, Aguel F, Janosky JE, Vogely E. Influence of fall height and impact surface on biomechanics of feet-first free falls in children. Injury 2004 Apr;35(4):417-24.

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Adjustment of Training Load by Seasonal Variations (Intervention 33)

I. Introduction and Discussion

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) on injury risk. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by LTC Steven Bullock:

- Search terms: musculoskeletal injury AND seasonal variation, change; musculoskeletal injury AND seasonal variation, changes, injury rates
- Total number of hits resulting from the search: 11
- Total number of studies that meet the inclusion criteria: 5

Discussion

Seasonal variations in injury rates appear to occur with rugby players, other elite athletes, and Army basic training recruits. The overall injury rates 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, higher environmental temperatures during the Summer may be 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.

II. Recommendation: Intervention 33

The JSPTIPWG concludes that the evidence is insufficient to recommend seasonably adjusting training load to prevent injuries. Evidence that seasonably adjusting physical training load is effective is insufficient and the balance of benefits and harms cannot be determined. Therefore, the WG recommends that future investigation be conducted to clearly demonstrate an association between temperature and overall injury incidence and evaluate the benefits and harms to adjusting physical training according to environmental conditions.

III. Classification Matrix: Intervention 33

The Classification Matrix of Literature Search Results is shown in Table 13-3.

Table 13-3. Classification Matrix of Literature Search Results: Intervention 33

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**	
No. of Refs Found					2			3				5
Literature Reviews	**Author/ Year**	**M**	**+/- /x**	**Score**	**Author/ Year***	**+/- /x**	**Score**	**Author/ Year***	**Author/ Year**	**Author/ Year**	**Author/ Year**	
					Phillips, L /98	+	6	Koutedakis, Y /98				
					Knapik, J /02	+	9	Breaux, C /90				
								Grimm, D /99				

*See references that follow for full citation.

IV. References: Intervention 33

1. Breaux CW Jr, Smith G, Georgeson KE. The first two years' experience with major trauma at a pediatric trauma center. J Trauma 1990 Jan;30(1):37-43.

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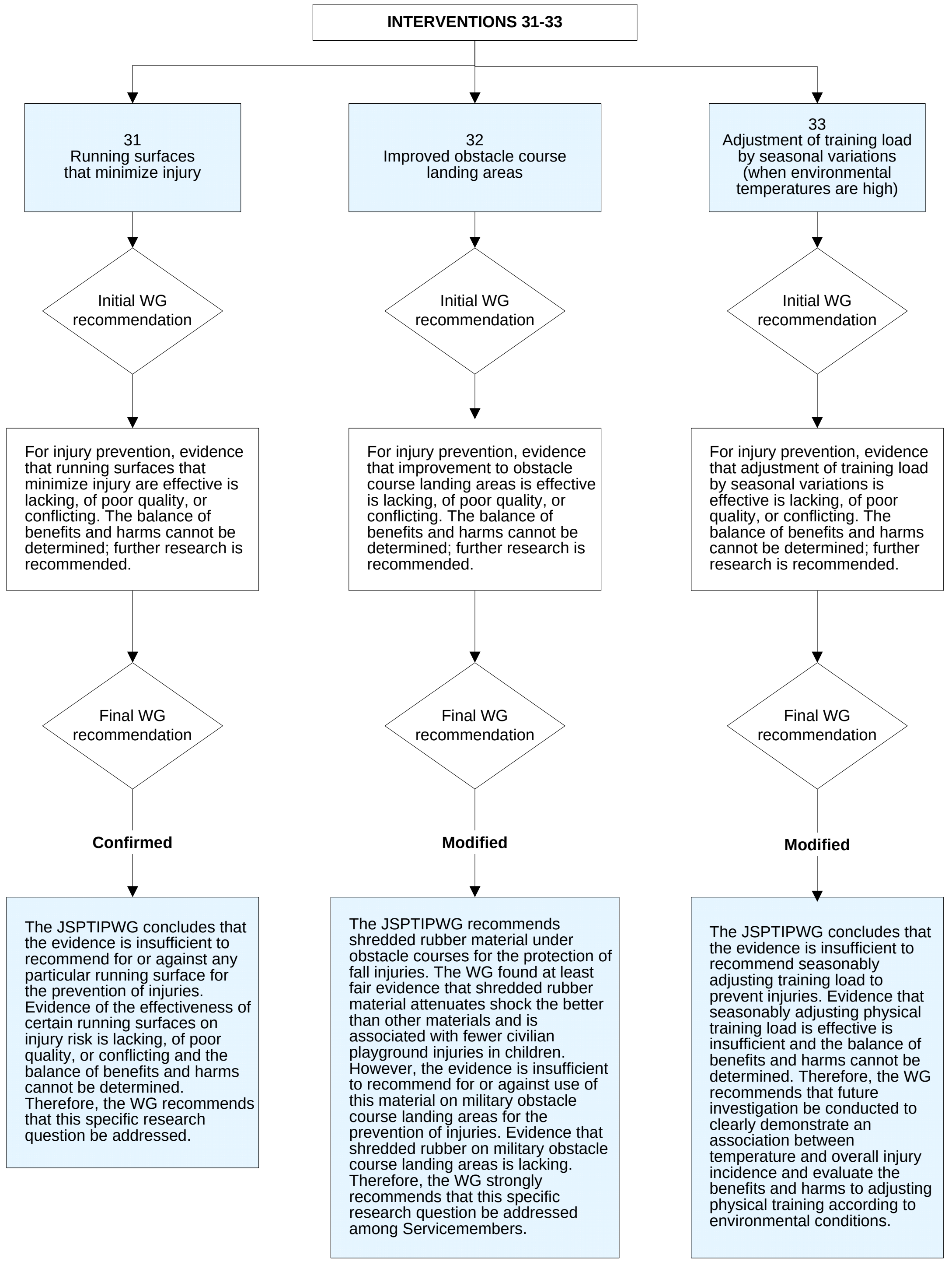
Figure 13-1. Review Process: Interventions 31, 32, and 33



Chapter 14

Education
(Interventions 34-36)

The following interventions are covered in this chapter:

- Intervention 34 - Injury Prevention Education to Leadership, Cadre, and Troops
- Intervention 35 - Smoking and Alcohol Cessation Programs
- Intervention 36 - Incorporate Safe Lifting Technique Training Into PT

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 14-1 at the end of this chapter.

Injury Prevention Education to Leadership, Cadre, and Servicemembers (Intervention 34)

I. Introduction and Discussion

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

The literature review was provided by Steven W. Marshall, PhD and LTC Steven Bullock:

- Search terms: musculoskeletal, injury, prevention, education
- Total number of hits resulting from the search: 116
- Total number of studies that meet the inclusion criteria: 3

Discussion
There are only three randomized trials that demonstrate the effect of education on musculoskeletal injury risks or rates but in conjunction with other interventions. Education as a specific intervention is difficult to measure alone as studies use education as a component of multiple intervention or community-based programs. One such program demonstrated a 75% reduction in soccer injuries when educated and supervised by physicians and physiotherapists among other things. Injuries were reduced 30% in Army initial entry trainees when an education program was coupled 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 the risk for Servicemembers. The dissemination of information regarding effective interventions 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 WG unanimously agreed that education should be considered an essential element of any successful injury prevention program in the military.

II. Recommendation: Intervention 34

The JSPTIPWG strongly recommends injury prevention education for all levels of leadership as a part of institutionalized continuing military education and distance learning programs. While education alone is not studied as a prevention intervention, the WG deems education as an essential program element. The reduction of injuries is most likely to occur if all levels of leadership (command and cadre) understand the injury risk factors Servicemembers face and which interventions work to prevent them. Education is the first step in disseminating evidence-based interventions that can be implemented at the unit level and is the first component of any successful program that reduces injuries. Leadership can then be empowered with the knowledge and skills necessary to effectively reduce injuries where they find them.

III. Classification Matrix: Intervention 34

The Classification Matrix of Literature Search Results is shown in Table 14-1.

Table 14-1. Classification Matrix of Literature Search Results: Intervention 34

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**	
No. of Refs Found	3											3
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year**	**+/-/x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
	Walters		+	3								
	Knapik	M	+	8								
	Ekstrand 1993	M	+	5								

*See references that follow for full citation.

IV. References: Intervention 34

1. 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.

2. 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.

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Smoking and Alcohol Cessation Programs
(Intervention 35)

I. Introduction and Discussion

Introduction

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

The literature review was provided by LtCol Vincent P. Fonseca, MD, MPH:

- Search terms: "smoking cessation OR alcohol cessation" athletic injuries; "smoking cessation OR alcohol cessation" and injury
- Total number of hits resulting from the search: 50
- Total number of studies that meet the inclusion criteria: smoking - 12, alcohol - 5

Discussion

Cigarette smoking is an independent risk factor among Army infantry Soldiers and Navy shipboard personnel. As a matter of fact, it appears that 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 should decrease over time. In fact, some studies recommend the inclusion of smoking cessation as a part of an integrated community-based injury prevention program. Unfortunately, the effect of smoking cessation on injury risk has not yet been demonstrated nor has the point at which smokers who have quit come to have the same risk of those who have never smoked been determined.

While alcohol use and abuse and its impact on serious injury such as from motor vehicle crashes has been well studied, no studies exist to demonstrate the relationship between alcohol and musculoskeletal injury. Since alcohol decreases physical and mental capacity and reasoning and increases risk taking, one could conclude that alcohol should increase the risk of musculoskeletal injury. It, therefore, stands to reason that alcohol cessation programs should lower the injury risk. However, this has not yet been demonstrated.

II. Recommendation: Intervention 35

- **Smoking Cessation.** While smoking has been identified as a strong risk factor for musculoskeletal injury we conclude that the evidence is insufficient to recommend for or against smoking cessation programs for the purpose of preventing injuries. Evidence that smoking cessation programs are effective in reducing injuries is lacking. Therefore, the JSPTIPWG strongly recommends that this specific research question be addressed.

- **Alcohol Cessation.** While smoking has been identified as a strong risk factor for musculoskeletal injury we conclude that the evidence is insufficient to recommend for or against smoking cessation programs for the purpose of preventing injuries. Evidence that smoking cessation programs are effective in reducing injuries is lacking. Therefore, the JSPTIPWG strongly recommends that this specific research question be addressed.

III. Classification Matrix: Intervention 35

The Classification Matrix of Literature Search Results is shown in Tables 14-2 for smoking cessation programs and 14-3 for alcohol cessation programs.

Table 14-2. Classification Matrix of Literature Search Results: Intervention 35 – Smoking Cessation Programs

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**	
No. of Refs Found	1				4			1	1	4	1	12
Literature Reviews	**Author/ Year***	**M**	**+/-/x**	**Score**	**Author/ Year***	**+/-/x**	**Score**	**Author/ Year***	**Author/ Year***	**Author/ Year***	**Author/ Year***	
	Jones/1999	M	+ -	9	Lappe/2001†	+	8	Reynolds/2000†	Gilchrist/ 2000†	Burse/1982	Dyer/1986	
					Altarac/2000	+	8			Scoughton/ 1975		
					Leistikow/1998	+	5			Du Bois/1998		
					Conway/1986	+	7			Breidenbach/ 1976		

*See references that follow for full citation.
†Citation not included in references.

Table 14-3. Classification Matrix of Literature Search Results: Intervention 35 – Alcohol Cessation Programs

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		
No. of Refs Found	0				1			1	0	1	2		5
Literature Reviews	Author/ Year	M	+/-/x	Score	Author/ Year	+/-/x	Score	Author/ Year†	Author/ Year	Author/ Year†	Author/ Year†		
					Lappe/2000*	+	8	Storms/2003		Schuckit/2000	Belle/2003		
											Holloway/1994		

*Citation not included in references
†See references that follow for full citation.

IV. References: Intervention 35

Smoking Cessation

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Alcohol Cessation

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2. Holloway Frank A. Low-dose alcohol effects on human behavior and performance: a review of post-1984 research, 1994 Nov.

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Incorporate Safe Lifting Training Into PT for the Prevention of Injuries in the Otherwise Healthy Individual (Intervention 36)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the strength of evidence for incorporating safe lifting techniques into physical 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.

The literature review was provided by Donald E. Goddard and Kelsey L. McCoskey:

- 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 andtervention andjury; back school
- Total number of hits resulting from the search: 631
- Total number of studies that meet the inclusion criteria: 34

Discussion

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 taught to those who are recovering from a low back strain or sprain. Studies in this category were inconsistent in how "back school" was defined and the exercise and lifting techniques were defined differently for each study. For example, even if all the studies found agreed that "exercise" as an intervention was preventive of low back pain it would be difficult to make a general conclusion to that effect because the studies combined different aspects 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 was truly preventive of low back pain. Furthermore, much research does not include education only interventions, rather most are multiple intervention studies where safe lifting technique training or back school were a part of a constellation of interventions. Many studies show a strong relationship to improved intermediate outcomes (process measures) of low back pain (i.e., spinal mechanics or lifting technique, improved functional capacity, perceived life quality, and return to work rates) with back school education courses and the literature is fairly supportive of back schools in preventing recurrences of low back pain in those with a history of injury. However, the literature does not yet clearly demonstrate efficacy on direct reduction of musculoskeletal injury in the otherwise healthy (non-injured). While the efficacy of the use of back schools teaching safe lifting techniques as a primary prevention measure has not been definitively demonstrated, clearly back school programs may be most effective in individuals with a history of low back pain.

II. Recommendation: Intervention 36

The JSPTIPWG concludes that the evidence is insufficient to recommend for or against pre-injury safe lifting technique training for the prevention of injuries in the otherwise healthy individual. Direct evidence that pre-injury safe lifting technique training in healthy individuals effectively reduces injury or minimizes injury risk is lacking. Therefore, the JSPTIPWG recommends further research into the effectiveness of safe lifting technique training in healthy, uninjured individuals on injury risk.

III. Classification Matrix: Intervention 36

The Classification Matrix of Literature Search Results is shown in Table 14-3.

Table 14-3. Classification Matrix of Literature Search Results: Intervention 36

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**	
No. of Refs Found	11				1			0	0	15	7	34
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	
	Fenello, S/99	M	+	1						Kingma, I/04	Heymans, MW/04	
	Penttinen, J/02	M	+	5						Wilson, MG/99		
	Vinh, DT/03	M	X	3						Lynch, RM/00		
	Helmhout, PH/04	M	X	6						Cedraschi, C/96		
	Heymans, MW/04	M	x	6						Hagen KB/93		
										Cady LD/79		
										Johnsson C / 02		
										Straker LM /02		
										Straker LM /02		

*See references that follow for full citation.

IV. References: Intervention 36

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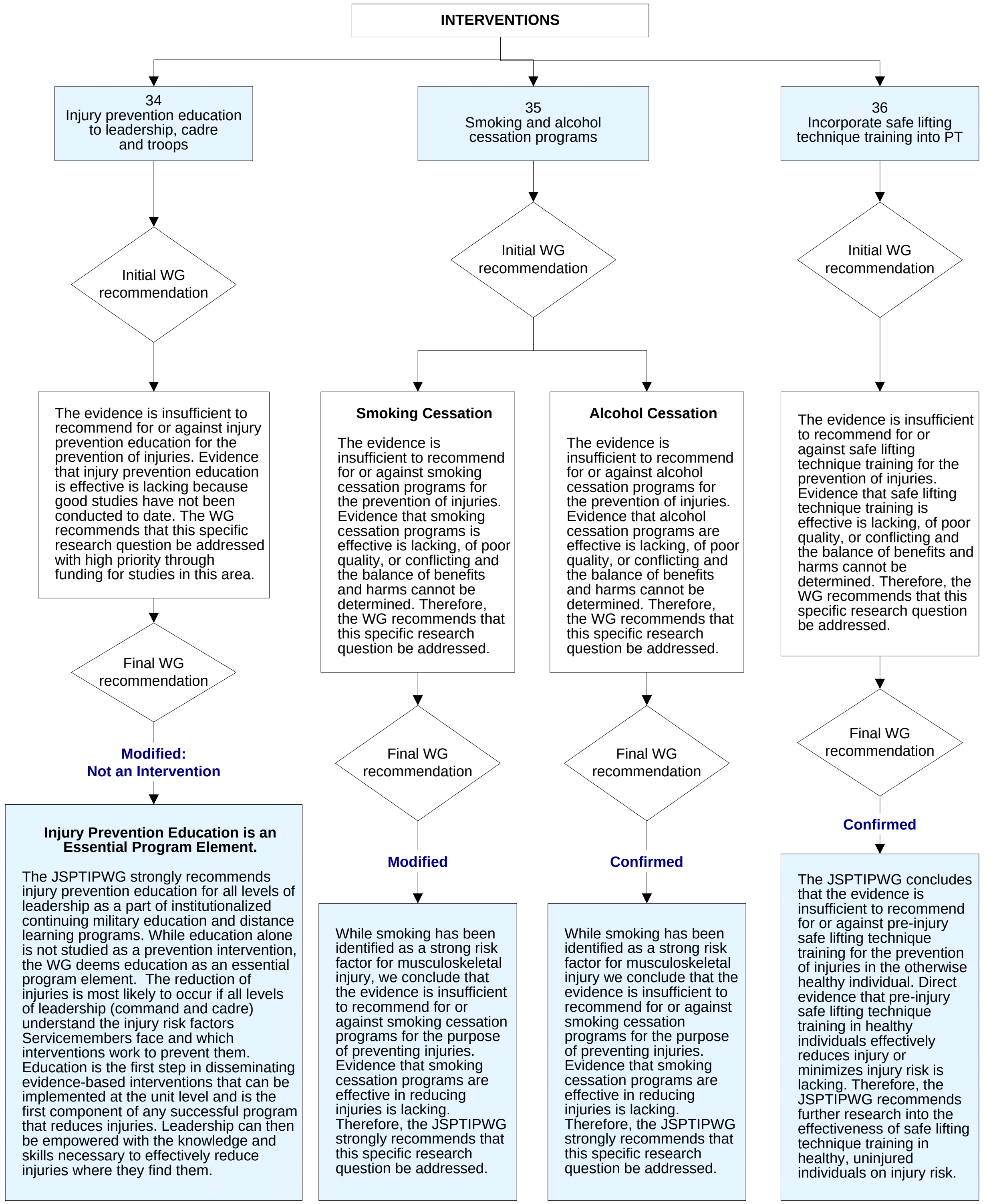
Figure 14-1. Review Process: Interventions 34, 35, and 36



Chapter 15

Education
(Interventions 8, 37, 38, and 39)

The following interventions are covered in this chapter:

- Intervention 8 – Cross Training
- Intervention 37 - Train Servicemembers in Special Awareness and Core Body Movement and Management Skills
- Intervention 38 - Health Care Professional Profile Writing – Especially on BCT/AIT Training
- Intervention 39 - Early Cryotherapy Self Intervention

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in

Train Servicemembers in Special Awareness and Core Body Movement and Management Skills (Interventions 8 and 37)

I. Introduction and Discussion

Introduction

Interventions 8 (cross-training) and the development of core body movement techniques (intervention 37) as defined here both have the ultimate objective of varying the stresses over the body by reducing the repetitive nature of similar exercises on the musculoskeletal system. Additionally, the literature reviews for each revealed that these interventions most often occurred simultaneously in research methods. Therefore, these two interventions were considered as one in the final recommendation.

The purpose of this review was to identify if varying the musculoskeletal stress by alternating exercise through the use of core body movement techniques and development of body management skills leads to the reduction of injuries. Rationale for combining interventions and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Julie Gilchrist, MD and James A. Onate, ATC, PhD:

- Search terms: cross-training, neuromuscular, training, coordination, agility, balance, proprioception, knee, ankle, injury prevention
- Total number of hits resulting from the search: 8,006
- Total number of studies that meet the inclusion criteria: 111

Discussion

Initially these two interventions (cross training and core body movement management skills training) were thought of as independent interventions that had merit for the prevention of musculoskeletal injuries. However, after reviewing the literature it became clear that cross training and core body management skills training were parallel interventions when combined in their application to military physical training programs. Several intervention trials using variable exercises focused on the development of core body management skills have shown to be effective in reducing musculoskeletal injuries.

Safer and more effective total body conditioning can be achieved with cross training. Originally, cross training referred to a conditioning regimen used by triathletes to train in all three events performed during a triathlon – running, biking and swimming. Athletes in a variety of sports also use cross training as a conditioning program to stay in peak shape during or after their competitive season as well as to limit the burden of repetitive motion or stress on one particular body part or system. But cross training is no longer a term applied exclusively to training for athletes but for military members alike. Cross training involves developing four major fitness components: aerobic capacity, muscular strength, muscular endurance and flexibility. The emphasis is on preparation for quick and lasting movement and load bearing through comprehensive conditioning in all major muscle groups. Cross training can also be used to improve a single component of fitness, by participation in a variety of cardiovascular activities.

Including more body movement skills training and more strength and agility conditioning in physical training sessions reduces injury risk for several key 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) musculoskeletal stresses of training are more evenly distributed across the body by these type drills (unlike running, which focuses stress narrowly in the lower body), thereby reducing injury risk; and (3) strength and stabilization exercises directed at the body core (trunk) represent many of the same movements required during more complex combat activities and thereby increase the likelihood of improved military occupational task performance. Physical training should vary cardiovascular stamina and strength and agility by providing strength and agility conditioning on alternate days from cardiovascular training (i.e., running, marching/hiking, etc.). Some examples where this kind of cross training has proven successful in the military are Physical Readiness Training for Army initial entry training and the Marine Corps Recruit Training Program. Consistent adherence to the standardized approach to body movement skills physical training will maximize PT time and develop the optimal combination of strength, coordination, agility, power, and stamina in warfighters.

II. Recommendation: Interventions 8 and 37

The JSPTIPWG strongly recommends that core body movement and management skills training be included in regular physical training. The WG found good evidence that increasing the proportion of physical training time devoted to varying musculoskeletal stress and the improvement of body movement skills through cross-training reduces injuries. Cross-training exercises and body movement skills must improve agility, posture, stability, flexibility, balance, speed, power, reactive ability, and coordination. Attention to precision of movement during execution of these exercises is paramount.

III. Classification Matrix: Interventions 8 and 37

The Classification Matrix of Literature Search Results is shown in Table 15-1.

Table 15-1. Classification Matrix of Literature Search Results: Intervention 37

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**	
No. of Refs Found	14				4			12	2	61	18	111
Literature Reviews	**Author/ Year***	**M**	**+/- /x**	**Score**	**Author/ Year***	**+/- /x**	**Score**	**Author/ Year***	**Author/ Year***	**Author/ Year***	**Author/ Year***	
	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 / 99	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		Brouwer, B / 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 / 03	Myer, G / 04	
	Wedderkopp, N / 99	M	x	7				Snedecor, M / 00		Cowling, E / 01	Myer, G / 04	
	Wedderkopp, N / 03	M	x	8						Cowling, E / 01	Risberg, M / 04	
	Heidt R / 00	M	+	4						DeMont, R / 04	Thacker, S / 03	

Table 15-1—*Continued*. Classification Matrix of Literature Search Results: Intervention 37

References Found/ Literature Reviews	Categories of Study Types: 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	Total
	Author/ Year*	**M**	**+/-/x**	**Score**	**Author/ Year***	**+/-/x**	**Score**	**Author/ Year***	**Author/ Year***	**Author/ Year***	**Author/ Year***	
Literature Reviews										Eils, E / 01	Thacker, S / 99	
										Ekdahl, E / 89	Thacker, S / 02	
										Emery, C / 95	Verhagen, E / 00	
										Ettlinger, C / 95	Yeung, E / 01	
										Fagenbaum, R / 03		
										Ford, K / 03		
										Fitzgerald, G / 00		
										Gervais, P / 97		
										Grabiner, M / 92		
										Gribble, P / 04		
										Hiemstra, L / 01		
										Hoffman, M / 95		
										Hoffman, M / 99		
										Hoiness, P / 03		
										Holm, I / 04		
										Hurley, M / 98		

*See references that follow for full citation.

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Improving Physical Profile Documentation (Surveillance Part II) (Intervention 38)

I. Introduction and Discussion

Introduction

This intervention was not reviewed. However, while it would not be expected that literature regarding a practice unique to the military health care system would be available, the relationship between health care intervention and re-injury remains an important issue.

The purpose of this review would have been to identify the strength of evidence for improving physical profile writing by health care providers to reduce the risk of re-injury. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

A literature review was not performed.

Discussion

Limitation of activity is often an important part of the health care management of Servicemembers with musculoskeletal injuries. However, in addition to specifying what an individual should not do, it can be helpful when health care providers identify activities that are permissible given the nature of the injury. Injuries can be characterized as mild, moderate, or severe. If a Servicemember reports pain but has a normal initial clinical examination, the injury is probably mild. Injuries with bruising and/or swelling should be classified as moderate or severe, depending on the extent and severity of the clinical signs. Duration of duty restrictions will typically range from 0 to 3 days for minor injuries, 1 to 2 weeks for moderate injuries, and greater than 2 weeks for severe injuries.

Writing physical restrictions to duty will always require independent judgment of the health care provider who must weigh many factors in determining appropriate activity limitations. Specific limitations prescribed will be influenced not only by the nature and severity of the injury, but also by the duty assignment and operational setting of the Servicemember. Too much or too little stress on a healing injury is not good. Understanding how to appropriately restrict physical activity due to an injury can enhance the recovery from an injury or possibly prevent recurrence of an injury among new recruits as well as Servicemembers.

There are reports of health care providers at military treatment facilities that do not fully understand the requirements of new recruits and consequently their restrictions are either too lenient or too severe; both of which can result in further injury from inadequate rehabilitation stress or lack of protection. There are a few case reports of duty restriction training for health care providers, tailored duty restriction forms, or case managers/clinic liaisons to supported units that have improved appropriate duty restrictions. However, the exact influence of these interventions on the prevention of reinjury has yet to be quantified. Yet, education on and standardization of the duty restriction process is a prudent initiative for the Military Healthcare System (MHS). Not only does physical profiling become more objective but this process improves the efficiency of health care delivery and further defines best clinical practice guidelines for musculoskeletal injuries.

II. Recommendation: Intervention 38

The JSPTIPWG strongly recommends that the Military Healthcare System include a systematic approach for restricting duty (including physical activity) within the electronic health record (AHLTA) of each Servicemember. While profiling has not been studied as a prevention intervention, a systematic approach for restricting activity provides objectivity, consistency, and longitudinal tracking for the protection of injury. The WG deems surveillance as an essential program element. The WG further recommends piloting the idea of a clinic liaison that would interface with supported military units to resolve duty restriction questions and inconsistencies to minimize the prevalence of under- or over-stressing injuries to prevent their recurrence.

III. Classification Matrix: Intervention 38

The Classification Matrix of Literature Search Results was not completed.

Early Self Intervention with Cryotherapy
(Intervention 39)

I. Introduction and Discussion

Introduction
This intervention is a self care treatment intervention thought to minimize existing injuries and/or prevent recurrence.

The purpose of this review was to identify the strength of evidence for early self application of cryotherapy (topical application of ice) to musculoskeletal injuries to avoid re-injury. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Keith G. Hauret and Diana Settles, MAT, ATC:

- Search terms: ice, cold, cryotherapy & athletic injury, soft-tissue injury, injury, leg injury, knee injury, ankle injury; ice packs, cryotherapy; ice, athletic injury; injury, soft-tissue injury
- Total number of hits resulting from the search: 1,494
- Total number of studies that meet the inclusion criteria: 24

Discussion
Cryotherapy is the topical application of ice. Cryotherapy is a primary therapeutic modality used to treat acute musculoskeletal injuries. When applied intermittently after injury, it 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, slows nerve conduction velocity, and serves as a topical analgesic. Ice is especially effective in the first 24 to 72 hours after injury onset.

Despite the long history of using cryotherapy to control edema and pain, there are very few randomized, controlled studies providing evidence to substantiate the effect of cryotherapy alone on measures of return-to-participation, activity, or 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. Our review of the literature for the effect of cryotherapy alone on return to participation metrics shows that cryotherapy may have a positive effect. However, the relatively poor quality of the studies reviewed is of concern. Randomized, controlled clinical studies of the effect of cryotherapy on acute injury and return to participation are needed.

II. Recommendation: Intervention 39

While cryotherapy affects other aspects resultant of injury such as swelling, pain, range of motion, etc., the JSPTIPWG concludes that the evidence is insufficient to recommend for or against cryotherapy for the prevention of reinjury. Evidence that cryotherapy is effective in preventing reinjury is lacking. Therefore, the WG recommends that the question whether the application of ice post injury is protective against re-injury be addressed.

III. Classification Matrix: Intervention 39

The Classification Matrix of Literature Search Results is shown in Table 15-3.

Table 15-3. Classification Matrix of Literature Search Results: Intervention 39

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**		
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	+										
	Isabell/1992†												
	Laba/1989†												
	Airaksinen/2004		+	6									

*See references that follow for full citation.
†Not scored by the reviewer but provided by the editor.

IV. References: Intervention 39

1. Airaksinen OV, Kryklund N, Latvala K, Kouri JP, Gronblad M, Kolari P. Efficacy of cold gel for soft tissue injuries: a prospective double-blinded trial. J Bone Joint Surg Am 2004: 86A:1101.

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9. Howatson G, Van Someren KA. Ice massage. Effects on exercise-induced muscle damage. J Sports Med Phys Fitness 2003;43:500-5.

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Figure 15-1. Review Process: Interventions 8 and 37, 38, and 39

INTERVENTIONS

8 and 37
Train service members in special awareness and core body movement and management skills (how to run, jump, land, cut, and decelerate)

Initial WG recommendation

The WG recommends specific exercises to improve body movement skills (agility, posture, stability, flexibility, balance, speed, power, reactive ability, and coordination) as they relate to military occupational task performance. Focus on improvement of movement techniques during execution of exercise. The WG found good evidence that increasing the proportion of PT time devoted to these exercises reduces injuries.

Final WG recommendation

Modified

The JSPTIPWG strongly recommends that core body movement and management skills training be included in regular physical training. The WG found good evidence that increasing the proportion of physical training time devoted to varying musculoskeletal stress and the improvement of body movement skills through cross-training reduces injuries. Cross-training exercises and body movement skills must improve agility, posture, stability, flexibility, balance, speed, power, reactive ability, and coordination. Attention to precision of movement during execution of these exercises is paramount.

38
Health care professional profile writing - especially on BCT/AIT training

Not reviewed

The JSPTIPWG strongly recommends that the Military Healthcare System include a systematic approach for restricting duty (including physical activity) within the electronic health record (AHLTA) of each Servicemember. While profiling has not been studied as a prevention intervention, a systematic approach for restricting activity provides objectivity, consistency, and longitudinal tracking for the protection of injury. The WG deems surveillance as an essential program element. The WG further recommends piloting the idea of a clinic liaison that would interface with supported military units to resolve duty restriction questions and inconsistencies to minimize the prevalence of under- or over-stressing injuries to prevent their recurrence.

39
Early cryotherapy self intervention (crushed ice and ice massage)

Initial WG recommendation

The evidence is insufficient to recommend for or against cryotherapy for the prevention of injuries. Evidence that cryotherapy is effective is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined. Therefore, the WG recommends that this specific research question be addressed.

Final WG recommendation

Modified

While cryotherapy affects other aspects resultant of injury such as swelling, pain, range of motion, etc., the JSPTIPWG concludes that the evidence is insufficient to recommend for or against cryotherapy for the prevention of reinjury. Evidence that cryotherapy is effective in preventing reinjury is lacking. Therefore, the WG recommends that the question whether the application of ice post injury is protective against re-injury be addressed.

Chapter 16

Pre- and Post-PT Nutrition, Supplementation, and Hydration
(Intervention 40)

The following intervention is covered in this chapter:

- Intervention 40 – Pre- and Post-PT Nutrition, Supplementation, and Hydration

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 16-1 at the end of this chapter.

Pre- and Post-PT Nutrition, Supplementation, and Hydration (Intervention 40)

I. Introduction and Discussion

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

The literature review was provided by Patricia A. Deuster, PhD, MPH:

- Search terms: nutrition, muscle injury, stress fracture, hydration, muscle damage, training injury, exercise, injury, protein
- Total number of hits resulting from the search: 66
- Total number of studies that meet the inclusion criteria: 18

Discussion
Research indicates that restoring energy balance and adequate muscle glycogen (carbohydrate stores in the muscle) decreases markers 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 then reduce their strength and 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.

Both civilian and military research have provided evidence that nutritional supplementation overcomes fatigue, minimizes muscle damage, and protects against heat injury. However, the timing of the nutritional intervention is critical. Specifically, research indicates that providing 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 not provided until more than one hour afterwards, the metabolic environment is less well prepared to absorb the nutrients; thus minimizing recovery.

The ideal amount of nutritional supplementation needed to allow for the most rapid replenishment of muscle glycogen to protect against muscle damage and accelerate the recovery process is roughly 50 to 75 grams of carbohydrate and 12 to 18 grams of protein (1 gram of protein for every 4 grams of carbohydrate).

II. Recommendation: Intervention 40

The JSPTIPWG recommends supplementing diet with a carbohydrate-protein snack and balanced fluid replacement beverage within one hour only after very strenuous, prolonged, continuous physical activity (e.g., prolonged road marching/hiking) to reduce musculoskeletal injury risk. The WG found sufficient evidence that supplementation of a carbohydrate-protein snack and balanced fluid replacement beverage within one hour after very strenuous, prolonged, continuous physical activity reduces injury and that the benefits outweigh the harms. Collateral benefits such as reduction of heat-related illness and enhanced physical performance can be expected.

III. Classification Matrix: Intervention 40

The Classification Matrix of Literature Search Results is shown in Table 16-1.

Table 16-1. Classification Matrix of Literature Search Results: Intervention 40

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**	
No. of Refs Found	9				3			1	0	0	5*	18
	Author/ Year†	**M**	**+/- /x**	**Score**	**Author/ Year†**	**+/- /x**	**Score**	**Author/ Year**	**Author/ Year**	**Author/ Year**	**Author/ Year**	
Literature Reviews	Bloomer 2004		+	8	Bennell 1996	+	6.67	Armstrong 2004				
	Flakoll 2004		+	6	Bennell 1995	+	5.33					
	Kreider 1999		X	7	Korpelainen 2001	X	3.35					
	Knitter 2000		+	5								
	Panton 2000		+	6								
	Paddon-Jones 2001		X	3								
	Saunders 2004		+	4								
	Shafat 2004		+	3								
	Umeda 2004		+	2								

*Contributor lists certain number but no specific references are identified.
†See references that follow for full citation.

IV. References: Intervention 40

1. Bennell KL, Malcolm SA, Thomas SA, Ebeling PR, McCrory PR, Wark JD, Brukner PD. Risk factors for stress fractures in female track-and-field athletes: a retrospective analysis. Clin J Sport Med 1995 Oct;5(4):229-35.

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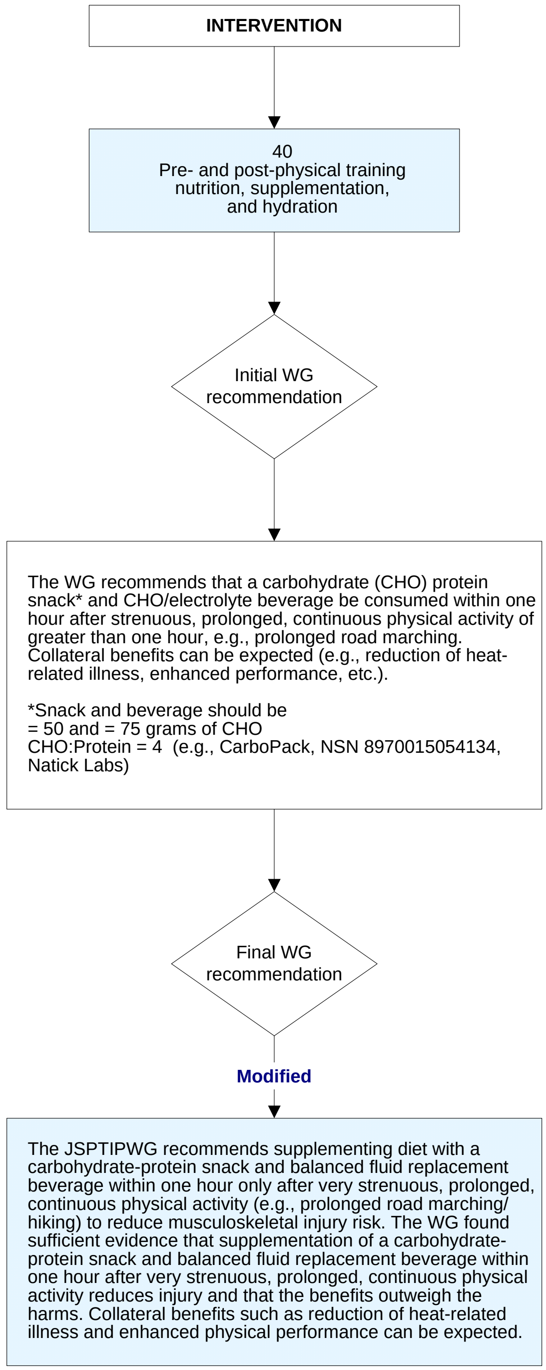
Figure 16-1. Review Process: Intervention 40



Chapter 17

Medication and Medical Care
(Interventions 41-44)

The following interventions are covered in this chapter:

- Intervention 41 – Pre-exercise Loading Anti-Inflammatory Medication
- Intervention 42 - Birth Control Pill Use Increases Knee Stability
- Intervention 43 - Standardized Reconditioning Program for the Recently Injured
- Intervention 44 - Use of Allied Health Professionals in Locations More Forward of Fixed Facility Treatment

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 17-1 at the end of this chapter.

Pre-exercise Administration of Anti-Inflammatory Medication (Intervention 41)

I. Introduction and Discussion

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

The literature review was provided by CPT Roberto Marin:

- Search terms: "NSAID" and injury, prevention, exercise, pre-exercise, loading
- Total number of hits resulting from the search: 197
- Total number of studies that meet the inclusion criteria: 8

Discussion
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 upon this fact that the hypothesis of non-steroidal anti-inflammatory drug (NSAID) being used prior to an exercise bout seems plausible. One such 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.

II. Recommendation: Intervention 41

The JSPTIPWG recommends against the administration of anti-inflammatory medication prior to exercise for the prevention of injuries. The WG found that the evidence for pre-administration of NSAIDs is lacking, of poor quality, or conflicting and it appears that the harms may outweigh the benefits.

III. Classification Matrix: Intervention 41

The Classification Matrix of Literature Search Results is shown in Table 17-1.

Table 17-1. Classification Matrix of Literature Search Results: Intervention 41

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**	
No. of Refs Found	2				3			0	0	3	0	8
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			Baker, J / 2005		
	Bourgeois, J / 1999	M	x	6	Sheikh RA, / 2002	x	4			Olsen,NV/99		
					Bauer, DC / 1996	x	7			Walker,RJ/94		

*See references that follow for full citation.

IV. References: Intervention 41

1. Baker J, Cotter JD, Gerrard DF, Bell ML, Walker RJ. Effects of indomethacin and celecoxib on renal function in athletes. Med Sci Sports Exerc 2005 May;37(5):712-7.

2. Bauer DC, Orwoll ES, Fox KM, Vogt TM, Lane LE, Hochberg MC, Stone K, Nevitt MC. Aspirin and NSAID use in older women: effect on bone mineral density and fracture risk. Study of Osteoporotic Fractures Research Group. J Bone Miner Res 1996 Jan;11(1):29-35.

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Birth Control Pill Use to Increase Knee Stability (Intervention 42)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the strength of evidence for the use of birth control pills to increase knee stability and, therefore, reduce knee injury. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by CPT Roberto Marin:

- Search terms: BCP and Injury, knee stability, knee injury, sex hormones and ACL, contraceptives and ACL
- Total number of hits resulting from the search: 367
- Total number of studies that meet the inclusion criteria: 17

Discussion

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 on 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. One study demonstrated a statistically significant decrease in anterior translation of the tibia as compared with nonusers. A most 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 the fact that oral contraceptives appear to improve the ligamentous integrity of the joints, it is clear that more research is needed before this intervention can be demonstrated as an effective injury prevention strategy for women.

II. Recommendation: Intervention 42

The JSPTIPWG concludes that the evidence is insufficient to recommend for or against birth control pill (BCP) usage to prevent injuries in females. Evidence that BCP usage is effective in reducing injuries is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined. Therefore, the WG recommends that this specific research question be addressed.

III. Classification Matrix: Intervention 42

The Classification Matrix of Literature Search Results is shown in Table 17-2.

Table 17-2. Classification Matrix of Literature Search Results: Intervention 42

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**		**Total**
No. of Refs Found	1				8			1	0	1	6		17
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 / 03	+	5	Gwinn, DE 2000		Lovering, RM 2005	Dugan, SA 2005		
					Piasecki, DP / 03	-	7				Ireland, ML 2002		
					Medrano, D / 2003	+	7				Hewett, TE 2001		
					Romani, W / 2003	-	7				Lebrun, CM 2001		
					Slaughterbeck JR / 2002	+	8				Hewett, TE 2001		
					Arendt, AT / 2002	+	7				Toth, AP 2001		
					Brooke-Wavell, K / 01	-	8						
					Karageanes, SJ / 2000	x	8						

*See references that follow for full citation.

IV. References: Intervention 42

1. Agel J, Bershadsky B, Arendt EA. Hormonal therapy: ACL and ankle injury. Med Sci Sports Exerc 2006 Jan;38(1):7-12.

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8. Karageanes SJ, Blackburn K, Vangelos ZA. The association of the menstrual cycle with the laxity of the anterior cruciate ligament in adolescent female athletes. Clin J Sport Med 2000 Jul;10(3):162-8.

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Standardized Reconditioning Program for the Recently Injured (Intervention 43)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the strength of evidence for a standardized reconditioning program for those individuals with recent injuries to reduce risk of re-injury. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by LTC Steven Bullock:

- Search terms: standardized injury rehabilitation/reconditioning, injury reconditioning, injury rehabilitation
- Total number of hits resulting from the search: 339
- Total number of studies that meet the inclusion criteria: 3

Discussion

Rehabilitation involves a functional progression through a systematic program of physical reconditioning involving joint flexibility, muscular strength, muscular endurance, muscular speed, integrated and coordinated movement (skill patterns), and cardiovascular endurance. Certainly health care providers are needed to properly diagnose a Servicemember prior to beginning any rehabilitation and constant monitoring of the Servicemember'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 Servicemember is achieved by progressively loading the injured body part while maintaining other aspects of fitness. There is a point at which a Servicemember is well enough to be out from under the direction of a health care provider but where reinitiating physical training with his or her military unit would provide an inappropriate amount of stress on the recovering injury. It is at this point where Servicemembers need a transition program from patient status to full duty.

A review of literature revealed the value of rehabilitation for specific injuries that hasten return to sports. However, there are no studies in the literature to date that look specifically at the value or effect of mass intermediate reconditioning training programs on rate of return to duty or sport or the incidence of re-injury. Perhaps more could be understood regarding this effect by looking at studies that address the prevention of re-injury of specific injuries. Certainly more research in military populations would further elucidate the effect of a transitional program for recovering Servicemembers on return to duty and re-injury rates.

II. Recommendation: Intervention 43

The JSPTIPWG concludes that the evidence is insufficient to recommend for or against a standardized injury reconditioning program for the prevention of further injury. While substantial evidence exists for the benefits of rehabilitation for specific injuries, evidence that a standardized reconditioning program for the masses is effective is nonexistent. Therefore, the WG recommends that a standardized injury reconditioning program to prevent re-injury be evaluated for efficacy and weigh the benefits and unintended consequences of such a program for mass military training.

III. Classification Matrix: Intervention 43

The Classification Matrix of Literature Search Results is shown in Table 17-3.

Table 17-3. Classification Matrix of Literature Search Results: Intervention 43

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**		
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.

IV. References: Intervention 43

1. Genuario SE, Vegso JJ. The use of a swimming pool in the rehabilitation and reconditioning of athletic injuries. Contemp Orthop 1990 Apr;20(4):381-7.

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Forward Deployed Allied Health Professionals
(Intervention 44)

I. Introduction and Discussion

Introduction
This intervention was not formally reviewed. However, the editors are aware of military programs that exist without peer-reviewed documentation of their efficacy.

The purpose of this review would have been to identify the strength of evidence for the use of allied health professionals (like physical therapists, occupational therapists, athletic trainers, etc.) in locations more forward of fixed military treatment facilities. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

A literature review was not performed.

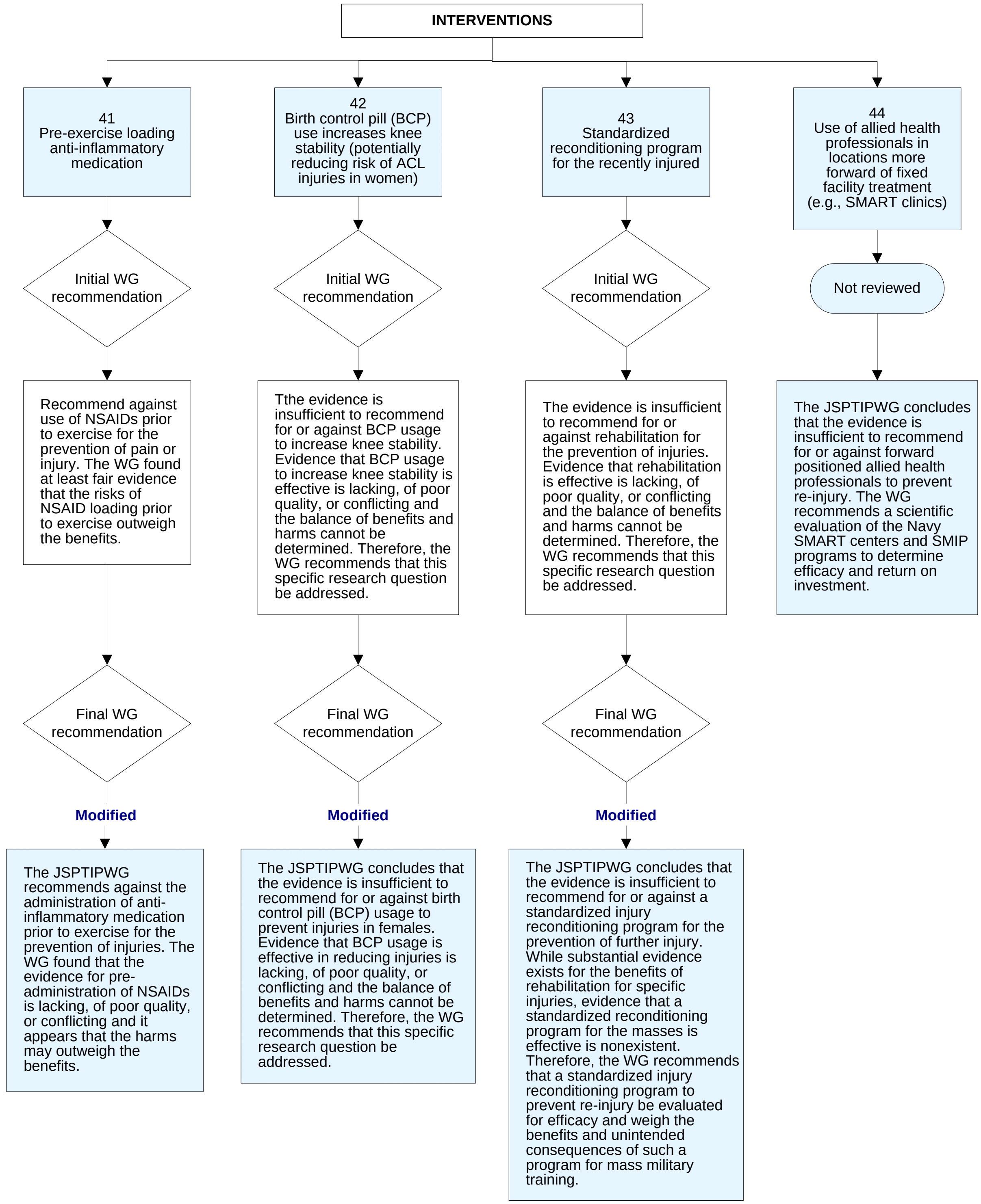
Discussion
Better access to health care is certainly a desirable situation, especially in the military. The question as to whether or not better access to musculoskeletal evaluation and treatment hastens Servicemember return to duty and reduces the risk of re-injury has yet to be determined. The US Navy has two programs that show some promise with regard to reduced attrition but injury risk has not been looked at (Sports Medicine and Rehabilitation Therapy – SMART – centers and Sports Medicine Injury Prevention – SMIP – programs). These programs deserve greater scrutiny and sound scientific evidence to prove their effectiveness and applicability to other Services as well as business case including return on investment analyses.

II. Recommendation: Intervention 44

The JSPTIPWG concludes that the evidence is insufficient to recommend for or against forward positioned allied health professionals to prevent re-injury. The WG recommends a scientific evaluation of the Navy SMART centers and SMIP programs to determine efficacy and return on investment.

III. Classification Matrix: Intervention 44

Figure 17-1. Review Process: Interventions 41, 42, 43, and 44



Chapter 18

Leadership and Accountability
(Interventions 45-47)

The following interventions are covered in this chapter:

- Intervention 45 - Rate Commanders and Exercise Leaders on Their Unit Injury Rate
- Intervention 46 - Rate Commanders and Exercise Leaders on Percentage of Individuals Passing Fitness Test
- Intervention 47 - Psychosocial Issues Related to Injury

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 18-1 at the end of this chapter.

Require Leadership Accountability for Unit Injury and Fitness Test Pass Rates (Interventions 45 and 46)

I. Introduction and Discussion

Introduction
These interventions regarding the responsibility of injury rates and fitness pass rates have been combined as they relate to one another as an element of military leadership. No scientific review could be conducted on these topics.

The purpose of this review would have been to identify the strength of evidence for requiring military leaders be accountable for their own unit injury rates and fitness test pass rates instead of overall unit fitness average score. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

A literature review was not performed.

Discussion
The value of leader responsibility and accountability cannot be overemphasized. In many aspects of life it is clearly understood that when someone who is responsible is held accountable, the rate of progress improves. While a literature review did would not reveal any studies that specifically addressed the impact of leadership responsibility and accountability on injury rates, the WG deemed Leadership Enforcement as an Essential Program Element of any successful injury prevention program at any and all unit levels.

Commanders should assume responsibility and be held accountable for all the outcomes of physical training 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 vigorous physical training or exercise (overuse injuries), unit injury rates provide another important measure of the success or failure of unit physical training. Therefore, commanders 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.

Commanders 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 may cause commanders and cadre 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 - greater risk of injury and diminished physical performance - two cardinal signs of overtraining syndrome. Conversely, this tradition of achieving the highest unit average fitness test score may cause some commanders to dismiss certain unit members as injured and, therefore, not feel responsible for them when assessing their unit fitness status. For example, a commander 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 profile, 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.

The ultimate in requiring leadership accountability for injuries would be for commanders to consider both unit fitness test pass rates and injury rates, not just unit average fitness test scores, when rating officers and noncommissioned officers, since physical readiness is a function of both physical performance and injury.

II. Recommendation: Interventions 45 and 46

The JSPTIPWG strongly recommends military and civilian leadership enforcement of injury prevention policies and programs at all levels, including the accountability for total unit injury rates and fitness test pass rates. While leadership alone has not been studied as a prevention intervention, the WG deems leadership enforcement an essential 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 interventions and common sense to reduce exposure to injury risk during physical training, field exercises, and off-duty recreational activities.

Psychosocial Issues Related to Injury
(Intervention 47)

I. Introduction and Discussion

Introduction

This intervention was not reviewed.

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 summary of salient points that lead to the final recommendation are presented in the discussion below.

A literature review was not performed.

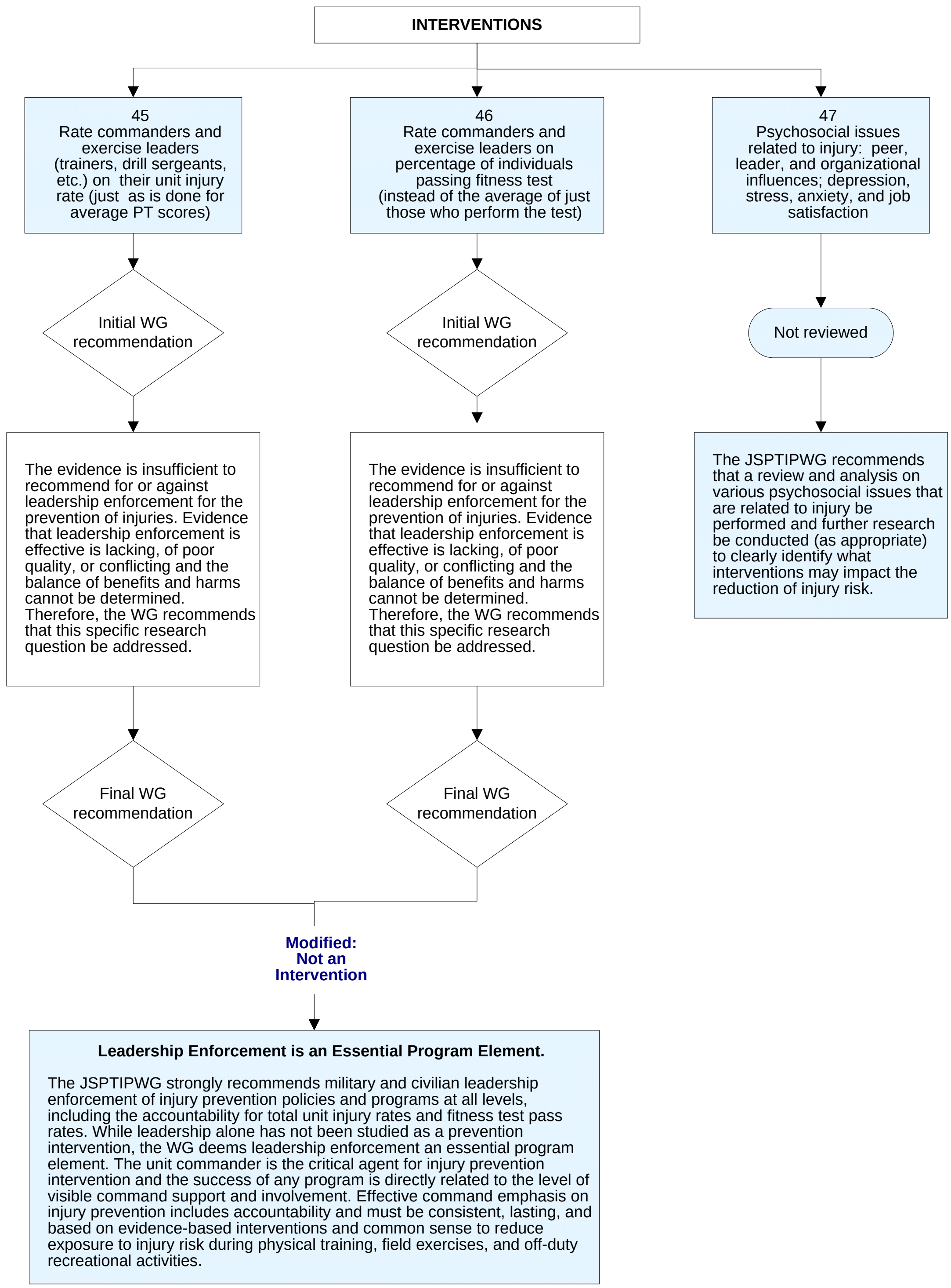
Discussion

The psychosocial issues related to injury are likely a bigger contributor to injury rates, especially in the military, than first thought. The influence of peers, leaders, and the organizational climate may well influence whether a Servicemember is at higher or lower risk for musculoskeletal injury. Depression, anxiety, and job stress and satisfaction all must play a part in the prevention of injury, recovery, and reinjury. Interventions designed to alter these psychosocial issues may, in fact, reduce injury risk. However, this was not reviewed by the WG.

II. Recommendation: Intervention 47

The JSPTIPWG recommends that a review and analysis on various psychosocial issues that are related to injury be performed and further research be conducted (as appropriate) to clearly identify what interventions may impact the reduction of injury risk.

Figure 18-1. Review Process: Interventions 45, 46, and 47



Chapter 19

Surveillance and Evaluation
(Interventions 48 and 49)

The following interventions are covered in this chapter:

- Intervention 48 - Provide Commanders Injury Rate Information on Their Unit and Challenge Them to Reduce It
- Intervention 49 - Can an Injury Risk Index be Developed that Would Categorize Individuals by Level of Risk Through Survey and Musculoskeletal Evaluation?

The results of the literature review for each intervention are presented in four sections:

- I. Introduction and Discussion
- II. Recommendation
- III. Classification Matrix
- IV. References

A flow chart illustrating the working group's review of these interventions is shown in Figure 19-1 at the end of this chapter.

Provide Commanders with Unit Injury Rate and Cause Reports (Surveillance Part I) (Intervention 48)

I. Introduction and Discussion

Introduction

This intervention could not be reviewed.

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 and causes of those injuries. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

A scientific literature review could not be performed.

Discussion

Injuries are decidedly a huge public health threat to all military Services. A health problem as big as military musculoskeletal injuries requires a systematic approach using the public health process. The first step in that process is to have appropriate 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 assess the effectiveness of interventions once put into place.

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 WG quickly determined that surveillance itself would not have been studied as an isolated intervention but rather is an essential component of a larger process to reduce injuries. The WG agrees 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 future improvement, and targeting interventions at the unit level. 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 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 failures 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.

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 could have the effect of encouraging greater command responsibility for unit physical performance and musculoskeletal health (as addressed in a preceeding review).

II. Recommendation: Intervention 48

The JSPTIPWG strongly supports mandatory injury cause coding in the outpatient electronic health record (AHLTA) and reporting to commanders. While surveillance has not been studied as a prevention intervention, the understanding of injury cause is crucial. The WG, therefore, deems surveillance as an essential program element. To systematically analyze and prevent injuries throughout the DoD, routine medical surveillance of injury causes is critical. Additionally, department wide surveillance of physical fitness would also provide rich information since it is one of the primary risk factors for injury. Data on injury cause and physical fitness would greatly facilitate the prioritization of resources, research, and the targeting of interventions to reduce injury rates, thereby improving physical readiness.

Predicting Injury Risk Through Use of an Injury Risk Index (Intervention 49)

I. Introduction and Discussion

Introduction

The purpose of this review was to identify the existence of an injury risk index in the literature that would predict the risk of sustaining an injury in otherwise healthy individuals. Reasons for pursuing this theory and summary of salient points that lead to the final recommendation are presented in the discussion below.

The literature review was provided by Stephen W. Marshall, PhD:

- Search terms: predicting musculoskeletal injury, musculoskeletal injury screening
- Total number of hits resulting from the search: 1,589
- Total number of studies that meet the inclusion criteria: 14

Discussion

A helpful tool that has provided a quick assessment of an individuals risk for sustaining a cardiac event is the Framingham Risk Index. A number of the most important risk factors are figured together to calculate level of risk as a way to alert one of their level of risk and to give them guidance on how to reduce that risk. 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 is a significant risk factor for future injury in basic combat training. Some programs have been developed to provide a train up for those less fit which has been shown to reduce injuries and attrition in Army basic combat training. 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 screen of feet (looking for pes cavus and planus) together with a history of previous injury. This multivariate risk factor screen did not have the predictive power seen in those screens that focused only on one risk factor. Given that there are several risk factors (intrinsic as well as extrinsic) for sustaining a musculoskeletal injury, such a risk index could alert individuals, health care providers, and military commanders of the potentially negative outcomes of military training and intervene where appropriate to reduce injury and attrition risk. No such risk index predicting musculoskeletal injury exists in the literature.

II. Recommendation: Intervention 49

The JSPTIPWG recommends that a statistical modeling technique 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 targeting interventions to reduce that risk. The WG did not find any composite musculoskeletal injury risk index in the literature. However, the WG did find at least fair evidence that certain tests are predictive of specific injuries and that screening for specific risk factors allows for interventions that reduce the overall risk. The benefits of developing an injury risk index clearly outweigh any harm.

III. Classification Matrix: Intervention 49

The Classification Matrix of Literature Search Results is shown in Table 19-2.

Table 19-2. Classification Matrix of Literature Search Results: Intervention 49

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**	
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 (in progess)		
	McGuine, 2000†				Canham-Chervak, 2000	+	8					
	Trojian, 2006†				Hier, 1997	+	6					
	Rudzki, 1997†											

*See references that follow for full citation.
†Added by the editor but not rated.

IV. References: Intervention 49

1. Canham-Chervak M, Knapik JJ, Hauret K, Cuthie J, Craig S. Determining physical fitness criteria for entry into Army basic combat training: can these criteria be based on injury risk? Technical Report 29-HE-1395-00. USACHPPM. Jan 2000.

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8. Knapik JJ, Hauret K, Lange JL, Jovag B. Retention in service of recruits assigned to Army physical fitness enhancement program in basic combat training. Mil Med 2003;166:46:490-492.

9. Krauss MR. Assessment of recruit motivation and strength (ARMS) phase 2: preliminary results on weight and disqualifications. Presentation to the committee on youth population and military recruitment: physical, medical, and mental health standards. National Academy of Sciences, Washington DC, November 1, 2004.

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12. Shaffer RA, Brodine SK, Almeida SA, Williams KM, Ronaghy S. Use of simple measures of physical activity to predict stress fractures in young men undergoing a rigorous physical training program. Am J Epidemiology 1999;149(3):236-242.

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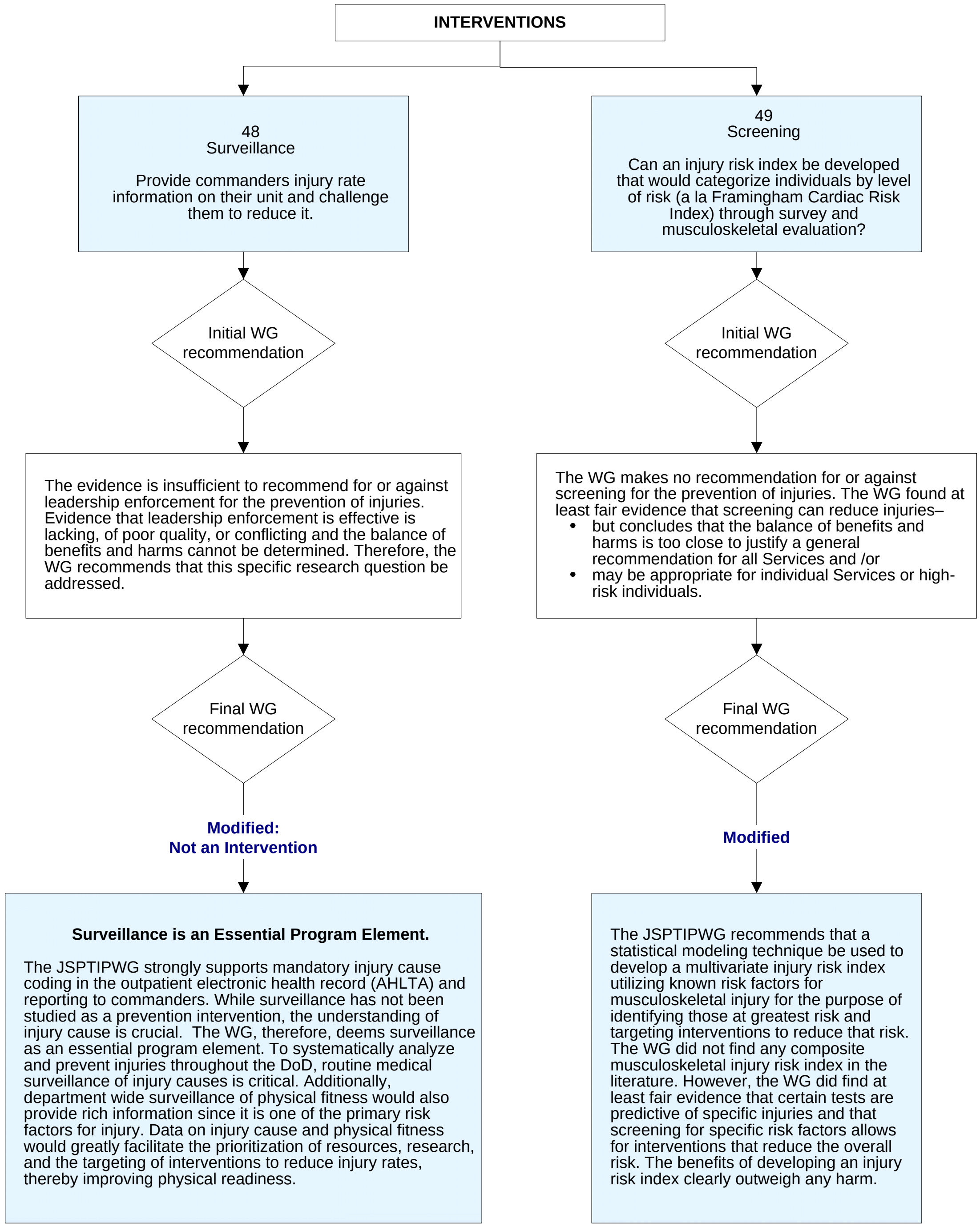
14. G, Uhorchak JM, Scoville CR, Williams Arciero RA, St Pierre P, Taylor DC. Risk factors associated with non-contact ACL injury: a prospective 4-year evaluation of 859 West Point cadets. Am J Sports Med 2003;31(6):831-842.

Figure 19-1. Review Process: Interventions 48 and 49



Chapter 20

Summary

Section I. Conclusions

The systematic process of evaluating interventions enabled the Joint Physical Training Injury Prevention Work Group to build TriService concensus around potentially controversial topics.   Using the guidelines that required a sufficient level of evidence before making any recommendation was the key to dividing the recommendations hierarchically. While the initial effort of the work group sought to illucidate the interventions specifically to reduce injuries in basic training, the principles behind the strongly recommended interventions are broadly applicable to operational training environments across the Services. Table 20-1 contains a summary of strong recommendations for all Servicemembers in basic training or operational units.

The interventions with enough evidence to make recommendations to a limited group of Servicemembers are presented in Table 20-3 (Recommendations with Limited Applicability). Perhaps a focus of research or program evaluation related to these interventions may broaden the applicability.

Tables 20-4 contains interventions that are not recommended. Table 20-5 contains interventions for which there is insufficient evidence to make positive recommendations. The JSPTIPWG unanimously agrees that more attention and resources must be placed into the identification and investigation of promising intervention strategies, like the ones listed in Table 20-5, to lower the musculoskeletal injury rate in the Department of Defense.

Section II. Recommendation Tables

Table 20-1. Strongly Recommended Interventions and Program Elements to Reduce Physical Training-Related Injuries

INTERVENTIONS	RECOMMENDATIONS
PREVENTION OF OVERTRAINING	The JSPTIPWG strongly recommends the de-emphasis of distance running during physical training to prevent overtraining. Overtraining (caused largely by excessive distance running) results in higher injury rates, lowered physical performance, decreased motivation, and attrition. Good evidence was found that physical training programs, especially in initial military training, that reduce distance running miles and

INTERVENTIONS	RECOMMENDATIONS
	incorporate the following elements prevent overtraining and reduce injury rates while maintaining or improving physical fitness. • Commanders at all levels should actively avoid combinations of physical and military training that exceed physiologic thresholds of overtraining that result in higher injury rates and do not improve 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. • Other ways to achieve this objective include the following recommendations: o Follow a standardized, gradual, systematic progression of running distance and speed beginning with lower mileage and intensity, especially for those just starting a physical training program (e.g., new recruits, changing units, or returning to PT after time off for an injury or leave). o Structure physical training injury prevention programs to target those Servicemembers at the highest risk of injury (those of average or below average fitness) by ensuring that the running mileage for the least fit Servicemembers is appropriate for their fitness level. ▪ Use fitness test performance (run times) to place Servicemembers in ability groups of similar fitness levels that provide each Servicemember with a more appropriate level of physiological stimulus to enhance fitness and minimize injury risk. (Running by time, not distance, allows the least fit to run shorter distances than the most fit, thus accommodating low and high fitness groups simultaneously.) ▪ Avoid remedial physical training programs that require the least fit Servicemembers, especially recruits, to do more training than fit Servicemembers since it significantly increases 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.) ▪ Limit formation running as it overtrains the least fit and provides an inadequate training effect for the most fit. o Replace some distance runs with higher intensity, shorter distance runs (e.g., interval training activities like repeated sprints, Fartlek training, and last-man-up, etc.) that increase speed and stamina more rapidly than distance running while limiting total miles run.

INTERVENTIONS	RECOMMENDATIONS
	o Vary the body's need for a physiologic training overload with the need for recovery and rebuilding by coordinating military and physical training to: ▪ Avoid exhaustive military or physical training (e.g., obstacle courses, long road marches with heavy loads, longer runs, maximal-effort physical fitness testing, etc.) on the same or successive days. ▪ Allow adequate recovery time between administrations of maximal effort physical fitness tests (ideally 3-5 days for Servicemembers in operational units) to prevent overtraining and increase the likelihood of improved physical performance. ▪ Alternate training days that emphasize lower body weight-bearing physical activity with training days focused on upper body conditioning. ▪ 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.
TRAIN SERVICE-MEMBERS IN SPECIAL AWARE-NESS AND CORE BODY MOVEMENT AND MANAGEMENT SKILLS	The JSPTIPWG strongly recommends that core body movement and management skills training be included in regular physical training. The WG found good evidence that increasing the proportion of physical training time devoted to varying musculoskeletal stress and the improvement of body movement skills through cross-training reduces injuries. Cross-training exercises and body movement skills must improve agility, posture, stability, flexibility, balance, speed, power, reactive ability, and coordination. Attention to precision of movement during execution of these exercises is paramount.
PRE-EXERCISE WARM-UP INCLUDING NEUROMUSCULAR ACTIVITIES	The JSPTIPWG strongly recommends the inclusion of neuromuscular and proprioceptive performance activities as the core of any warm-up activity. The WG found good evidence that a structured program of task-specific, dynamic warm-up activities prior to more intense physical training or sport participation prevents injury. For example, brisk walking or light jogging before running; before sport participation, exercises and agility drills to improve awareness and control of major joints by throwing, cutting, plyometric jumping, landing, and exercise to improve neuromuscular control, balance, and strength. Stretching exercises are not a necessary component of the warm-up.
MOUTHGUARDS TO REDUCE OROFACIAL INJURY	The JSPTIPWG strongly recommends all Services provide mouthguards for all individuals participating in high-risk activities. The WG found good evidence that mouthguards reduce orofacial injuries when worn during activities with high orofacial injury risk (e.g., combatives, obstacle courses, rifle/bayonet training, etc., and contact sports such as basketball, football, etc.).
ANKLE SUPPORT WITH SEMI-RIGID ANKLE BRACES	The JSPTIPWG strongly recommends that semi-rigid ankle braces be utilized during participation in high risk physical activity. The WG found good evidence that semi-rigid ankle braces reduce re-injuries for individuals with previous moderate or severe ankle sprains and good evidence that semi-rigid ankle braces reduce ankle injuries when

INTERVENTIONS	RECOMMENDATIONS
	participating in high-risk physical activity such as airborne operations (parachuting), obstacle courses, basketball, volleyball, soccer, etc.
PRE- AND POST-PT NUTRITION, SUPPLEMENTATION, AND HYDRATION	The JSPTIPWG recommends supplementing diet with a carbohydrate-protein snack and balanced fluid replacement beverage within one hour only after very strenuous, prolonged, continuous physical activity (e.g., prolonged road marching/hiking) to reduce musculoskeletal injury risk. The WG found sufficient evidence that supplementation of a carbohydrate-protein snack and balanced fluid replacement beverage within one hour after very strenuous, prolonged, continuous physical activity reduces injury and that the benefits outweigh the harms. Collateral benefits such as reduction of heat-related illness and enhanced physical performance can be expected.
STRONGLY RECOMMENDED INJURY PREVENTION PROGRAM ELEMENTS	
REQUIRE LEADERSHIP ACCOUNTABILITY FOR UNIT INJURY AND FITNESS TEST PASS RATES	The JSPTIPWG strongly recommends military and civilian leadership enforcement of injury prevention policies and programs at all levels, including the accountability for total unit injury rates and fitness test pass rates. While leadership alone has not been studied as a prevention intervention, the WG deems leadership enforcement an essential 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 interventions and common sense to reduce exposure to injury risk during physical training, field exercises, and off-duty recreational activities.
PROVIDE COMMANDERS WITH UNIT INJURY RATE AND CAUSE REPORTS (SURVEILLANCE – PART I)	The JSPTIPWG strongly supports mandatory injury cause coding in the outpatient electronic health record (AHLTA) and reporting to commanders. While surveillance has not been studied as a prevention intervention, the understanding of injury cause is crucial. The WG, therefore, deems surveillance as an essential program element. To systematically analyze and prevent injuries throughout the DoD, routine medical surveillance of injury causes is critical. Additionally, department wide surveillance of physical fitness would also provide rich information since it is one of the primary risk factors for injury. Data on injury cause and physical fitness would greatly facilitate the prioritization of resources, research, and the targeting of interventions to reduce injury rates, thereby improving physical readiness.
IMPROVING PHYSICAL PROFILE DOCUMENTATION AND REPORTING (SURVEILLANCE – PART II)	The JSPTIPWG strongly recommends that the Military Healthcare System include a systematic approach for restricting duty (including physical activity) within the electronic health record (AHLTA) of each Servicemember. While profiling has not been studied as a prevention intervention, a systematic approach for restricting activity provides objectivity, consistency, and longitudinal tracking for the protection of injury. The WG deems surveillance as an essential program element. The WG further recommends piloting the idea of a clinic liaison that would interface with supported military units to resolve duty restriction questions and inconsistencies to minimize the

INTERVENTIONS	RECOMMENDATIONS
	prevalence of under- or over-stressing injuries to prevent their recurrence.
INJURY PREVENTION EDUCATION TO LEADERSHIP, CADRE, AND SERVICEMEMBERS	The JSPTIPWG strongly recommends injury prevention education for all levels of leadership as a part of institutionalized continuing military education and distance learning programs. While education alone is not studied as a prevention intervention, the WG deems education as an essential program element. The reduction of injuries is most likely to occur if all levels of leadership (command and cadre) understand the injury risk factors Servicemembers face and which interventions work to prevent them. Education is the first step in disseminating evidence-based interventions that can be implemented at the unit level and is the first component of any successful program that reduces injuries. Leadership can then be empowered with the knowledge and skills necessary to effectively reduce injuries where they find them.
RESEARCH AND PROGRAM EVALUATION	The JSPTIPWG strongly recommends a greater investment of resources (DoD wide) to investigate promising interventions to reduce injuries. The WG deems research and program evaluation as an essential program element. The sparse number of interventions that had enough scientific evidence to evaluate effectiveness for the leading health problem impacting on U.S. military force readiness today is a testament to the need for more research and program evaluation in this area of musculoskeletal injury prevention. The remaining recommendations and other possible interventions in this report serve as a comprehensive list of interventions which merit further investigation into their efficacy.

Table 20-2. Original Overall Scores for Strong Recommendations (for All Servicemembers) in Rank Order

INTERVENTION	SCORE	SD	MEDIAN	MINIMUM	MAXIMUM
Preventing Overtraining	86.3	8.5	87	68	100
Body Movement Skills	77.7	7.8	76	66	94
Mouthgaurds	74.2	11.6	74	48	100
Ankle Bracing	70.1	10.3	68	50	90
Nutrition	67.0	11.6	66	54	94

INTERVENTIONS	RECOMMENDATIONS
ISOLATED MUSCLE STRENGTH TRAINING	The JSPTIPWG recommends specific muscle group strengthening for rehabilitation of injury to aid in recovery where appropriate and prevent injury recurrence. The WG found good evidence that targeted muscle strengthening provides recovery in the treatment of injuries and fair evidence to suggest that isolated muscle strengthening of the low back may prevent injuries in the low back. The WG concludes that more research on the precise series or combinations of strengthening exercise in the military population is necessary.
PRE-ACCESSION FITNESS PROGRAM	The JSPTIPWG recommends a preconditioning program 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. The WG found at least fair evidence that pre-accession fitness programs reduce injuries and attrition for low-fit recruits and have the added benefit of improved physical fitness scores at the end of the basic training cycle.
SPECIAL SOCKS AND ANTIPERSPIRANTS TO PREVENT BLISTER INJURIES	The JSPTIPWG recommends the use of moisture-wicking socks (e.g., polyester blended) to prevent blister injuries to the feet during physical training and extended foot marching. The WG found at least fair evidence that special moisture-wicking socks or antiperspirants can prevent blister injuries to the feet, especially for long distance use. The WG concludes that the benefits and harms of antiperspirant use on the foot too close to justify a general recommendation for all Services.
IMPROVED OBSTACLE COURSE LANDING AREAS	The JSPTIPWG recommends shredded rubber material under obstacle courses for the protection of fall injuries. The WG found at least fair evidence that shredded rubber material attenuates shock the better than other materials and is associated with fewer civilian playground injuries in children. However, the evidence is insufficient to recommend for or against use of this material on military obstacle course landing areas for the prevention of injuries. Evidence that shredded rubber on military obstacle course landing areas is lacking. Therefore, the WG strongly recommends that this specific research question be addressed among Servicemembers.
INCORPORATE SAFE LIFTING TRAINING INTO PT FOR INDIVIDUALS WITH A HISTORY OF BACK INJURY	The JSPTIPWG recommends education, including safe lifting technique training, to prevent injury recurrence in those individuals with prior history of low back pain or related diagnoses where improper body mechanics have contributed to (or caused) the injury. The WG found fair evidence that back education prevents recurrences of low back pain in those individuals with a history of back injury and concludes that the benefits outweigh the harms.
PREDICTING INJURY RISK THROUGH USE OF AN INJURY RISK INDEX	The JSPTIPWG recommends that a statistical modeling technique 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 targeting interventions to reduce that risk. The WG did not find any composite musculoskeletal injury risk index in the literature. However, the WG did find at least fair evidence

	that certain tests are predictive of specific injuries and that screening for specific risk factors allows for interventions that reduce the overall risk. The benefits of developing an injury risk index clearly outweigh any harm.

Table 20-3. Recommendations with Limited Applicability

Table 20-4. Recommendations Against

INTERVENTIONS	RECOMMENDATIONS
PRE-EXERCISE STRETCHING	The JSPTIPWG does not recommend pre-exercise stretching as a component of exercise warm-up. The WG found good evidence that pre-exercise stretching is ineffective as an injury prevention intervention during follow on activity. Studies to date have not specifically targeted individuals with limited motion. Because epidemiological data indicate that both extremes of flexibility (too much or too little) are associated with increased injury rates, the WG recommends research on selective targeting of individuals with limited range of motion to determine the effect of stretching on this select population.
BACK BRACES, HARNESSES, AND SUPPORT BELTS	The JSPTIPWG recommends against the use of back braces, harnesses, and support belts for the prevention of low back injuries. The WG found at least moderate to strong evidence that back belts/supports are ineffective or that the harms outweigh the benefits. Furthermore, DoD has issued policy against their use for injury prevention.
PRE-EXERCISE ADMINISTRATION OF ANTI-INFLAMMATORY MEDICATION	The JSPTIPWG recommends against the administration of anti-inflammatory medication prior to exercise for the prevention of injuries. The WG found that the evidence for pre-administration of NSAIDs is lacking, of poor quality, or conflicting and it appears that the harms may outweigh the benefits.

Table 20-5. Intervention Theories Recommended for Further Research

INTERVENTIONS	RECOMMENDATIONS
REINITIATING EXERCISE AT LOWER INTENSITY LEVELS FOR THE DETRAINED	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 the exact point of detraining that requires exercise reinitiation at lower levels. The JSPTIPWG recommends further research into how much detraining requires a lower level of intensity and duration of exercise to prevent injury.
POST-EXERCISE COOL-DOWN	The JSPTIPWG recommends a literature review be conducted on the use of cool-down activities for the prevention of injuries.
POST-EXERCISE STRETCHING	The evidence is insufficient to recommend for or against post-exercise stretching for the prevention of injuries. Evidence that stretching after exercise as an intervention for injury prevention is lacking. The JSPTIPWG recommends further research on the effect of stretching targeted only at those with very low flexibility on injury rates.
PLACE SHORTER SERVICEMEMBERS IN FRONT OF FORMATIONS TO SET RUNNING PACE	The evidence is insufficient to recommend for or against placing the shorter Servicemembers in the front of a marching formation and those who are taller to the rear for the prevention of injuries. Evidence that placing Servicemembers in ranks from front to back by their physical height an intervention strategy to prevent lower extremity injuries is weak. Therefore, the JSPTIPWG recommends that this specific research question be addressed.
RUN AND MARCH AT OWN STRIDE LENGTH	The evidence is insufficient to recommend for or against allowing Servicemembers to march at their own stride length for the prevention of injuries. Evidence that stride length manipulation as an intervention for lower extremity injuries is lacking or of poor quality. Therefore, the JSPTIPWG recommends that this specific research question be addressed.
STANDARDIZED GRADUATED HIKING PROGRAM	The evidence is insufficient to recommend for or against a standardized graduated hiking program for the prevention of injuries. Evidence that a standardized graduated hiking program is effective is lacking. Therefore, the JSPTIPWG recommends that this specific research question be addressed if the mission so dictates.
INTRODUCTION OF FLAK VESTS IN BCT: INCREASES IN LOAD BEARING EQUIPMENT	The evidence is insufficient to recommend for or against introduction of flak vests in BCT/ increases in load-bearing equipment for the prevention of injuries. Evidence that introduction of flak vests in BCT/increases in load-bearing equipment is effective is lacking. Therefore, the JSPTIPWG recommends that this specific research question be addressed.
MASS VS. INDIVIDUAL TRAINING	The JSPTIPWG recommends a literature review and quality analysis be conducted on mass or individual training in like units to affect injury rates.
AVOIDANCE OF	The evidence is insufficient to recommend for or against eliminating or avoiding any

“HARMFUL” EXERCISES	specific exercise or movement for the prevention of injuries. Evidence that eliminating or avoiding any specific exercise or movement is lacking. Therefore, the JSPTIPWG recommends that research on specific exercises or movements called into question be addressed individually.
ASSESS BODY WEIGHT AND PHYSICAL FITNESS ON DIFFERENT DAYS	The evidence is insufficient to recommend for or against separating weigh-ins from performance tests for the prevention of injuries. Evidence that separating weigh-ins from performance tests is effective is lacking. Therefore, the JSPTIPWG recommends that this specific research question be addressed.
REPLACEMENT OF RUNNING SHOES	Shoe manufacturers and biomechanical studies on running shoes report that shoes should last between 400 and 600 miles and should therefore be replaced by that period of time. The WG concludes that the scientific evidence is insufficient to recommend for or against replacing running shoes for the prevention of injuries at that interval. Evidence that replacing running shoes at specific intervals is effective is lacking and the balance of benefits has not been determined. Therefore, the WG recommends that this specific research question be addressed.
INDIVIDUAL RUNNING SHOE PRESCRIPTION	The common practice of fitting the foot with a running shoe that is consistent with foot shape (generally based on the assumption that foot shape is a surrogate for foot arch height and foot/ankle flexibility) to prevent foot and lower extremity injury has not been definitively confirmed. The evidence that prescription running shoes are effective is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined. Therefore, the JSPTIPWG recommends that this specific research question be addressed.
SHOCK-ABSORBING INSOLES	The JSPTIPWG makes no recommendation for or against shock-absorbing insoles for the prevention of injuries. The WG found at least fair evidence that shock-absorbing insoles can reduce injuries but concludes that the balance of benefits is too close to justify a general recommendation for all Servicemembers. Insoles may be appropriate for individual Servicemembers or high risk populations only. Therefore, the WG recommends further research on shock absorbing insoles, particularly for use in military boots as cushioning technology of running shoes is adequate.
KNEE OR ELBOW JOINT BRACES	The JSPTIPWG concludes that the evidence is insufficient to recommend for or against the prophylactic use of knee or elbow braces for the prevention of injuries. Evidence that knee or elbow bracing is effective is lacking or of poor quality and the balance of benefits and harms cannot be determined. Therefore, the WG recommends further research on this topic.
ANKLE TAPING	The evidence is insufficient to recommend for or against ankle taping for the prevention of ankle sprain injuries. Evidence that ankle taping is effective is lacking. However, since implementation of this particular intervention in the military may be impractical, the WG recommends that this specific research question be addressed and the feasibility of implementation with only specific target groups of the military be evaluated.

MOUTHGUARDS TO PREVENT CONCUSSION	The evidence is insufficient to recommend for or against mouthguards to prevent concussion injuries. Evidence that mouthguard use (for concussion injuries) is effective is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined. Therefore, the WG recommends that this specific research question be addressed.
RUNNING SURFACES THAT MINIMIZE INJURY	The JSPTIPWG concludes that the evidence is insufficient to recommend for or against any particular running surface for the prevention of injuries. 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. Therefore, the WG recommends that this specific research question be addressed.
ADJUSTMENT OF TRAINING LOAD BY SEASONAL VARIATIONS	The JSPTIPWG concludes that the evidence is insufficient to recommend seasonably adjusting training load to prevent injuries. Evidence that seasonably adjusting physical training load is effective is insufficient and the balance of benefits and harms cannot be determined. Therefore, the WG recommends that future investigation be conducted to clearly demonstrate an association between temperature and overall injury incidence and evaluate the benefits and harms to adjusting physical training according to environmental conditions.
SMOKING CESSATION PROGRAMS	While smoking has been identified as a strong risk factor for musculoskeletal injury we conclude that the evidence is insufficient to recommend for or against smoking cessation programs for the purpose of preventing injuries. Evidence that smoking cessation programs are effective in reducing injuries is lacking. Therefore, the JSPTIPWG strongly recommends that this specific research question be addressed.
ALCOHOL CESSATION PROGRAMS	The evidence is insufficient to recommend for or against alcohol cessation programs for the purpose of preventing injuries. Evidence that alcohol cessation programs are effective is lacking. Therefore, the JSPTIPWG recommends that this specific research question be addressed.
INCORPORATE SAFE LIFTING TRAINING INTO PT FOR THE PRE-VENTION OF INJURIES IN THE OTHERWISE HEALTHY INDIVIDUAL	The JSPTIPWG concludes that the evidence is insufficient to recommend for or against pre-injury safe lifting technique training for the prevention of injuries in the otherwise healthy individual. Direct evidence that pre-injury safe lifting technique training in healthy individuals effectively reduces injury or minimizes injury risk is lacking. Therefore, the JSPTIPWG recommends further research into the effectiveness of safe lifting technique training in healthy, uninjured individuals on injury risk.
EARLY SELF INTERVENTION WITH CRYOTHERAPY	While cryotherapy affects other aspects resultant of injury such as swelling, pain, range of motion, etc., the JSPTIPWG concludes that the evidence is insufficient to recommend for or against cryotherapy for the prevention of reinjury. Evidence that cryotherapy is effective in preventing reinjury is lacking. Therefore, the WG recommends that the question whether the application of ice post injury is protective against re-injury be addressed.
BIRTH CONTROL PILL	The JSPTIPWG concludes that the evidence is insufficient to recommend for or against

USE TO INCREASE KNEE STABILITY	birth control pill (BCP) usage to prevent injuries in females. Evidence that BCP usage is effective in reducing injuries is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined. Therefore, the WG recommends that this specific research question be addressed.
STANDARDIZED RECONDITIONING PROGRAM FOR THE RECENTLY INJURED	The JSPTIPWG concludes that the evidence is insufficient to recommend for or against a standardized injury reconditioning program for the prevention of further injury. While substantial evidence exists for the benefits of rehabilitation for specific injuries, evidence that a standardized reconditioning program for the masses is effective is nonexistent. Therefore, the WG recommends that a standardized injury reconditioning program to prevent re-injury be evaluated for efficacy and weigh the benefits and unintended consequences of such a program for mass military training.
FORWARD DEPLOYED ALLIED HEALTH PROFESSIONALS	The JSPTIPWG concludes that the evidence is insufficient to recommend for or against forward positioned allied health professionals to prevent re-injury. The WG recommends a scientific evaluation of the Navy SMART centers and SMIP programs to determine efficacy and return on investment.
PSYCHOSOCIAL ISSUES RELATED TO INJURY	The JSPTIPWG recommends that a review and analysis on various psychosocial issues that are related to injury be performed and further research be conducted (as appropriate) to clearly identify what interventions may impact the reduction of injury risk.

Appendix A. 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 B. 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 C. USACHPPM-JHCIRP Army Injury Prevention Priorities Work Group

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Assistant Scientist, JHBSPH

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 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 & health infrastructure
- Adequacy of resources
- Benefits greater than costs
- Evaluation capability

4. Brainstorm additional criteria.

Additional criteria added by 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 & 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 C-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 C-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. 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 & facilities, safety staff & 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 & 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-1. 25 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 & biological weapons, terrorism)
12. Late effects of injury	
13. 13. Lifting/pushing/pulling	25. Water transport

*Alphabetical list compiled from Atlas of Injuries in the U.S. Armed Forces, *Mil Med* 164(8):5-46.

Appendix F. Joint Services Physical Training Injury Prevention Work Group (JSPTIPWG) Members

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

	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 (defined in Appendix B) 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**	Srudies 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

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 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 us 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 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).

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

Conduct an online literature search.

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

- Limit your search to human studies only for the years 1970-2005, in the English language.
- Refer to the criteria in Appendix A 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.

SAMPLE **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

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**	
	Stasinopoulis, S / 03	M	+	8	Thomas, R / 99	x	5		Smith, J / 01			
	Taft, R / 98		+	6								
No. of Refs Found[a]												
Literature Reviews												

[a] The "No. of Refs Found" indicates the number of studies that met the search and inclusion criteria from appendices A and B. 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 it 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 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 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-values 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. 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 WG recommends further research on the following: ____ ____ ________________.

*Adapted from United States Preventive Services Task Force (USPSTF).

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.

USPSTF: Strength of Recommendations and Quality of Evidence. *Guide to Clinical Preventive Services, Third Edition: Periodic Updates,* 2000-2003. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/3rduspstf/ratings.htm

Appendix O. JSPTIPWG Criteria for Ranking Physical Training 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 the Defense Safety Oversight Council Criteria, 2004.

Date of Review:______________ Name of Reviewer: ________________________________

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

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

1. Running volume (intensity, duration, frequency, over load)
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. Mouth guards, 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. Health care 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 vs. 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

Note: Reviewers were blinded to primary authors' names and affiliations, but not to study results.

Appendix R. Format for Revised Recommendations*

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 WG recommends further research on the following: ____ ____ ________________.

*Adapted from United States Preventive Services Task Force.