

## Health-Related Fitness in the Royal Netherlands Army

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### **SUMMARY**

*Physical fitness is often divided up into skill-related fitness and health-related fitness. Health-related fitness in its turn is often subdivided into three components that together determine overall health status: cardiorespiratory fitness, musculoskeletal fitness, and body composition. For military personnel, HRF can be seen as the foundation on which general fitness, task-specific fitness, and, eventually, physical preparedness for unit missions can be built. Moreover, a sufficient level of health-related fitness is a prerequisite to prevent from disease. Two of the main health-related fitness issues that the Royal Netherlands Army is currently dealing with are musculoskeletal injuries and lifestyle-related health problems. Research efforts, intervention activities, and policies within the Dutch Army on each of these two issues are reviewed and exemplified in this paper.*

### **1.0 DEFINING HEALTH-RELATED FITNESS IN THE MILITARY**

The Army is well known for its demanding and rigorous physical training. Despite continuing mechanization and automation of warfare, a high level of physical fitness is still a critical aspect of military preparedness. In the military context, physical fitness is defined as the physical capacity to perform physical demands of one's occupation or unit missions. [1]

Being a broad term and complex subject, physical fitness is often divided up into skill- or performance-related fitness and health-related fitness.[2] Skill-related fitness is integral to success in specific physical tasks that require one or more of the following skill components: speed, reaction time, agility, balance co-ordination, and power. These components do not necessarily contribute to health and disease prevention. In the literature, health-related fitness (HRF) has been defined as "a state characterized by an ability to perform daily activities with vigor and a demonstration of traits and capacities that are associated with low risk of premature development of the hypokinetic diseases (i.e., those associated with physical inactivity)." [3]

HRF can be subdivided into three components that together determine overall health status: cardiorespiratory fitness, musculoskeletal fitness, and body composition. Cardiorespiratory (or aerobic) fitness is the ability to continue or persist in strenuous tasks involving large muscle groups for extended periods of time. Musculoskeletal fitness is determined by the individual's muscular strength (i.e., the maximal one-effort force that a muscle can exert against a resistance), muscular endurance (i.e., the ability of the muscle to supply a submaximal force repeatedly), and flexibility (i.e., the ability of the joints to move through a full range of movement), respectively. Body composition comprises the relative amounts of body fat and lean-body tissue or fat-free mass such as muscle, bone, and water.

## Report Documentation Page

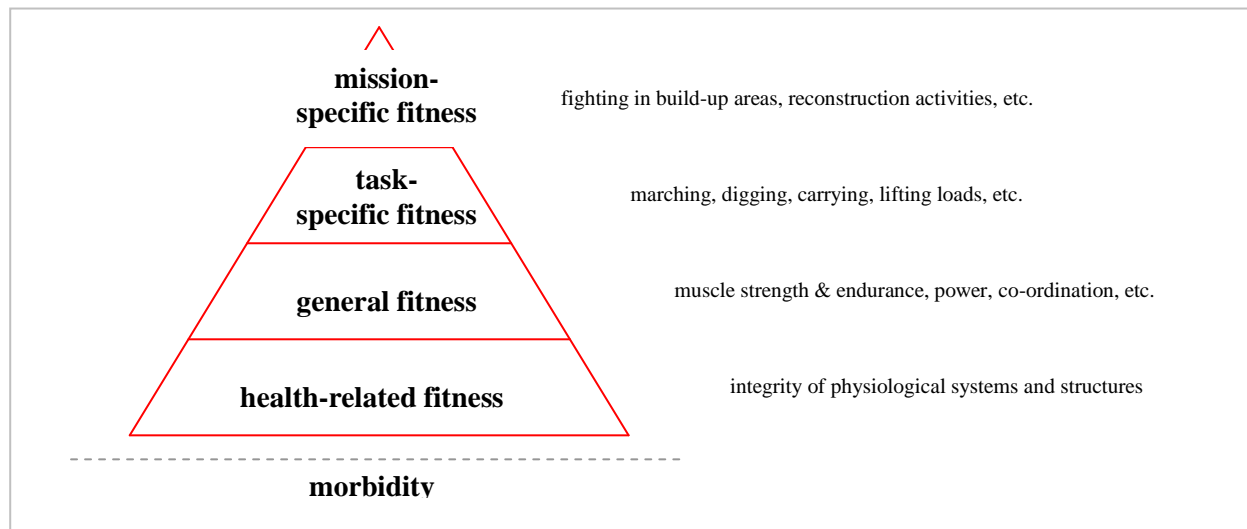
*Form Approved*  
*OMB No. 0704-0188*

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1. REPORT DATE <b>OCT 2009</b>	2. REPORT TYPE <b>N/A</b>	3. DATES COVERED <b>-</b>	
4. TITLE AND SUBTITLE <b>Health-Related Fitness in the Royal Netherlands Army</b>		5a. CONTRACT NUMBER	
		5b. GRANT NUMBER	
		5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)		5d. PROJECT NUMBER	
		5e. TASK NUMBER	
		5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Training Medicine and Training Physiology Personnel Command Royal Netherlands Army Complex Arthur van Schendelstraat P.O. Box 90.004 3509 AA Utrecht NETHERLANDS</b>		8. PERFORMING ORGANIZATION REPORT NUMBER	
		10. SPONSOR/MONITOR'S ACRONYM(S)	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
		12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>	
13. SUPPLEMENTARY NOTES <b>See also ADA562561. RTO-MP-HFM-181 Human Performance Enhancement for NATO Military Operations (Science, Technology and Ethics) (Amelioration des performances humaines dans les operations militaires de l'OTAN (Science, Technologie et Ethique)). RTO Human Factors and Medicine Panel (HFM) Symposium held in Sofia, Bulgaria, on 5-7 October 2009., The original document contains color images.</b>			
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15. SUBJECT TERMS			
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>SAR</b>
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>	
			18. NUMBER OF PAGES <b>10</b>
			19a. NAME OF RESPONSIBLE PERSON



For military personnel, HRF can be seen as the foundation on which general fitness, task-specific fitness, and, eventually, physical preparedness for unit missions can be built. Moreover, a sufficient level of HRF is a prerequisite to prevent from disease. See Figure 1.



**Figure 1: Model of physical fitness in the military.**

In modern society, where technology and mechanization have taken the place of physical labor and where physical education has been de-emphasized, military personnel are exposed to the same negative trends in lifestyle behavior and health status that affect civil populations. For example, an older active duty member that has not adequately adapt his/her lifestyle (e.g., nutritional behaviour, level of physical activity) to the transition of a physically demanding occupation as an operational commander to a more sedentary job as a staff executive, may be confronted with the consequences of overweight and other cardiovascular risk factors. Moreover, a young recruit may suddenly meet physical demands that are far above those previously exposed to, eventually leading to musculoskeletal injuries.

Generally, the downsize of military forces in the last decade means the readiness of every RNLA member becomes even more important. Two of the main HRF issues that the Royal Netherlands Army (RNLA) is currently dealing with are musculoskeletal injuries in military training settings and lifestyle-related (cardiovascular) health problems. Research efforts, intervention activities, and policies within the RNLA on each of these health problems will be reviewed and exemplified in this paper.

## 2.0 MUSCULOSKELETAL INJURIES

### 2.1 Introduction

Early withdrawal of recruits in basic military training programs is a major problem for Western military forces that depend on volitional service members. In recent years, the RNLA has frequently been confronted with vacancies, especially for the infantry. In the three school batallions of the RNLA, musculoskeletal injuries are a major reason for recruits to withdraw from the training. Overload injuries of the lower extremities (knee, lower leg, ankle) together make as high as 75% of the total amount of injuries in basic infantry training that is

registered by the medical officer. On average, one out of ten Dutch recruits ends up in a remedial platoon, in which custom physical training programs are provided that aim at a quick return of the injured recruits to the regular military training. Only half of this group completes the regular program successfully.

A number of preventive measures have been taken in the last few years to diminish the injury rate, amongst other things, in the Dutch armed forces. Several of these measures will be addressed here, clustered into *recruitment & selection* measures, *education & training* measures, and *health care* measures.

### 2.2 Recruitment & Selection

Baseline fitness is a well-recognized determinant of injury risk during basic training. Improving the fitness of low-fit recruits before exposing them to basic training may, therefore, be a promising approach. In recent years, civil vocational training institutes in the Netherlands have introduced an annual educational program, the so-called 'Orientation Year Dutch Army', aimed at preparing potential recruits, i.e., students who are interested for a military job, for the armed forces. This training also includes a thorough physical exercise program aimed at increasing the chance of passing the initial RNLA examination.

The RNLA examination comprises both psychological and physical tests. The physical examination has been validated against major military tasks that involve physical labour (e.g., marching, carrying) and consists of:

- An evaluation of the individual's carrying capacity by means of isokinetic upper body measurements;
- The individual's marching capacity by means of bicycle ergometry and isokinetic lower body measurements; and
- The individual's body composition by means of skinfold measurement.

Moreover, solicitants who have passed the initial military examinations are given tailored information - based on their physical scores - on how to maintain their level of fitness until the actual start of the basic training.

### 2.3 Education & Training

In recent years, basic RNLA training regimes on (speed) marching with/without loads have been modified to reduce the frequency of overuse injuries without adverse effects on fitness levels. On the basis of literature and field research, the Physical Education & Sports Organization of the RNLA has recently updated its training manuals on (speed) marching with, amongst others, the following guidelines:

- More gradual progression in training load (e.g., speed marching only starts after several weeks of basic training, use of periodization-model);
- Week cycles in which marching and speed marching are alternated; and
- Lowering the total marching distance in training regimes by introducing training sessions in which less kilometres are marched with more load.

Since 2000, agreements on the preparation, execution, and evaluation of annual physical training programs per RNLA unit are embedded in a 'physical education & training' document. This document is a co-production of the unit's physical education & sports department and the unit commander.

For over a decade now, the RNLA operates a so-called 'boot protocol' which allows fresh recruits to gradually get used to walking on their boots by interspersing with their sports shoes.

### 2.4 Health Care

Since the mid 90s, military health care professionals from the RNLA have been co-operating in so-called Sports Medical Advice Teams (SMAT). These local committees, consisting of military GPs, company medical officers, physiotherapists, and fitness instructors, meet on a regular basis to discuss casuistry and injury trends within units, and to advise unit commanders. Recently, the working procedures for these SMATs have been updated, in a sense that the unit commander has become a key player in the team. Partly on the advice of the health care professionals, the unit commander decides whether an injured recruit is transferred to the SMAT for a rehabilitation program. At this stage, the recruit is formally out of the regular unit program. He or she will go through two rehabilitation phases: a 'physio-fit' phase co-ordinated by the physiotherapist PT, and a 'sports-fit' co-ordinated by the fitness instructors. After this, the recruit returns to the unit for the last ('job-fit') phase, in which the unit commander is responsible for the individual's work up to the a necessary level of physical readiness.

There is inconsistent evidence that the use of custom insoles or specific types of running shoes during basic training will reduce injuries in military recruits. Specialists and researchers from the RNLA are planning to investigate the potential of a dynamic footscan system (RS Scan International<sup>®</sup>) at the entry of the basic military training for predicting lower limb injuries in recruits during the training. This research is expected to start in the second half of 2009.

Several measures for the secondary prevention of injuries in the RNLA have been investigated or will be investigated in the near future. In the last few years, RNLA clinical researchers have studied the potential of a sports medicine based training approach in service members with nonspecific low back pain, named 'isolated lumbar extensor training'. Several randomized clinical trials were performed on, in total, 273 service members with back pain. All trials showed concordance in their outcomes, in the sense that specific back training gave no clearly favorable results in restoring back function compared to usual (military) care. [4-6]

Currently, a study is performed at the school batallion of the RNLA Air Mobile Brigade that aims to reduce the early withdrawal of recruits in basic military training due to injuries. The predictive value is evaluated of a physical fitness profile of each recruit, based on both physical tests and a brief survey with items on, among other things, sports history and injury history. Moreover, the effectiveness as well as the applicability of individualized and differentiated training regimes are assessed in this project.

For the near future, RNLA clinical researchers are evaluating the possibilities of studying two potentially promising techniques in overuse injuries: autologous platelet-rich plasma application in traumatic tendon injuries, [7] and collagen hydrolysate in joint pain [8].

## 3.0 LIFESTYLE-RELATED HEALTH PROBLEMS

### 3.1 Introduction

Concordant to the increasing interest in health surveillance in society, the RNLA recognizes the need to monitor fitness and health of its service members. The focus of monitoring has generally been on performance standards for maintaining personnel readiness rather than on health risks. Consequently, existing data resources and collection procedures within the RNLA have not been designed to provide comprehensive epidemiologic data on health and health-related fitness issues.

Until now, the need for RNLA health monitoring has been met incidentally through ad hoc studies conducted within specific populations. These one-time assessments, apart from being labor-intensive, have been not

proved efficient as ongoing tracking systems to evaluate the efficacy of health promotion efforts, but they at least gave a broad idea about the health status of the army personnel. A short overview of health assessments within the RNLA in this last decade is given below.

### **3.2 Health Assessments in the RNLA**

In the mid 90s, two health assessments among military personnel from the RNLA have been conducted. One study population comprised 277 male participants (mean age 38 yr, range 21-54 yr) of a medical screening as part of a job rotation procedure. The other study population consisted of 284 male participants (mean age 35 yr, range 27-47 yr) of career courses for NCO's and officers. Both studies had similar outcomes. Comparison with a limited number of other studies among men in The Netherlands showed that the prevalence of several risk factors for cardiovascular disease (overweight, cholesterol level, blood pressure) were unfavourable. The most prominent increase in risk factors was seen in military service members under 40 years of age. It was concluded that health policy should be directed at the prevention in younger populations and at the lowering of risk factors in the over 40 population, by measures directed at physical activity and nutrition.

In 2006, lifestyle behavior was examined in a group of 110 male Air Mobile Brigade recruits (age 19-26 yr), before and after their basic military training. Baseline and post-training results are presented in Table 1.

**Table 1: Lifestyle behaviour AMB recruits during basic military training.**

<b>Start of basic military training</b>	<b>End of basic military training</b>
90% involved in sports activities	100% involved in sports activities
50% used tobacco on a daily base	40% used tobacco on a daily base
90% did not meet nutritional standards <sup>1</sup>	60% did not meet nutritional standards
25% skipped breakfast	5% skipped breakfast

<sup>1</sup> Dutch nutritional standards: 2 pieces of fruit plus 200 grams of vegetables a day

The frequency of junk food (fried products) had increased dramatically during this period, likely due to the fact that these products were available at the military mess on a large scale and at low prices. It was concluded that health promotion activities for this target group were beneficial, but only in concordance with a health-stimulating environment. Therefore, changes in price setting and product range in military messes were advised.

In 2008 and 2009, a wide range of health and fitness parameters were examined in two RNLA subpopulations: staff from an education and training unit for logistic personnel (163 male, 2 female) and staff from the RNLA commanding staff (88 male, 9 female), both representing a relatively old age-group and the latter also with relatively high psychological job demands/responsibilities. The results from these studies are summarized in Table 2. It was concluded that overweight percentages in these military populations are similar to reference groups of Dutch adults (approx. 50%), obesity percentages are even 5-10% higher than in Dutch adults. As far as tobacco use is concerned, the training unit staff scored similar to civilian references (approx. 30%), the commanding staff scored much healthier (8%). The majority of the commanding staff personnel (approx.

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60%) did not meet Dutch standards for physical fitness and healthy food, almost half of this group (45%) did not meet the Dutch health standard.

**Table 2: Health and fitness parameters of two RNLA military populations.**

	<b>Staff Education &amp; Training Unit (N =165)</b>	<b>Commanding Staff (N = 97)</b>
Mean age (range)	44 years (24-57)	46 years (26-57)
Overweight <sup>1</sup>	44%	51%
Obesity <sup>1</sup>	15%	19%
Unhealthy waist circumference <sup>2</sup>		
Action level 1	34%	28%
Action level 2	20%	28%
Tobacco use	27%	8%
Does not meet Dutch health standard <sup>3</sup>	-	60%
Does not meet Dutch fitness standard <sup>4</sup>	-	45%
Does not meet Dutch nutritional standard <sup>5</sup>	-	63%
Does not meet basic HRF Test standards <sup>6</sup>	-	53%

<sup>1</sup> Measured with body mass index (BMI): healthy weight; BMI < 25,5; overweight, BMI 25,5-29,5; obesity, BMI ≥ 29.5.

<sup>2</sup> Action level 1, overweight without abnormal abdominal fat distribution; Action level 2, overweight with abnormal abdominal fat distribution.

<sup>3</sup> Basic HRF Test: performances on 4 strength devices (leg press, chest press, shoulder press, vertical traction) and cardio-stepper (progressive protocol), according to gender- and age- specific standards.

Conclusively, these one-time assessments indicate that despite the fact that the military population is not demographically representative of the civilian work force (e.g., most are male), poor health habits of military members are quite similar and often are more prevalent. Therefore, health risk management and health promotion activities are of current interest for RNLA policy makers.

### 3.3 Physical Fitness and Cardial Screening

Mandatory medical checks as part of a job rotation procedure within the RNLA were abolished in the mid 90s. Instead, the RNLA medical officer has been using a system of multi-staged cardial screening ever since. This screening is linked to the annual army Physical Fitness Test (PFT), a mandatory test for basic (health-related) fitness for all military army personnel, consisting of a 12-minute run, push-ups, and sit-ups, each with gender- and age-specific standards. Military service members of 40 years and more are obliged to undergo the multi-staged screening every other year before participating in the PFT.



In this screening, individual cardiovascular risk profiles are using the SCORE-system. [litt.] If cardiovascular complications are found in the screening, individuals are not allowed to participate in the PFT. The medical officer will, then, refer the individual to either a RNLA sports physician or cardiologist, depending on the problem. The multi-staged medical check is not mandatory for personnel under the age of 40. Instead, a checklist has to be filled in (items on physical activity and medical complaints) to see whether it is recommended to visit a medical officer before participating in the PFT. In 2011, the army PFT will serve as an annual basic fitness test for the entire Dutch defence organization. A different screening method before entering the PFT will be used, based on checklists in which suitability for participation is assessed by the individual him- or herself.

Besides, RNLA policy makers are currently considering the installation of a routine examination setting that is required for all RNLA active duty members, aimed both at the screening of cardiovascular risks and health-related occupational hazards by the medical officer. Certain behavioral risk factors for cardiovascular disease can be examined, such as alcohol consumption, physical activity, information on smoking prevalence, back problem prevalence, height, weight, body fat composition, hypertension prevalence, elevated cholesterol levels etcetera. Occupational factors such as work satisfaction, level of stress or several determinants of work ability (e.g., working pace, variation, independency) may be assessed as well in this periodic check. Both self-reported data and information from the attending health care provider can be obtained, for example comprising a brief survey completed by the service member and medical examiner at the time of the periodic physical examination. This routine health check may be of value for collecting health promotion information. Because the periodic examination is required for all service members, specific populations (e.g., older service members, women, lower pay grade) can be reached. Obtaining reliable data for these special subgroups is important in light of the fact that morbidity and lifestyle behavior may vary substantially by age, sex, and socioeconomic status.[9] As said, the content of such periodic health is currently under debate, as well as the the boundary condition for assuring the collection of reliable, accurate health promotion information for the RNLA. Alternatives need to be investigated regarding the periodicity of survey administration and duration of data collection. Computerized systems may be needed to collect service members' physical examination data by attending medical personnel.

### 3.4 Health Promotion Interventions

So far, health promotion efforts within the RNLA have been basically decentralized, with services provided by a variety of organizations as part of their many responsibilities. The majority of activities have been on a local scale, taking place at military installations, and were integrated with the medical or personnel functions. Some examples of initiatives within the RNLA since the mid 09s:

- A health promotion campaign on three major military locations, comprising health classes on the beneficial effects of physical activity and nutrition, day campaigns on healthy food issues in the military mess, and individual/group counseling by professional dieticians, respectively;
- Development and implementation of WeightCo@ch, an interactive computer program aimed at weight management, which is freely available for all service members that have an defence intranet account;
- Other nutritional campaigns have recently been organized at the military messes of the Dutch military academy and the RNLA commanding staff location; information stands on healthy food issues were installed, dieticians could be counseled, and fruits and healthy snacks/sandwiches were offered for free or at a discount; and
- Beside the aforementioned health and fitness assessments in a staff group of an education and training unit and in the RNLA commanding staff, respectively, participants were offered tailored fitness

programs using the Technogym Wellness System® and accompanied by fitness instructors, as well as dietetic counseling and counseling by sports physicians and manual therapists.

Clearly, in developing intervention programs, the barriers to health promotion must be considered, many of which are habitual unhealthful lifestyles. For example, despite the fact that fresh recruits come from the age group which already exhibits increased risk with respect to several health practices,[10] the urge to actually worry about chronic disease following these practices is often lacking. Therefore, messages for this target group should aim for the beneficial influence of a healthy lifestyle on military readiness and appearance, rather than on the prevention of chronic disease.

Besides, the military has more control over behavior in some health practices than others. For example, organizational policy mandates service members to abide fitness standards and to refrain from smoking in military buildings. Policies for shaping other health practices are less stringent (e.g., alcohol use, weight management) and need different ways to motivate members in changing unhealthy habits.

#### 4.0 FUTURE RESEARCH EFFORTS

In this paper, an overview has been given of the research efforts, intervention programs and policies within the RNLA concerning musculoskeletal injuries and lifestyle-related cardiovascular health problems. Other topics that currently have special attention are health issues in specific subpopulations such as older service members (e.g., osteoporotic problems), women (e.g., female athlete triad), and frequently deployed personnel (e.g., underrecovery symptoms). Together with the Dutch research institute TNO, the Dutch Defence Organization (DDO) are aiming for a 4-year research program, starting 2011, on these health-related fitness issues. An integral approach is used to address longitudinal surveillance of these health problems, to scrutinize the (cost-) effectiveness of the current DDO health care system, and to develop, implement and evaluate interventions.

Parallel to this program, a NATO Research Task group has recently been installed to specifically focus on the impact of (unhealthy) lifestyle on military fitness. Main objective of this research task group is to scrutinize the implications of lifestyle-induced societal health changes for recruitment, education & training, sustainability, medical care, and public health in the military. Moreover, efforts are made to define a common core set of data that can be obtained from long-term routine surveillance. The research group includes representatives from Germany (chair), USA, Canada, United Kingdom, Austria, Czech republic, Georgia, Estonia, and The Netherlands. Deliverance of a technical report is planned for 2012.

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