CISM 2000 INTERNATIONAL SCIENTIFIC SYMPOSIUM

GABORONE, BOTSWANA, 23-27 OCTOBER

Topic 2

Physical Fitness Concept.

Lecture 1 : "Development and Implementation of Physical Fitness Standards for Canadian Forces Personnel"

Mrs. Sue Jaenen (Canada)

Lecture 2 : "Physical Fitness in the United States Navy"

Lt. Julie Althoff (USA)

Lecture 3 : "Battle Focused Physical Training – a Career Long Commitment"

Colonel Jeanne M. Picariello (USA)

Lecture 4 : "The Norwegian Injury Prevention Programm"

Dr. Trand Heir (Norway)

Lecture 5 : "Physical Training Behaviour in French Militaru Population and the New Physical Evaluation in the Army Recruiting Centers"

Médecin en chef Francis Huet (France)

Lecture 6: " Role of Physical Fitness on Health"

Captain Dr. M. Butale (Botswana)

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Lt. M. Mashiane (South Africa)

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Lecture 9: "Negative and Positive Effects of Training on Human Health"

Major Dr. SMT Mudambo (Zimbabwe)

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Commandant Ronald Nys (Belgium)

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General Soulieman Bou Rizk (Lebanon)

THE DEVELOPMENT AND IMPLEMENTATION OF PHYSICAL FITNESS STANDARDS FOR CANADIAN FORCES PERSONNEL

By
Sue Jaenen, MSc.

CISM INTERNATIONAL SYMPOSIUM ON PHYSICAL EDUCATION IN THE ARMED FORCES

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THE DEVELOPMENT AND IMPLEMENTATION OF PHYSICAL FITNESS STANDARDS FOR CANADIAN FORCES PERSONNEL

By

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Physical fitness is a critical aspect of military preparedness and an integral part of military service. Although warfare continues to become increasingly mechanized and automated, many military operations still demand that soldiers be physically fit (NATO, 1994). Canadian Forces (CF) members must be physically fit to meet military operational requirements, to perform under a wide range of geographical and environmental conditions, to cope with the stresses of sustained operations, and to be ready to respond on short notice (Department of National Defence, Canadian Forces Administrative Order, 50-1). Physical fitness standards permit Commanding Officers to assess the physical operational readiness of their soldiers, and take corrective action for the unfit by providing physical fitness training programs. Physical fitness testing is important as the obtained data provides the basis for the development of exercise prescriptions. Physical fitness testing also permits Commanding Officers to assess the effectiveness of training programs.

The Canadian Forces Exercise Prescription (CF EXPRES) Program consists of a number of researched and scientifically validated physical fitness standards and training programs. There are three levels within the CF EXPRES program, which are hierarchical in nature. The Canadian Forces Minimum Physical Fitness Standards (CF MPFS) are based on the *Universality of Service* policy which states that "members of the Canadian Forces must at all times and under any circumstances perform any functions that they may be required to perform" (Government of Canada, 1985a). The principle of *Universality of Service* together with the requirement that combat duty is the primary responsibility while performance of a trade is secondary, implies that all CF members must be able to perform common tasks in emergency situations regardless of age, gender, rank or military occupation. Being successful in meeting the CF MPFS does not necessarily mean that one is fit to perform specific occupational requirements, because some unique occupations, units or environments have specific job demands which require a higher level of physical fitness than the minimal level. Therefore, physical fitness standards that reflect the physical demands of the job have been researched and developed for Army personnel, Fire Fighters, Search and Rescue Technicians and Special Forces Operations personnel. Currently, physical fitness standards for Divers (Ships Team, Clearance, Combat, Search and Rescue) and Parachutists are being developed.

In Canada, the creation and implementation of physical fitness standards as a condition of service is governed by the Canadian Human Rights Act. The Canadian

Human Rights Act, administered by the Department of Justice, is based on the principle that all individuals should have equal opportunities of employment to build lives for themselves and have their needs accommodated without being hindered by discriminatory practices. The Act clearly prohibits employment policies and practices that discriminate against individuals on the basis of race, national or ethnic origin, colour, religion, age, sex, sexual orientation, marital status, family status, disability or a criminal conviction for which a pardon has been granted (Government of Canada, 1985a). An important exception to these prohibitions, given in paragraph 15(1a) of the Act, states that "it is not a discriminatory practice if any refusal, exclusions, expulsion, suspension, limitation, specification or preference in relation to employment is established by an employer based on a Bona Fide Occupational Requirement"(Government of Canada, 1985a). This is an important paragraph because physical fitness standards necessarily establish barriers to entry into physically demanding occupations. The purpose of a fitness test and the attached standard is to limit employment to those personnel who are capable of performing the essential tasks of the job. If everyone succeeds, then there is no reason for the test to exist.

The Canadian Human Rights Act defines a Bona Fide Occupational Requirement (BFOR) as a "condition of service which is imposed in sincere belief that it is reasonably necessary for safe, efficient, and reliable performance of a job, and which is objectively, reasonably necessary for such performance (Government of Canada, 1985a). Three key factors determine whether a BFOR exists. These include classification of the essential components of the job, requirements for safe, efficient and reliable performance of the job tasks, and means of assessment to determine whether an employee has the capacity to fulfil these requirements (Government of Canada, 1985b). These three key factors form the basis of the methodology for the research and development of physical fitness standards for CF personnel.

The first step in the process to develop bona fide physical fitness standards is to determine the essential components of the job. All resource materials pertaining to the military occupation, including training manuals and plans, incident reports, occupational specifications, and occupational analyses if available, are reviewed to form an understanding of the occupational requirements, and to identify tasks which have a physical demand. Visitations to typical job sites are conducted in order to become as familiar as possible with the conditions and environment under which tasks are conducted. Demographics of the military occupation (gender, minority status, age, years of experience) for which the physical fitness standard is being developed is important in order to ensure the sample used to develop the standard is representative of the Canadian Forces population and not just the military occupation. Should women be absent in the particular military occupation for which physical fitness standards are being researched and validated, innovative methods are employed by the Canadian Forces to ensure representation of women's task performance and fitness data in the data base from which standards are derived. One approach is to recruit civilian women employed in similar occupations. For example, the demographics of the CF fire fighter occupation revealed that there were approximately 1500 male fire fighters and only 6 female fire fighters. In order to ensure adequate measurement of female fire fighter performance in the development of physical fitness standards for CF fire fighters, civilian female professional fire fighters were recruited to participate in the research process (Deakin, Pelot, Smith, Stevenson, & Wolfe, 1995). Other approaches include the recruitment of physically fit women from other CF occupations for participation in the research process.

In the development of physical fitness standards, only those essential tasks that have a physical component are important for analysis. The information derived from the review of resource materials, site visitations, and job analyses form the conceptual basis for the conduct of a subject matter expert panel. Using a computerized decision making process, subject matter experts are required to identify the physical demands of each of the critical tasks using a 7 point Likert scale (1 = very, very light; 7 = very, very hard). Tasks are then ranked from most physically demanding to least physically demanding and verified as being accurate by the subject matter experts. Those tasks that elicit a hard physical demand (tasks with an average score of 5.0 or greater) are retained for further analysis. The subject matter experts are then requested to identify the frequency that each of the most physically demanding tasks are performed in a mission or as training for a mission, using a 5 point or 7 point Likert scale as applicable. Subject matter experts may also be requested to identify the underlying physical constructs (aerobic, anaerobic, strength etc) required for the performance of the most physically demanding tasks, and rank the importance of each construct for the successful performance of each task using a Likert scale. Other information may also be gathered with respect to environmental conditions or influencing factors which affect job performance.

The second step in the process to develop bona fide physical fitness standards is to determine the capacities necessary for the performance of the essential components of the job. For each of the physically demanding tasks identified by the subject matter experts (those tasks with an average score of 5.0 or greater), tasks analysis and physical demand analyses are conducted. For each task under consideration, the time required to complete the task, the mass of all equipment, frequency and distances that equipment must be moved, the heights of all lifts etc. are documented. For each task under consideration, the requisite level of physical fitness to perform the tasks is quantified. This step consists of a number of field and laboratory measurements. Dependent upon the environment, measurements of actual job performance may be conducted. Should this approach not be feasible due to interference with actual operations, work samples may be conducted during operational training. However, the physiological demands of the work samples must be reflective of the physiological demands of the actual job. Whether measuring task performance on the job or during a work sample, subjects should be instructed to perform the tasks at the same pace that they would perform the tasks on the job. Supervisors' ratings and physiological data may be utilized to confirm acceptable task performance with respect to pacing.

The quantification of the requisite levels of fitness to perform the physically demanding tasks include the measurement of the aerobic cost, forces and torques associated with performance of the tasks, heart rate responses, and blood lactate levels. When feasible, the oxygen cost of task performance is directly measured in the field using a portable metabolic measurement device (Aerosport – KB1C®). Forces and torques can be measured using load cells, force transducers, and force gauges. Other physiological data such as heart rate and core temperature responses may be measured by telemetric devices. Once task performance measurements have been completed, each subject then undergoes comprehensive fitness testing (laboratory and field) to establish their current level of fitness, so that the relationships between fitness scores and task performance in the field may be established.

Upon completion of the task and physical demand analyses, the researcher in conjunction with the major stakeholders must decide upon the model that will be utilized to assess whether an individual has the capabilities required for the performance of the essential components of the occupation. The CF utilizes three different assessment models:

(i) Fitness Component Testing or Construct Validation Model;
(ii) Task Simulation Testing or Content Validation Model; or
(iii) Hybrid testing which is a combination of fitness component testing and task simulation testing.

Fitness component testing identifies the fundamental physiological factors or constructs needed to safely and efficiently perform a task. Fleishman (1964) developed a taxonomy of human performance measurements by identifying physical constructs and determining appropriate physical tests to evaluate each one. Simple physical tests such as pull-ups, chin-ups, push-ups, and hand-grip dynamometer were identified as some of the best measures of strength and endurance (Fleishman, 1964). Identification of constructs underlying task performance becomes the first stage of a process that allows for use of any number of tests to either confirm or deny their importance in successful completion of the job. The pattern of correlation between test performance and job performance verifies the extent to which they are related. Stepwise regression analyses are computed for the entire sample as well as by gender, and the order of test variable selection and strength of relationships are documented. The results of these analyses usually provide confirmation of the most important predictor test variables (Deakin, Pelot, Smith & Weber, 2000). Separate analyses across gender allow for the detection of differential ordering of predictor variables if they exist. Different loading patterns across gender would suggest that fitness is characterized by different constructs in men and women, providing the rationale for different test batteries for males and females. Alternatively, a finding that males and females have the same structure of principal component scores argues for a common test battery for men and women (Deakin et al., 2000).

There are many advantages to using fitness component testing to assess an individual's capabilities to perform physically demanding tasks. First, fitness component tests are comprised of well-known, scientifically valid and reliable protocols, which are usually simple, economical and relatively safe to administer. Normative data for these tests have been created, and often these norms differentiate between age and gender, acknowledging the performance differences between genders (gender fair) and various ages. Fitness component tests may also be educational as results can be linked to health and healthy behaviours, facilitating counselling and lifestyle modification. They also facilitate the development of educational material to help subjects move towards making healthier lifestyle choices (Tefft, 1999).

There are also a number of disadvantages to using fitness component testing to assess an individual's capabilities to perform physically demanding tasks. Individual test items usually have limited predictive power, explaining no more than 50-60% of the variance in task performance (Deakin, Smith, Pelot, and Weber, 2000). Most of the fitness tests used in fitness component testing models are twice removed. For example, the direct determination of aerobic capacity through the collection and analysis of expired gases during maximal exercise is the "gold standard" of the available techniques (Canadian Society for Exercise Physiology, 1993). This procedure requires costly apparatus normally found only in clinical and exercise physiology laboratories and requires slightly more time than predictive methods (Canadian Society for Exercise Physiology, 1993). Therefore, for ease of administration, a variety of sub-maximal and maximal tests can be used to estimate or predict aerobic capacity. These tests have been validated by examining the correlation between directly measured aerobic capacity and the aerobic capacity estimated from physiological responses to sub-maximal exercise (American College of Sports Medicine, 2000). However, as with any prediction, there are inherent error rates associated with each test that must be acknowledged. Most strength tests in fitness component testing models determine a subject's ability to move his/her own body weight. These tests do not reflect one's ability to perform external work. In many physically demanding military occupations, the capacity to perform external work is essential. A subject may do very well at completing pushups but do poorly or even fail when required to perform external strength activities such as lifting sandbags, jerry cans, or ammo boxes. The content or face validity with fitness component testing is also low, as military personnel have difficulty understanding the relationship between the test items and the job.

Task simulation testing duplicates the demands of the job, and has gained acceptance as a viable alternative to fitness component testing in the Canadian Forces. Task simulations that are representative of the major aspect of the work duties are developed in conjunction with subject matter experts. Subject matter experts then confirm that the demands of the simulations are representative of the occupation. In addition, physiological performance measurements on the simulation can be correlated and compared to the corresponding measurements taken in the work environment. Following scientific validation of the task simulation test, incumbents are tested and performance criteria are established by statistical procedures. The advantages of task simulation testing is that tasks can be adjusted and refined to duplicate the exact physical demands of the job, and simulations can be standardized for valid and reliable administration. Task simulations incorporate movement patterns typical to the occupation, and permit individuals a certain amount of flexibility in performance, thereby recognizing individual and gender differences in the execution of tasks (gender free). Task simulation testing is easily understood and accepted by military personnel as the simulations look like tasks performed in the occupation. There are disadvantages associated with task simulation testing. Fitness and skill level may be confounded in task simulation testing. If tasks are skill based, there is usually a learning curve associated with successful performance. Therefore, this must be considered in the testing application. Typically, task simulations are logistically and administratively more difficult in mass testing scenarios than the administration of fitness component tests.

A third approach utilized by the Canadian Forces is a hybrid or blended model. This type of model uses a combination of fitness component and task simulation testing. Hybrid or blended tests have been employed in an attempt to demonstrate a better relationship between job demands and evaluation tools (Deakin, Pelot, Smith & Weber, 1999).

The third step in accordance with the Canadian Human Rights Act (Government of Canada, 1985b) is to assess whether an individual has the capacities determined to be necessary for the safe, efficient and reliable performance of the essential components of the job. To this end, all CF members are required to participate in the CF EXPRES Program and meet the CF MPFS on an annual basis, unless they meet a higher physical fitness standard on an annual basis such as an environmental or trade standard. Since physical fitness standards are not meant to be punitive in nature, supporting physical fitness unit and individual training programs are available to all personnel. Personnel failing to meet established fitness standards are provided with a remedial physical training program that is directly supervised by a fitness professional, and provided with an opportunity for a retest upon completion of the remedial training program. In addition, professional fitness staffs, training facilities and state of the art training equipment are made available at all military establishments.

REFERENCES

American College of Sports Medicine (2000). ACSM's Guidelines for Exercise Testing and Prescription, Sixth Edition. Philadelphia : Lippincott Williams & Wilkins.

Canadian Society for Exercise Physiology (1993). Professional Fitness and Lifestyle Consultant Resource Manual. Ottawa : Canadian Society for Exercise Physiology.

Deakin, J.M., Pelot, R., Smith, J.T., & Weber, C.T. (1999). Development and Validation of a Bona Fide Physical Fitness Test for Canadian Forces Search and Rescue Technicians. Kingston, Ontario : Queen's University.

Deakin, J.M., Pelot, R., Smith, J.T., & Weber, C.T. (2000). Methodological Considerations in the Development of Physical Maintenance Standards : A Paper for the BFOR Consensus Forum. Bona Fide Occupational Requirements National Forum held in Toronto, Ontario 13-16 September 2000.

Deakin, J.M., Pelot, R., Smith, J.T., Stevenson, J.M., & Wolfe, L.A. (1995). Development of a Bona Fide Physical Maintenance Standard for CF and DND Fire Fighters. Kingston, Ontario : Queen's University.

Department of National Defence. Canadian Forces Administrative Order 50-1. Government of Canada.

Fleishman, E.A. (1964). The Structure and Measurement of Physical Fitness. Englewood Cliffs, New Jersey : Prentice Hall.

Government of Canada (1985a). Canadian Human Rights Act R.S.C. Chap. H-6. Department of Justice.

Government of Canada (1985b). Bona Fide Occupational Requirement and Bona Fide Justification: Interim Policies and Explanatory Notes. Department of Justice.

North Atlantic Treaty Organization Research Group (1994). Final Report and Resource Manual on Military Physical Fitness Training. Panel 8 on the Defence Applications of Human and Biomedical Sciences. Research Study Group 17 on Biomedical Aspects of Military Training. Report AC/243(Panel 8) TR/16.

Tefft, R. (1999). Ensuring Force Readiness and Beneficiary Health Promotion and Preventive Medicine Health System: A Position Paper. Military Medicine, 164.

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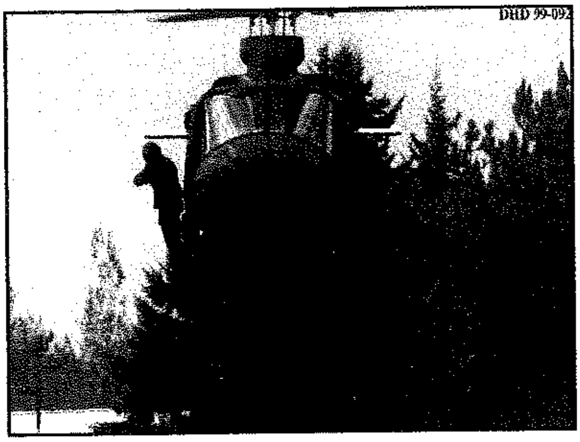


MILITARY REQUIREMENT FOR PHYSICAL FITNESS

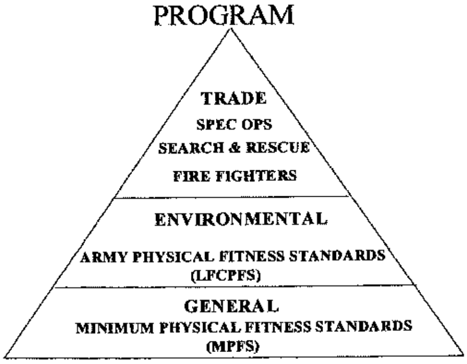
"Canadian Forces (CF) members must be physically fit to meet military operational requirements, to perform under a wide range of geographical and environmental conditions, to cope with the stresses of sustained operations and to be ready to respond on short notice"

(Canadian Forces Administrative Order 50-1)

PURPOSE OF PHYSICAL FITNESS STANDARDS

- Assess physical operational readiness;
- Take corrective action for the unfit by providing programs;
- Determine effectiveness of training programs; and
- Act as goals for some personnel.

CF EXercise PREScription (EXPRES) PROGRAM



CANADIAN HUMAN RIGHTS ACT

(Gov't of Canada, 1985)

Prohibits employment practices and policies that discriminate against individuals on the basis of race, national or ethnic origin, colour, religion, age, sex, sexual orientation, marital status, family status, disability or a pardoned conviction

CHARTER OF HUMAN RIGHTS
(para 15(1a))

"It is not discriminatory practice to refuse, exclude, expulse, expend, limit, specify or prefer in relation to any employment if the employer establishes the practice to be based on BFOR"

(Gov't of Canada 1985)

DEFINITION OF BFOR

Condition of employment which is imposed in sincere belief that it is reasonably necessary for safe, efficient and reliable performance of a job and which is objectively, reasonably necessary for such performance

(Gov't of Canada, 1985)

STEPS IN DETERMINING BFOR
(Gov't of Canada, 1988)

- Determine the essential components of the job
- Determine the capacities necessary for safe, efficient and reliable performance of the essential components of the job
- Assessing whether the individual has the capacities determined to be necessary for the safe, efficient and reliable performance

STEP #1: DETERMINE THE ESSENTIAL COMPONENTS OF THE JOB

- **Literature Review**
- **Job Familiarization**
- **Demographics**
- **Expert Opinion** **(Subject Matter Experts - SME's)**

STEP 2: DETERMINE CAPACITIES NECESSARY FOR PERFORMANCE OF ESSENTIAL COMPONENTS

- TASK ANALYSIS
  - time req'd to complete each task
  - physical constructs req'd for performance of tasks
  - mass of all equipment, frequency and distances moved
  - heights of all lifts

STEP 2: DETERMINE CAPACITIES

- PHYSICAL DEMAND ANALYSES
  - field and laboratory measures
  - on the job/work samples
  - quantification of fitness levels to perform the tasks;
    - O2 cost of tasks
    - Forces & torques
    - Heart Rate response
    - Blood Lactate

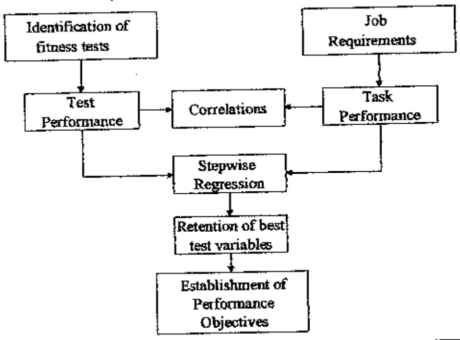
ASSESSMENT MODELS

- **Fitness Component Testing**
  - Construct Validation Model
- **Task Simulation Testing**
  - Content Validation Method
- **Hybrid**
  - Blended tests

FITNESS COMPONENT TESTING
(Construct Validation Model)

This type of testing identifies the fundamental physiological factors or constructs needed to safely and efficiently perform a task


DEVELOPMENT OF STDS
(Construct Validation Model)



FITNESS COMPONENT TESTING
(Construct Validation Model)

ADVANTAGES
- Simple validated protocols;
- norms have been created and validated (gender fair);
- not dependant upon prior learning
- easy to administer;
- educational;
- economical & relatively safe;
- measures physical fitness.

FITNESS COMPONENT TESTING
(Construct Validation Model)

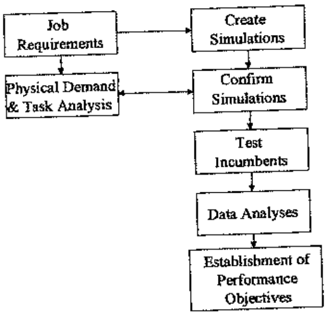
DISADVANTAGES
- have limited predictive power (they explain no more than 50 - 60% of the variance);
- requires more effort to document job relatedness;
- does not discriminate well between who can/cannot do the job.
- most tests are twice removed;
- most strength tests are relative;
- content or face validity is low;

TASK SIMULATION TESTING
(Content Validation Model)

Task simulation tests duplicate the demands of the job and have a high level of face validity



DEVELOPMENT OF STDS
(Content Validation Model)



TASK SIMULATION TESTING
(Content Validation Model)

➢ **ADVANTAGES**
- can be adjusted and refined to duplicate the exact physical demands of the job;
- incorporate movement patterns typical to the occupation;
- allow individuals a certain amount of flexibility in their performance recognizing individual differences in the execution of a task (gender fair);
- operational capability measurement;
- easily understood

TASK SIMULATION TESTING
(Content Validation Model)

➢ **DISADVANTAGES**
- may require prior learning (skill based);
- learning curve (5-12% improvement in performance);
- not educational;
- logistically and administratively more difficult to administer;
- usually elicit maximal physiological responses - perceived safety problems;
- does not measure physical fitness.

HYBRID
(Blended Tests)

➢ Combination of fitness component test and task simulation tests;

➢ hybrid tests amalgamate the strengths of both fitness component testing and task simulation testing


STEP #3: ASSESS CAPABILITIES

➢ **Participation in CF EXPRES Program;**
- pre-screening, evaluation, exercise prescription

➢ **Supporting Training Programs;**
- unit, individual, remedial

➢ **Supporting Infrastructure;**
- professional fitness staffs, facilities, state of the art training equipment