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Basic Recruit Training: Health Risks and Opportunities

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The present review examines the impact of basic recruit training on health and lifestyle. Many of those recruited begin training with a less than optimal lifestyle with respect to fitness, smoking habits, alcohol consumption, drug abuse, and exposure to sexually transmitted diseases. Thus, there is scope to enhance training programs that address fitness and lifestyle, minimizing potential losses in health and efficiency from upper respiratory infections, musculoskeletal injuries, cardiac catastrophes, mental disturbances, and adverse responses to extreme environments.

Introduction

Given the current low levels of fitness and poor lifestyle found among many young adults,[1,2] basic recruit training provides a good opportunity to develop cardiorespiratory performance and muscle strength as well as to correct such adverse habits as cigarette smoking and drug and alcohol abuse. However, there is also a risk of adverse physical and mental consequences from the physical, mental, and environmental stresses associated with a concentrated training course. An effective and well-organized health service is thus needed to serve new recruits.[3–5]

Health and Lifestyle

Physically Active Leisure

A Canadian survey found that some 23% of new recruits cited indoor sport and 20% cited outdoor sport as their preferred leisure activity; 80% of recruits were taking part in sport or other types of vigorous leisure activity at least once or twice per week (Table I). However, 10% were doing so only two to three times per month, and 10% were either inactive or exercising less than once per month.[6] Lack of adequate physical activity was linked in this sample to other adverse health behaviors, including heavy drinking and smoking.

Strength and Aerobic Power

Many of those recruited to the armed services initially have lacked the strength or aerobic power to carry out essential duties of front-line service or even to complete basic training. Two early reports[7,8] found substantial increments (22 and 25%) in aerobic power during the first 6 months and the first year of attendance at the Canadian Royal Military College, respectively. The gain in aerobic power was associated with a decrease in the average time to run 1.6 km from 6 to 5.5 minutes during the first 6 months of training. Moreover, a significant association was found between the individual's aerobic power and an arbitrary assessment of the potential to be an effective officer ("officer qualities"). Another report noted an increase of maximal oxygen intake from 43 to 50 mL/kg/min during a summer medical officer training program.[9] However, because of either selective pressures or a greater emphasis on population fitness, a more recent report found that candidates arriving at the Canadian Forces Officer Candidate School had higher than anticipated levels of fitness.[10] In consequence, improvements in physical condition with training were relatively small; there were significant changes in body composition (a 4.9-mm decrease in the thickness of three skinfolds and a 1.6-kg increase in lean body mass) but only minor gains in strength and flexibility.

Some 80 to 90% of heavy military tasks can be categorized as manual material-handling activities,[11,12] and unfortunately, a lack of strength is a common failing. On recruitment to the Canadian Forces, 9% of men and 99% of women were unable to meet one validated occupational criterion (lifting to a shoulder height of 1.1 m a weight of 18 kg frequently and 35 kg occasionally)[11]. A study of Canadian recruits found little effect of basic training on body fat, but the weight that could be lifted on an incremental lifting task increased by 12% in men and 9% in women.[13]

The ability to sustain a period of rapid marching while carrying a pack is determined mainly by the individual's aerobic power, which is also influenced by a person's age and gender (Fig. 1). Fatigue develops if the imposed metabolic load exceeds 40% of maximal oxygen intake.[14] Training has the potential to increase aerobic power, and thus marching capacity, by 20 to 25%.[1,8] Exacting programs such as the Canadian cadet-training course at the Royal Military College in Kingston have achieved results of this order, but the regular Canadian infantry training program for new recruits has little effect on aerobic power or capacity (I.K.M. Brenner, R.J. Shephard, P.N. Shek, unpublished data).

Smoking and Drug Abuse

The habit of smoking has been linked rather consistently with a low level of physical fitness, poor endurance performance, and susceptibility to infection among service personnel.[15–19] In addition, smoking is a major cause of fires, it increases cleaning costs, and it adversely affects productivity, both through time lost in the mechanics of smoking[20] and from a prolongation of minor respiratory infections.[21] Despite a perception that smoking helps in weight control, a study of U.S. Air Force basic training recruits found no association between smoking and body weight in women and only a minimal association in men.[22]

At one time, the availability of duty-free cigarettes encouraged an above average prevalence of cigarette smoking among military personnel.[23,24] A 1989 Canadian survey found that 43% of

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TABLE I

THE FREQUENCY OF PARTICIPATION IN VIGOROUS EXERCISE (SUFFICIENT TO INDUCE SWEATING) DURING THE PREVIOUS 4 MONTHS AMONG NEW CANADIAN MILITARY RECRUITS[6]

Frequency of Participation	Percent of Recruits
>3 times/week	45
1–2 times/week	35
2–3 times/month	10
About 1 time/month	4
<1 time/month	3
Never	3

male and 44% of female operational personnel and 49% of male and 60% of female new recruits were current smokers[6]; however, 60% of new recruits who smoked indicated that they wished to stop smoking. More recently, smoking has been actively discouraged in North American units, particularly at entry and during recruit training,[25] both by total prohibition[26] or restriction of smoking to specific periods of the day[27] and by specific educational programs. Some investigators have found a small increase in the percentage of nonsmokers and a decrease in cigarette consumption among continuing smokers with restriction of smoking[27,28]; unfortunately, however, these benefits have not always persisted subsequent to basic training.[29,30] A no-smoking policy at entry reduced the prevalence of smoking from 51 to 43% at 3-month follow-up.[31] Education programs are useful in discouraging recruits from commencing smoking during basic training, but they are less effective in encouraging smokers to give up the habit.[30] Among those smoking at entry to the services, the reported prevalence of smoking decreased by 40% at the end of 8 weeks of basic training, and at a 1-year follow-up, 19% of initial smokers were still nonsmokers.[26] Currently, the Canadian Forces offer a "general awareness briefing" on lifestyle issues, including smoking, and what were once "smoke breaks" have been renamed "refreshment breaks." There is no initiative specifically tailored to the needs of recruits, although they are eligible to participate in the Forces "Butt Out" smoking cessation program.

In Canada, some 18% of new recruits are heavy drinkers (>3 units/day).[6] Motivations to drink included "a friendly social activity" (61%), "relaxing" (58%), and "cheaper on the base" (38%). A study of U.S. naval diving trainees reported that the frequency of alcohol and drug abuse among individuals failing to complete their training course was three times greater than in the remainder of the sample.[32] A U.S. survey for the period 1976 to 1995[33] examined drug use in 20 cohorts of more than 27,000 young adults at high school graduation and 2 years after graduation; illicit drug use declined more among military recruits than among their civilian counterparts, suggesting that military illicit drug use policies may have played a deterrent role. This finding contrasts with Swiss reports for 1975[34] and 1981[35]; these found a downward trend in overall drug use between the two studies but little change in rates of drug use before and after military training.

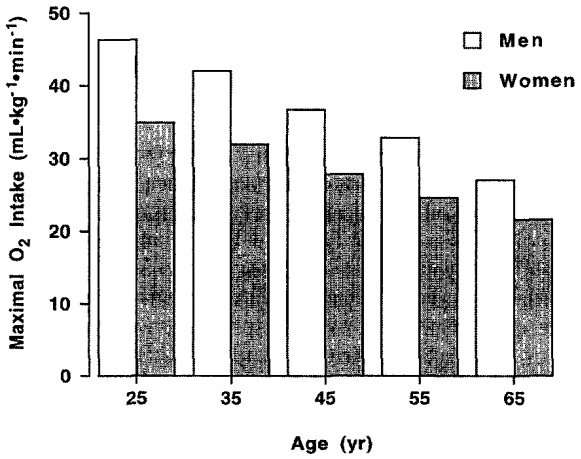

Fig. 1. Influence of age and gender on the maximal oxygen intake of the general Canadian population (based on data from the Canada Fitness Survey[104]).

In Canada, inferences about the use of drugs and alcohol at recruitment can be based on surveys of provincial high school students, who form the bulk of the recruit population. One report suggested that during the immediately past 12 months, new recruits had used marijuana (21.6%), hallucinogens (6.7%), and cocaine or crack (6.0%); all of these figures were much higher than those found for operational members of the armed services.[6] However, drug use subsequent to recruitment decreased to much lower levels, comparable with that of the armed services as a whole. High school data suggested a decrease in the use of illicit drugs throughout the 1980s, but apparently there was a resurgence in the 1990s (Lt Col G.J. Cook, personal communication, November 24, 1999).

Immune Function and Acute Infections

Although one early Canadian report found that at the Canadian Forces Officer Candidate School sick-call attendance caused no more than a 1% time loss from training,[10] most reports covering a period of some 30 years suggest a high incidence of upper respiratory infections during training.[36–41] Such infections can impair cognitive functioning, with an adverse impact on the training process,[42] may contribute to soldier attrition,[43] and are a significant source of hospitalizations.[44]

The likelihood of infection is increased by life at close quarters in military barracks and by contact with potential bacteria, parasites, and vectors such as ticks[45] during activities that involve moving through swamps and crawling over infested terrain. As little as 10 days of a very demanding field exercise may also exacerbate the risk of infection.[39] Factors contributing to the increase in susceptibility include the combined effects on immune function of work that is heavy relative to the individual's physical condition, sleep deprivation, food restriction, and psychological stress.[46] Conversely, risks can be minimized by an increase in physical fitness, ensuring adequate sleep, maintaining energy balance, and minimizing psychological stress.[46]

Participation in basic military training does not appear to cause a clinically significant decrease in immune function.[47] Lee et al.[48] examined the effects of 4 weeks of basic cadet training among 96 first-year U.S. Air Force Academy cadets. They found a 35% decrease in lymphocyte proliferation in response to training, but there was no evidence of reactivation of the Epstein-Barr virus. Moreover, if the recruit is allowed to adapt progressively over a longer period of training, resting immune function may be enhanced. Thus, 18.5 weeks of basic infantry training augmented lymphocyte function (including both natural killer

cell activity and mitogen-stimulated lymphocyte proliferation); it had no effect on antigen responses, but a reduction of salivary immunoglobulin levels at the end of the course suggested some persistent negative consequences of the training.[49]

Intense and specialized courses of military training compromise immune function more consistently. Boyum et al.[50] examined the effects of a week-long training course that involved continuous exercise (at 35% maximum oxygen consumption), an energy deficit, and sleep deprivation. They reported a granulocytosis but a reduction in lymphocyte subsets (CD4 T cells, CD8 T cells, B cells, and natural killer cells) and serum immunoglobulin levels, with a variable lymphocyte proliferative response. Fairbrother et al.[51] observed a significant decrease of lymphocyte proliferation among participants in the U.S. Army Special Forces Assessment and Selection Course. However, infection did not contribute to medical attrition in that study.

The U.S. Army Ranger Training Course is one of the most physically demanding military training courses. It lasts for 62 days and involves food restriction, sleep deprivation, geographical challenges (forest, mountain, swamp, and desert exposures), and prolonged low-intensity physical work. Recruits participating in this course have demonstrated a leukocytosis, a decrease in the number and percentage of T cells (helper, suppressor, and pan T cells), a suppression of lymphocyte proliferation, a decrease in release of the soluble interleukin-2 receptor to phytohemagglutinin, an impaired delayed-type hypersensitivity skin test, and an increase in the incidence of infections.[52,53] The majority of these infections involve cellulitis of the lower extremities and upper respiratory tract infections.[43]

The changes in immune response seem to have substantial clinical importance in that upper respiratory infections are a common problem of basic training for both men and women.[38,54] Jones et al.[38] examined the incidence of, and the risk factors for, injury and illness among 310 Army basic trainees (124 men and 186 women). Some 48% of female and 35% of male recruits reported to sick-call for an illness. Of this proportion, 26% of females and 28% of males required medical care for an upper respiratory tract infection (URTI).

Food restriction makes a major contribution to the observed immunosuppression in these demanding exercises.[52,55] During Ranger training, energy expenditure greatly exceeds energy input, so that subjects lose up to 16% of body mass.[52,53] One obvious countermeasure is to increase food intake; a 15% increase of energy intake during training reduced the decrease in body mass to 12% and improved (but did not completely reverse) changes in cellular immune function.[52,55]

The importance of maintaining and developing physical fitness was emphasized in this report. A low level of prior activity was a risk factor for developing an URTI in both men and women, and for males, slow mile times were also associated with an increased risk of URTI.

Among environmental stressors, heat may compound the exercise-induced suppression of immune function.[56] Likewise, cold exposure can interact with heavy exercise to augment the depression of immune function,[57,58] possibly exacerbating the risk of upper respiratory infections.[59] Recruits who dislike cold weather training become depressed, angry, and fatigued,[60] and this stress has the potential to exacerbate further the impairment of immune function. The tissue hypoxia associated with high-altitude exposure limits the potential for metabolism of fat, increasing the tendency for depletion of glycogen and thus suppression of the immune system.[46]

One specific but important aspect of infection among new recruits is that of sexually transmitted diseases. Here the problem is not a suppression of immune function but rather an inappropriate lifestyle. In a 1989 survey, almost a half of new Canadian recruits admitted having multiple sexual partners and thus were at increased risk of sexually transmitted diseases.[6] Moreover, only 24% of this group used a condom on a regular basis. Plainly, this remains an important area in the health education of new recruits.

Risks of Musculoskeletal Injury

Musculoskeletal injuries can lead to costly interruptions of basic training, back-coursing, and (in the United States) a recruit attrition of 1.5 to 2.2%.[61-63] Such injuries also pose a significant threat to military effectiveness, particularly in operations that demand teamwork. Problems arise not only from the injury itself but also from a potential interaction between muscle damage and the suppression of immune function.[46]

The incidence of musculoskeletal injuries during basic military training is disturbingly high in many countries.[64-75] Risks among recruits are increased by such factors as a high running mileage in a given military unit,[70] a progressive increase in running distance, running on uneven surfaces, and running in boots.[40]

In some programs, training is mandatory, so that course participants cannot rest if they sense muscle fatigue. One study of an infantry battalion in Alaska found 142 injuries per 1,000 soldiers during a 6-month period.[76] Injuries are commonly of the overuse type.[71] The most frequent diagnosis is musculoskeletal pain, followed by strains, sprains, and cold-related injuries. In one series, some 56% of patients returned to full duty, 31% were assigned to limited duties, and 1% were hospitalized, with fractures accounting for the largest proportion of limited duty days.[76] With more intensive training, the prevalence of injuries is even higher. Thus, in Norwegian recruits, the incidence was 13 to 23 injuries per 100 recruit months, and in U.S. Sea-Air-Land Special Warfare trainees, the combined incidence of medical and musculoskeletal conditions was 61.4 cases per 100 trainee-months.[40] In this last series, overuse injuries (particularly iliotibial band syndrome, patellofemoral syndrome, and stress fractures) accounted for 90% of injuries. The distribution of injuries is illustrated in Figure 2.

Factors predisposing to musculoskeletal injury include age, smoking, previous injury, low levels of physical activity before recruitment,[63,77] body mass index > 26.9 kg/m^2,[63,78] low initial levels of physical fitness, as assessed by poor times for a 2.4- to 3.2-km run and a low sit-up score, and either an excess or a lack of flexibility.[69,70,76] However, in the civilian situation, higher fitness is sometimes associated with greater physical activity and thus a higher incidence of injuries, and poor fitness is not always a risk factor even among military recruits.[79,80] The probable explanation of the effect of physical condition in military populations is that all recruits must undertake the same training program, regardless of their initial level of fitness.[76] Somewhat surprisingly, basic trainees with flat feet are at a lower overall risk of injury.[81]

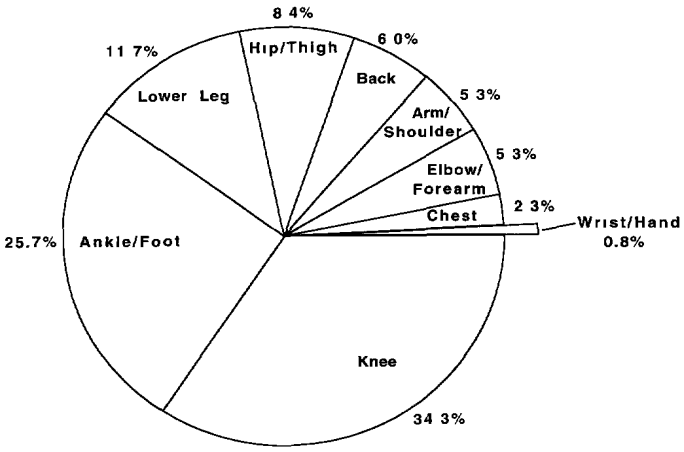

Fig 2 Distribution of injuries among naval special warfare trainees (based on data from Linenger et al [40]) in a sample showing a total incidence of 26 5 injuries per 100 trainees.

Blisters can also be a serious handicap to infantry soldiers. A study of 319 basic cadet recruits found a 44% incidence of blisters after completing a 21-km road march in 6.5 hours. Risk factors included ethnicity (a lower risk in black recruits), sickness during the previous 12 months, no previous experience of active military duty, use of smokeless tobacco, and flat feet.[82]

Risks of Sudden Death

Cardiovascular Deaths

Although an individual's overall prognosis is favorably affected by vigorous physical training, there is a 5- to 50-fold increase in the risk of sudden death during an immediate bout of exercise, particularly if the effort is heavy and the activity is performed in an adverse environment or is associated with high-level competition or emotional stress.[83,84] In young adults, causes include an undiagnosed congenital cardiac lesion (particularly an anomalous origin of the coronary arteries), hypertrophic cardiomyopathy, infectious myocarditis, malignant arrhythmia, and cerebral aneurysm.[85] There is also some evidence that the risk of infectious myocarditis may be increased if the immune system is suppressed by very vigorous physical activity.[46,86] Electrocardiographic changes and/or echocardiography suggested that as many as 3% of 126 Finnish conscripts had asymptomatic myocarditis, possibly related to vaccination.[87,88] With the possible exception of myocarditis in those with an acute infection, there is, unfortunately, little potential to detect those individuals at risk by preliminary screening.[89]

Several military units have reported incidents of unexpected sudden death after exercise. An early analysis of some 1,000 sudden deaths in apparently healthy U.S. soldiers (undertaken between 1942 and 1946) found a cardiac cause in some 350 incidents. Most of the sample was older personnel, and some 300 cases (mainly in those aged 30 to 39 years) were attributed to coronary atherosclerosis.[90] During a 10-year period, the British army encountered 56 cases of sudden death after sport or other forms of strenuous exercise (an incidence of 3.5 sudden deaths per 100,000 man-years).[91] Many of the cases in that series, also, were older individuals, and the predominant diagnosis was again coronary atherosclerosis (63% of the sample).

Because they are generally younger, the incidence of problems is often much lower among basic trainees. A 20-year review of U.S. Air Force recruits found 19 sudden cardiac deaths among ostensibly healthy, medically screened inductees during a 42-day basic training period; 17 of these cases were associated with strenuous exertion.[92] The estimated risk, 0.017 deaths per 50,000 exercise hours, was very low. The most frequent underlying pathology in this series was thought to be myocarditis.[92]

A 25-year study of Finnish conscripts found 6.8 sudden deaths per 100,000 man-years.[93] Acute symptoms began during strenuous exertion in one-third of the group, and cardiovascular problems accounted for two-thirds of deaths. Five of the 4 deaths occurred soon after vaccination.

In the Israeli armed forces, there were 20 sudden deaths in a 13-year period. Autopsy suggested a cardiac problem in at least 10 of the affected individuals.[94] Two soldiers had febrile illnesses and thus may have had subclinical myocarditis. The most common warning symptom was syncope, noted in 8 of the 20 cases.[9]

Heat Stress

A study of 217,000 Marine Corps recruits found 1,454 cases of heat stress during a 12-week training program, 11% of the male cases being sufficiently severe to require hospitalization.[9] However, long-term complications were rare, and there was only one death among at least 80 cases diagnosed as exertional heat stroke.[95] The risk increased progressively at wet-bulb globe thermometer temperatures in excess of 18°C (65°F), but because many cases occurred in the cooler early morning hours, a cumulative effect of previous heat exposure was suspected.[95] An additional factor is that accepted ceilings of wet-bulb globe thermometer readings[96] were established for marching, whereas in recent years basic training has included other more vigorous activities such as jogging and running.[95] Unexplained exercise-related deaths in black recruits[97,98] may be caused by an interaction between heat stress and sickle-cell trait. It is suspected that heat-induced dehydration compounds exertional rhabdomyolysis, predisposing to acute renal failure in individuals with the sickle-cell trait.[99] In such patients, the hypoxia of high altitude may interact with the stress of heavy physical activity to induce a crisis.[100]

Basic Training and Mental Health

The physical and mental demands of many recruit training programs make heavy demands on the mental health of inductees. The stress of course demands is compounded by separation from home and family, lack of access to personal belongings, depersonalization, sleep deprivation, living in closed quarters, frequent and repeated verbal discipline, and lack of personal control over diet and hours of sleeping. Thus, it may be important to identify vulnerable individuals who are unlikely to complete a course successfully.

Among basic recruits, psychoses are uncommon, but there were 557 psychiatric admissions among 139,360 U.S. Air Force recruits attending a 6-week basic training experience, an incidence of 1.43 cases per 100,000 inductees.[101] The most common problem was a risk of suicide (identified in 60% of cases). Six of the 557 cases developed a brief reactive psychosis related temporally to the beginning of training. Paranoid symptoms were

present in all six cases, and Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised criteria were satisfied. An earlier study of soldiers used the less precise criterion of schizophrenic reactions, finding these in some 5 per 1,000 recruits during the first month of duty.[102] Among military student pilots, course demands are greater, and there is a correspondingly greater incidence of mental problems. A group of 99 who had difficulty in adapting to job requirements were identified among a population of some 4,000 trainees. Anxiety (26%), marital conflict (22%), somatization (15%), depression (13%), phobic reactions (12%), and misconduct (11%) were the main characteristics of the problem group.[103] More than half of these individuals failed to complete their training program.

A 1989 survey of Canadian recruits found that 8% had seriously considered suicide during the previous 12 months.[6] Most of the recruits reported a high level of well-being, but 14% of men and 22% of women noted a high level of tension. There is a general program for suicide prevention in the Canadian Forces, and military police and junior and senior leaders are given suicide intervention training, but there is currently no initiative directed specifically at new recruits. Better prescreening techniques and deployment of military social services could probably help such individuals.

Conclusions

The period of basic training has the potential to establish a lifestyle that will ensure fit and healthy personnel with a high level of combat readiness. However, much needs to be accomplished for this potential to be realized. In many units, the proportion of smokers remains higher than in the general population, gains in muscle strength and aerobic fitness may be insufficient to satisfy front-line needs, and the efficiency of basic training may be impaired by medical and surgical problems, particularly a high incidence of musculoskeletal injuries. Further research is needed on the mechanisms of injury and their interactions with environmental and psychosocial stressors to mount a program incorporating effective countermeasures.

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