

Temporal Trends in Health and Fitness of Military Personnel

A Literature Review and Recent Bibliography

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The military frequently requires its personnel to serve in physically demanding conditions. Therefore, the effectiveness of military operations is often dependent upon the physical fitness of its members. The impacts of low fitness are evident in studies that have examined aspects of military performance such as training outcomes, attrition, injuries, and readiness.¹ Since military recruits are drawn from the civilian population, negative trends in physical fitness, overweight and obesity, and health behaviours observed in many countries may have an impact on the ability of military organizations to recruit and retain high-quality, physically fit personnel. The present report reviews literature on health and fitness among military members, indicating parallel trends in civilian populations.

Physical fitness consists of a number of components, including muscular (e.g., muscular strength and endurance), motor (e.g., speed), cardiorespiratory, and morphological (e.g., body mass index: see Knapik *et al.*, 2006b). Body mass index (BMI), which is calculated using a ratio of height and weight, is an indicator of health-related risks associated with underweight, overweight, and obesity (WHO, 1995; 2000). Very high BMI scores indicate a greater risk of disorders such as type-2 diabetes, hypertension, and heart disease, while very low BMI scores, although less common, are associated with greater risk of undernutrition, osteoporosis, and impaired immune system functioning (Health Canada, 2003). In addition to the health risks associated with BMI, cardiorespiratory fitness is associated with a lowered risk of cardiovascular disease, diabetes, and mortality,² while musculoskeletal fitness is associated with health benefits such as lower risk of mortality and greater overall quality of life (Warburton *et al.*, 2001).

Since military personnel differ in several aspects from the general population (e.g., being on average younger and predominantly male), trends in the military may not exactly mirror those in the general population. However, research demonstrating that the younger age groups in the general population have shown the greatest increases in obesity has important implications for military recruiting. Since military personnel are recruited from the civilian

¹ See, for instance, Haddock *et al.*, 2007; Knapik *et al.*, 2001b; Poston *et al.*, 2002.

² Carnethon *et al.*, 2003; Wei *et al.*, 1999.

population, trends of decreasing health and fitness, particularly among youth and young adults, may affect the ability to recruit and retain healthy, fit individuals. In a study of civilian adults aged 17-20 years in the US, it was found that at least 13% of young men and 17% of young women would not be eligible for acceptance into the military because they would fail the screening test for weight (Nolte *et al.*, 2002). In a more recent study of civilian adults, at least 18% of young men and 21% of young women exceeded maximum weight limits for acceptance into the military (Yamane, 2007), which is an increase in ineligibility over a relatively short time period. Among individuals aged 20-39 years in the Canadian general population, 19% of males and 21% of females were classified as obese (Shields *et al.*, 2010). These data indicate that there is an increasingly smaller pool of fit applicants to draw upon for entrance into the military.

Physical fitness has been linked to a number of factors important for the successful performance of military duties, and it is an important predictor of success in military training, attrition, injuries, and reactions to stress. For example, being underweight was a predictor of medical discharge during basic military training and in the first year of service in the US Air Force (Poston *et al.*, 2002). In addition to a higher rate of discharge, recruits with low physical fitness were more susceptible to injuries compared to their fit peers (Knapik *et al.*, 2001a; 2001b). Low levels of aerobic fitness and muscular endurance were also associated with a greater risk of injury in basic training in other countries, including Australia (Pope *et al.*, 1999) and Norway (Heir & Eide, 1997). On the other hand, having a high level of fitness, particularly cardiovascular fitness, may help individuals to function in physically demanding, stressful situations, as it has been associated with success in entry-level infantry training (Burke *et al.*, 1989). Fitness level is also a predictor of readiness for military duties. Among US military personnel, obese and underweight individuals were more likely to experience restricted activity or to miss work due to their physical health, compared to normal-weight individuals (Haddock *et al.*, 2007). As well, BMI was the single most important factor predicting failure in a military physical readiness test, in which 80% of the failures occurred among overweight or obese personnel (Gantt *et al.*, 2008). In addition to training success, physical fitness also has an influence on stress reactions to training. Among US Army personnel, individuals who were higher in aerobic fitness were less likely to perceive a military survival training exercise as stressful (Taylor *et al.*, 2008). It was suggested that physical fitness may buffer stress reactions via its effects on attenuating anxiety, which may allow individuals to more effectively cope with stressful situations. In line with this, a study of females in the general Canadian population indicated that several fitness-related variables, including cardiovascular fitness, self-reported fitness level, involvement in sports, and lower BMI, were associated with faster heart rate recovery following a laboratory cognitive stressor (Jamieson *et al.*, 1994). These studies suggest that the protective benefits of fitness extend beyond the physical, and may aid individuals in coping with mental and emotional stressors such as those experienced during military training.

Temporal Trends in Health and Fitness Levels

Overweight and Obesity

The prevalence of overweight and obesity in Canada and other countries has increased over the past several decades, while fitness levels have declined.³ Comparisons of data from national health surveys revealed an increase in overweight and obesity in Canada from the early 1970s to the 1990s (Torrance *et al.*, 2002). More recently, comparisons of health and fitness data collected in 1981 and 2007-2009 revealed that muscular strength and flexibility have decreased among males and females aged 20-59 years, while measures of adiposity and fat distribution have increased (Shields *et al.*, 2010). Among adults aged 20-39 years, BMI increased significantly over time, while the percentage of individuals with a high waist circumference, which is an indicator of abdominal obesity associated with health risk (Janssen *et al.*, 2002a), more than quadrupled. In addition to these cross-sectional comparisons, longitudinal research has shown a trend toward weight gain over time. In the Canadian general population, one-third of adults whose weight was normal in 1994-95 were overweight by 2002-03, while one-quarter of individuals transitioned from overweight to obese during this time (Le Petit & Berthelot, 2006). Health and fitness levels, including BMI, flexibility, and muscular strength, have also declined among children and youth in the past 30 years (Tremblay *et al.*, 2010), paralleling the trends in the adult population.

The increase in overweight and obesity over time in Canada is comparable to trends in the general populations of other countries, including Finland, New Zealand, UK, and the US (Flegal, 1999). For example, the prevalence of overweight and obesity among young adults in the US increased by about 25% from 1960 to the 1990s.⁴ However, data taken from the Canadian Health Measures survey and U.S. National Health and Nutrition Examination survey indicated that the prevalence of adult obesity is lower in Canada compared to the US (Shields *et al.*, 2011). Even when examining shorter time periods, it is evident that fitness levels have decreased. The prevalence of obesity in 18-29 year old adults in the US increased twofold between 1991 and 1999 (Mokdad *et al.*, 1999; 2000), and there was a significant increase in overweight and obesity among US male and female children and adolescents, and among adult males, between 1999 and 2004 (Ogden *et al.*, 2006). In addition to the increase in overweight and obesity over time, the decrease in muscular strength is also cause for concern. These changes may be related to other health issues, such as lower bone mineral density, and a greater risk of physical disability, mortality, and metabolic syndrome.⁵

Studies of military populations have demonstrated that despite the fitness standards imposed on them, military populations are experiencing a trend towards increased body fat, which mirrors that of the general population. For example, studies of US recruits from the

³ Shields *et al.*, 2010; Torrance *et al.*, 2002; Tremblay *et al.*, 2002.

⁴ Flegal *et al.*, 1998; Nolte *et al.*, 2002

⁵ Radim *et al.*, 2005; Rantanen *et al.*, 1999; Ribom *et al.*, 2004; Ruiz *et al.*, 2008.

1970s to the 1990s showed that recent recruits had a higher body weight and a greater percentage of body fat, although their aerobic capacity and muscular strength were comparable to that of the recruits from earlier years (Sharp *et al.*, 2002). Some studies have also shown evidence of decreased fitness levels among military personnel. For instance, a study of Canadian military recruits found that there has been a decrease in fitness levels between 2002 and 2009, specifically among females. Furthermore, reported BMI scores increased and performance on the Canadian Forces fitness test decreased (Sudom *et al.*, 2010). Another study, which examined obesity in the United Kingdom Armed Forces, reported that the levels of obesity increased with age and that the levels of obesity were comparable to the general population (Fear *et al.*, 2011). Another review, of US Army physical fitness data, revealed that BMI levels of recruits increased over time, while muscular strength improved, no change was found in muscular endurance, and only a small decline was found in cardiovascular fitness (Knapik *et al.*, 2006b). A study that examined body fat composition in Army soldiers in the US revealed that individuals with less body fat were more likely to perform better, compared to those with more body fat, on anaerobic and aerobic activities as well push-ups and activities that required shoulder strength (Crawford *et al.*, 2011). The prevalence of overweight and obesity among civilian applicants to the US military increased from 1993 to 2006 (Hsu *et al.*, 2007). Additionally, increases in cardiovascular risk factors in US military personnel parallel those of the civilian population (McGraw *et al.*, 2008).

Although there is limited historical data on fitness levels of Canadian Forces (CF) personnel, data available in the past decade has revealed that the prevalence of obesity among Regular Force members has increased significantly between 2004 and 2008-09. For instance, from 2004 to 2008 the rate of obesity increased from 21% to 24%, with higher rates of obesity being reported among males.⁶ As well, individuals who were considered obese, as having a BMI greater than 30, reported poorer health and more limitations when completing vigorous activity compared to those who had a BMI less than 30 (DFHP, 2010). A study of self-reported health trends in CF recruits from 2003 to 2006 found that the proportion of female recruits who perceived themselves as overweight increased during this time, with a corresponding increase in actual BMI (Lee, 2010). Although the proportion of obese recruits was slightly lower than that of the general Canadian population, the proportion classified as overweight was higher, and the results still suggest unfavourable temporal trends in unhealthy weight levels among military recruits.

Health Behaviours

Reductions in physical activity, coupled with increased caloric intake, have been suggested as reasons for the increase in body weight over the past several decades. In the US, it was found that approximately one-quarter of adults did not participate in any leisure-time physical activity (Mokdad *et al.*, 2003). For instance, roughly 69% of the Canadian

⁶ Directorate of Force Health Protection [DFHP], 2010.

population, between 2007 and 2009, spent their time during the day in sedentary activities (e.g., occupational sitting: Colley *et al.*, 2011a), which is also consistent with the trends in children and youth, who spend about 8.5 hours a day in sedentary activities (Colley *et al.*, 2011b). Among Canadians aged 12 and over, almost half reported being inactive during their leisure time (Gilmour, 2007). Despite the seemingly large prevalence of inactivity, data from both Canada and the US have shown that leisure-time physical activity has actually increased over time.⁷ For example, 52% of Canadians reported being at least moderately active in 2005, compared to 43% in 1996 (Gilmour, 2007). There has also been an increase in physical activity between the years 2007 and 2009 (Colley *et al.*, 2011a). However, technological advances have contributed to an overall decrease in physical activity in the workplace (Craig *et al.*, 1999). Caloric intake has also increased over time, while the types of food ingested have changed among young adults, primarily reflecting an increase in carbohydrate intake and a greater proportion of calories from convenience items such as fast foods.⁸ Thus, although participation in physical activities appears to have increased in recent decades, this may be offset by lower levels of occupational physical activity as well as a greater number of calories consumed and a greater proportion of those calories being derived from foods with little nutritional benefit. That being said, the increases observed in leisure-time activity may not be sufficient for weight loss or maintenance of a healthy weight.

In line with the civilian data, a study of weight and physical activity patterns among US military personnel demonstrated that both physical activity and overweight increased over a three year period in the 1990s (Lindquist & Bray, 2001). It was found that approximately 40% of CF recruits did not engage in sufficient physical activity in the three months prior to recruit training, although it was noted that compared to a study of the Canadian general population, a higher proportion of recruits were at least moderately active (Lee, 2010). In a study of CF Regular Force personnel, not having enough time and having too many other demands were reported as being the biggest obstacles to health promotion, even though individuals reported that they were aware of the actions they could take to improve their health (DFHP, 2005). Similarly, in the US military, being too busy was reported as the primary barrier to participating in physical activity, although individuals recognized the importance of activity for their weight, appearance, and maintenance of military physical fitness standards (Sigrist *et al.*, 2005).

Although the majority of CF recruits reported good to excellent eating habits, only about half consumed the recommended amount of fruits and vegetables according to Canada's food guide (Health Canada, 2009). The proportion of recruits with healthy eating habits decreased slightly over the period of 2003 to 2006 (Lee, 2010). Overall, the eating habits of CF recruits were superior to those of the general Canadian population. In the US, although approximately half of military personnel felt that it was very important to have a diet low in

⁷ Craig *et al.*, 1999; Ham *et al.*, 2004.

⁸ Wright *et al.*, 2004; Harnack *et al.*, 2000; Nielson & Popkin, 2003; Nielson *et al.*, 2002.

saturated fat and high in fruits and vegetables, such attitudes did not align with their actual intake, as the majority of individuals did not consume more than three vegetable servings per day (Warber *et al.*, 1999). Another study of US military personnel found that the primary barrier reported for not eating healthfully was being too busy (Sigrist *et al.*, 2005). Although military personnel recognize the benefits of healthy eating, similar to the perceptions of participation in physical activities, they may perceive barriers to actually engaging in such healthful behaviours.

In addition to dietary changes, one explanation that has been suggested for the increase in overweight and obesity over time is the decline in smoking rates in the general population (Flegal *et al.*, 1995). Nonetheless, a study of the Canadian general population found that BMI levels increased among both smokers and non-smokers from the 1970s to the 1990s (Torrance *et al.*, 2002), suggesting that the decrease in smoking in the general population may not have a significant effect on weight. In a study of US Air Force recruits, heavy drinking and binge drinking were associated with a number of negative outcomes including being involved in fights, having injured oneself or others, and being unable to remember the previous night because of drinking (Taylor *et al.*, 2007). Research has also shown that individuals who were smokers were more likely to self-report worst general health in the Australian Defence Force (Barton *et al.*, 2010). Smoking was a strong predictor of several domains of military readiness (i.e., mental health, physical health, substance use, and legal problems) among US military personnel (Haddock *et al.*, 2007).

There is evidence to indicate that smoking is associated with lower levels of physical activity. For instance, physical activity levels were lower among US Air Force recruits entering basic military training who smoked, compared to non-smokers (Ward *et al.*, 2003). A history of cigarette smoking is one of the known risk factors for injuries during US Army basic military training,⁹ and current tobacco use also showed a positive, though not significant, increase in attrition risk in US recruits (Niebuhr *et al.*, 2009). In the Canadian general population, smoking rates are highest in the 20-34 age group, although the rate of regular smoking has decreased over time (Statistics Canada, 2009). The proportion of both male and female CF recruits who reported binge drinking on a monthly basis or more increased steadily from 2003 to 2006, and in general, the rates of binge drinking were higher compared to age-stratum specific data from the Canadian general population (Lee, 2010). The proportion of recruits who smoked, however, did not change significantly during this time, and the proportion of smokers (approximately one-fifth of recruits) was similar to that of the general population. However, a comparison of smoking rates from 2000 and 2004 surveys of Regular Force CF members revealed a decrease in smoking that was greater than in the general Canadian population (DFHP, 2005). In the US, cigarette smoking has declined substantially in the military since 1980, although heavy alcohol use has remained stable (Bray *et al.*, 2006).

⁹ Altarac *et al.*, 2000; Reynolds *et al.*, 1994.

Limitations

The research reviewed in this article provides evidence to suggest that although military recruits may be healthier than their peers in the general population, temporal trends in health and fitness levels of military personnel are still unfavourable. Some inconsistencies are evident in the literature. For example, among US Army recruits, some fitness measures have actually remained stable or improved over time, while BMI scores have increased.¹⁰ Some studies have shown that both leisure time physical activity and caloric intake have increased.¹¹ These findings speak to the importance of examining multiple measures of health and fitness when looking at temporal trends in military populations. Given the demographic and cultural differences between the military and civilian environments (e.g., the military being a predominantly male, younger population, with an emphasis on maintaining standards of fitness), it is important to continue to study trends in military populations in order to influence the development of policies and programmes to enhance and maintain the health and physical fitness of military personnel.

Although not covered here, gender differences in health and fitness trends may be an important variable to examine in the future, since males and females may have unique issues in this regard. For example, US data has shown that many female military personnel meet the diagnostic criteria for an eating disorder, and report a higher incidence of fasting, vomiting, excessive exercising, and use of medication to lose weight, compared to women in the general population (McNulty, 2001). Women may experience unique issues in a military environment in which they are the minority gender. The examination of trends in health and fitness levels should consider that gender differences may exist that may not be apparent in the civilian population.

It must be noted that there are limitations inherent in self-report data, which was the source of much of the data reviewed in this report. For example, a study of US Army personnel found that individuals tended to slightly over-report their performance on a physical fitness test (Jones *et al.*, 2007). In addition, there are several known limitations associated with using BMI scores as a measure of health risk (Health Canada, 2003). First, BMI provides a measure at one point in time. Individuals who recently gained or lost weight may experience risks associated with the weight fluctuation, even if at the time of BMI calculation they are within the normal range for health risks. Second, young adults who have not yet attained their full growth, or those who are highly muscular, may be at a different level of health risk than that associated with their BMI score. In particular, BMI is susceptible to overestimation among individuals with higher muscle mass, which is common among young males and those who are physically active (Health Canada, 2003). Further, it is known that physical fitness and diet can offset some of the negative impacts of excess body weight (Health Canada, 2003).

¹⁰ Knapik *et al.*, 2006b; Sharp *et al.*, 2002.

¹¹ Craig *et al.*, 1999; Ham *et al.*, 2004; Wright *et al.*, 2004.

These are particularly important limitations to consider in the military recruit population, where very young individuals who may still be experiencing some growth, young males with high muscle mass, and those who regularly participate in weight training or sports programmes, may have BMI scores that do not accurately reflect their risk for health problems. In addition, although BMI is correlated with percentage of body fat, it does not provide information on the distribution of fat, which is important since excess abdominal fat is associated with health risks independent of BMI (Janssen *et al.*, 2002b). Finally, the BMI classification system was developed using a predominantly Caucasian population, and may not be as accurate in classifying health risk of other racial or ethnic groups (Health Canada, 2003). Despite these limitations, however, BMI is generally considered an acceptable proxy for health risk, and combined with other measures such as physical fitness test results, diet, physical activity, and prevalence of alcohol and tobacco use, can provide important information about the health of military personnel.

Conclusion

It is clear that enhancing the health and fitness of military personnel has important implications for recruitment, retention, health and well-being, and performance of military duties. Promotion of health and fitness and of health behaviours will have an impact on the ability of military organizations to attract and retain high quality personnel. Social support appears to be one means by which health and fitness may be enhanced, as it has been shown to be an important motivator for physical activity (Miller & Iris, 2002). Social support and self-motivation have been found to influence health behaviours, including physical activity, nutrition, smoking and alcohol use, among civilian, reserve, and active duty personnel in the US Army (Wynd & Ryan-Wenger, 2004). Among active duty personnel, the perception of a hierarchical organizational culture was also associated with positive health behaviours among those with high levels of self-motivation and physical activity, suggesting that the externally-motivated requirement to exercise may eventually be internalized to increase the desire to maintain one's own health (Wynd & Ryan-Wenger, 2004). The incorporation of social support, self-motivation, and leadership encouragement of positive health behaviours may enhance the success of health promotion programmes. Group health and fitness challenges, which offer a supportive environment while at the same time enhance individual motivation to succeed, may be useful in enhancing the fitness levels of military personnel. Although less common, it is important to consider that underweight individuals may also be at risk of health problems. The focus of many health promotion programmes is on losing weight, although being underweight has been linked to a greater risk of health problems such as undernutrition, osteoporosis, and impaired immune system functioning (Health Canada, 2003). For example, Haddock *et al.* (2007) found that both obese and underweight individuals were more likely to have physical health problems that could impact their readiness to perform military duties.

Programmes and policies to enhance the health and fitness of military personnel, as well as assessments of military fitness, should also address health behaviours, such as smoking cessation, alcohol use, and nutrition, in addition to maintaining a healthy body weight. It is important to look beyond body weight as a measure of health and fitness, and to also consider health behaviours. In fact, it has been suggested that body composition may be limited as an indicator of military readiness (Haddock *et al.*, 2007), since the prevalence of obesity in the military is relatively small, and research has shown that many overweight individuals can actually be fit and experience few adverse health outcomes (Blair & Brodney, 1999; Blair & Church, 2004). Indeed, Haddock *et al.* (2007) found that smoking was a better predictor of readiness than weight, indicating that a broader range of factors may contribute to military health and fitness.

This review covered trends in overweight and obesity, fitness, and several health behaviours including participation in physical activity, nutrition, and substance use. An increasing body of literature has demonstrated that while fitness levels are declining in the general population, the prevalence of overweight and obesity is increasing. Although some research shows that military recruits tend to be healthier than the general population, temporal trends are still in an unfavourable direction. Despite medical screening and physical fitness testing, fitness trends in the military appear to mirror those of the general population. The decline in fitness levels has a number of important implications for military personnel, including increased risk of injuries during training, attrition, and medical complications which can affect performance of military duties (e.g., increased risk of cardiovascular disease). In addition, the increasing prevalence of overweight and obesity in youth and young adults has implications for the ability of militaries to recruit and retain physically fit personnel. As this trend continues, it will become increasingly difficult to maintain a fit force. Several studies have indicated that the decline in fitness observed in the general population is particularly prevalent among youth and young adults, especially young males, populations which are targeted for recruitment by the military. For example, data from the Canadian general population has indicated that although overweight and obesity levels are increasing in the overall population, this increase is particularly pronounced in children, and there is a higher prevalence of overweight among men compared to women (Tremblay *et al.*, 2002). US data has also shown significant increases over time in overweight and obesity among children, adolescents, and young adult males (Ogden *et al.*, 2006). Since obesity in childhood has been linked to obesity in adulthood (Whitaker *et al.*, 1997), such trends have important implications for current and future recruiting efforts. This diminishing pool of potential applicants may result in failure to meet target numbers of recruits as greater numbers of youth and young adults in the civilian population exhibit unhealthy weights and low levels of physical fitness. In addition, excess body weight and its related health concerns are costly to the military, both in terms of the direct costs of health care as well as the indirect costs associated with missed workdays. At the recruit training stage, additional costs may be incurred when the military

spends significant resources to train individuals who subsequently become injured or are unable to complete training due to having an unhealthy body weight. The results of this review point to the importance of encouraging a healthy body weight and healthy behaviours in military personnel, particularly at the recruit stage.

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