Initial assessment of well-being in South African armed services personnel

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Abstract

As professionals in law enforcement and defence (armed services) function under high pressure, the maintenance of overall health should be emphasized and closely monitored in training facilities. The aim of this research was to assess current health status and risk factors of the members of three armed service training facilities. This represents the first step in an integrated approach toward health maintenance in this important sector. The sample consisted of 323 members from three different armed service training facilities in South Africa. The subjects completed a questionnaire on health history and coping with stress. Heart health, body composition, general fitness and co-ordination were then examined. The mean age of the sample was 38.08 years (SD=8.81). The mean blood pressure readings were pre-hypertensive (Systolic 127.4mmHg, SD=16.67; Diastolic 82.74mmHg, SD=10.94) and the mean BMI was in the overweight category ($27.97kg/m^2$, SD=8.81). The percentage (more than 40 %) of subjects that require physical fitness intervention reflects an urgent need for effective implementation of wellness programmes in this sector.

Key words: Armed services, wellness, heart health, body composition, stress, fitness.

Introduction

According to the World Health Organisation, cardiovascular disease is the leading cause of death in developing countries and is responsible for 29.2% of total global deaths (WHO, 2010). The lifestyle an individual chooses to follow plays a major role in determining whether they will develop any kind of cardiovascular disease (CVD) (Shaw & Shaw, 2005). According to the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Joint National Committee, 2003), risk factors for cardiovascular disease are hypertension,

obesity (body mass index >30 kg/m^2), dyslipidaemia, diabetes mellitus, cigarette smoking, physical inactivity, micro-albuminuria, estimated glomerular filtration rate <60 mL/min, age (>55 years for men, >65 years for women) and family history of premature CVD (men age <55, women age <65). The greater the number of risk factors in an individual's life, the greater the risk of developing cardiovascular disease (Morris, Clayton & Everitt, 1990).

Recent media reports suggest that obesity and poor fitness are major challenges facing the South African armed services (Nair, 2010; Witness Reporters, 2010). Aside from the potential risks these conditions represent for overall well-being, there are far-reaching consequences for the efficient execution of everyday tasks. The Law Enforcement Training Network (LETN) in America estimates that 20% of police officers are unable to perform their physical duties (LETN, 2009).

Physical activities that are likely to be performed in these sectors include arrest and self-defence skills that incorporate the use of weapons and physical activities such as kicks, pushes and firearm training (Drzewiecki 2002; Nieuwenhuys *et al.,* 2009). These situations require the use of psycho-physical and motor efforts, where the level of fitness and tolerance towards physical efforts and stressful situations are factors that affect the efficiency of skill execution. There are other factors that should be taken into account when examining risks to well-being in the armed services. These include stress and anxiety.

Studies have shown that in high pressure situations, law enforcement agents show decreased levels of performance (Anderson *et al.,* 2002; Thompson & McCreary, 2006; Behan & Wilson, 2008). The high levels of stress experienced by these individuals may cause decreased motor activity and visual abilities, attention lapses, short-term memory impairments and biased information processing that can contribute to errors in judgment (Drzewiecki 2002; Oudejans & Niewenhuys, 2009; Oudejans & Pijpers, 2009). The stress of routine police work has also been associated with increased risk of post-traumatic stress disorder (PTSD) (Maguen, Metzler, McCaslin, Inslicht, Henn-Haase, Neylan & Marmar, 2009).

It is in the best interest of the public to select the right people to work in law enforcement and defence sectors of the country (Nieuwenhuys, Caljouw, Leijsen, Scheits & Oudejans, 2009). Given that professionals in law enforcement and defence (referred to here as armed services personnel) function under high pressures and are subjected to high physical and mental demands (Anderson, Litzenberger & Plecas, 2002), maintenance of overall health should be an integral part in training.
The aim of this research was to assess the current health status and risk factors of the members of three groups of armed service training personnel. This represents the first step in an integrated approach toward health maintenance, which begins with a comprehensive assessment and is followed by monitoring, feedback and intervention.

Methodology

Sample

The sample consisted of 323 recruits, from three different armed service training facilities in South Africa. The population sampled in this study focused on a age group between the ages of 20 and 60 years and can be used as a study foundation for future studies to build upon so that the subject of physical wellness as well as the role of specific age groups can be expanded.

The participants were selected based on compliance with the inclusion criteria. The study included only participants who enrolled for the training program, completed the informed consent and had no visual disorder or ailment preventing them from performing the tests. For the sake of confidentiality, the institutions were labeled as institution 1, 2 and 3 in this study.

The study procedure was approved and ethical clearance obtained from the Research Ethics Committee of the Faculty of Health Sciences, University of Pretoria (protocol 46/2010), in accordance with the principles of Helsinki Declaration. Informed consent was obtained from participants. The test battery consisted of a questionnaire that examined biographical, health history and stress coping attributes; tests for heart health (blood pressure, heart rate, QRS duration and cardio stress index), body composition (body mass index (BMI), body fat percentage and waist-to-hip ratio), general fitness (coordination, muscle and cardiovascular endurance), and co-ordination (Wilson & Falkel, 2004; Powers & Dodd, 2009).

Questionnaire

The questionnaire consisted of biographical information items and questions regarding family and personal history of conditions such as obesity, heart attacks and respiratory problems. The stress questionnaire indicates how well individuals perceive their stress coping capabilities (Powers & Dodd, 2009). This questionnaire had five items scored on a three-point rating scale. The summed score is directly proportional to the perceived ability to handle stress.

Heart's health

Under healthy conditions, a human heart displays a beat-to-beat variation. This shows that the heart is constantly influenced by internal and external stimuli to which it reacts in adequate fashion. However, during stressful conditions adjustments are made to the reactions of the heart, such as increased heart rate or a reduction of the variation range of the heart rate from beat to beat (Prentice, 1999). This variation is known as heart rate variability (HRV) and various parameters for HRV are transferred via evaluation formulae into the cardio stress index (CSI). A battery

operated Viport device (Energy-Lab Technologies GmbH) was used to determine the CSI of the participants. The device also provides additional information about heart rhythm, heart rate (HR) and QRS duration.

Prior to testing, subjects positioned themselves in a seated, relaxed manner. The three metal corners (electrodes) of the Viport were moistened with conducting gel, after which the device was placed on the left side of the chest. The correct measurement position was identified by placing the index finger on the left collarbone of the subject, and then affixing the Viport approximately three finger-widths below this position. Once the Viport was correctly positioned, the measurement was started by pushing the start button. Participants were instructed to breathe calmly and avoid talking and moving for the two minute duration of the test. The audible signal at the end of each measurement indicated the appropriate time to remove the Viport from the chest and record the results from the display. A CSI reading lower than 20% is indicative of high HRV, or normal cardiac stress load. A heart rate of between 60-80 beats per minute (bpm) is considered normal and QRS duration should lie between 60-110 milliseconds (ms). QRS duration > 120ms has been associated with increased mortality (Shenkman, Pampati, Khandelwal, McKinnon, Nori, Kaatz, Sandberg & McCullough, 2002).

For the assessment of blood pressure, individuals sat in an upright chair in a comfortable environment for five minutes with their left arms supported at heart level and elbows slightly flexed with no restrictive clothing around the arm. An electronic blood pressure measuring device was used. At least two readings were taken on each individual and results were recorded to the nearest 2 mm Hg (Prentice, 1999; Powers & Dodd, 2009). The JNC 7 guidelines for hypertension were used to determine which subjects exhibited normal blood pressure (<120/80mmHg), pre-hypertension (120-139/80-89mmHg) or hypertension (>140/90mmHg) (Joint National Committee, 2003).

General fitness

General fitness parameters include flexibility, muscle endurance and cardio-respiratory endurance. The level of flexibility was tested after subjects warmed up with a low-intensity activity such as walking or easy jogging. Subjects removed their shoes, sat with their backs against a wall and legs together, and extended in front of them. Subjects then reached as far forward as possible, with palms down, arms evenly stretched and knees fully extended. The position of maximum reach had to be held for two seconds. The stretch was performed twice. Points were awarded according to whether the stretch reached the knees, shins or toes (Roberts, 2002).

For the assessment of muscle endurance, subjects had to perform crunches and push-ups. For the crunches, two 60 cm long tape strips were placed parallel to each other

(8 cm apart) on the ground. Subjects started the exercise by lying on their backs on an exercise mat, with their knees bent at 90° and feet 30-45 cm from buttocks. Their positions were adjusted so that the longest fingertip of each hand touched the end of the near tape strip. Crunches were performed by flexing the spine while sliding the fingers across the floor until the fingertips of each hand touched the second tape strip and then returning to the starting position. The shoulders had to remain relaxed and touched the ground between crunches. The feet and buttocks remained on the floor throughout the exercise. Subjects performed as many crunches as possible in one minute at a steady pace while maintaining in the correct position (Prentice, 1999; Roberts, 2002; Powers & Dodd, 2009).

For the push-up and half-push-up tests subjects had to place their hands directly under their shoulders, or slightly wider to put more weight on the chest. Keeping fingers pointing forward and the torso and legs straight, arms had to be bent to about 90°. The body had to be lowered while keeping the head in line with the spine. The number of push-ups completed in one minute was recorded. For the half push-up, arms were positioned as for the full push-up, but the knees were in contact with the floor. The number of half push-ups completed in one minute was recorded (Prentice, 1999; Roberts, 2002; Powers & Dodd, 2009). Those that could not perform the full version did the half-push-up test.

Cardio-respiratory endurance was assessed by means of a three-minute step test. A bench 40 cm high, a stop watch for monitoring timing, a metronome to maintain a standard tempo and a POLAR^{TM} watch for measuring heart rate were used. Each step had four beats (up-up and down-down). Males performed the test at a tempo of 24 steps per minute and females at a tempo of 22 steps per minute. After three minutes the test was stopped and heart rate was measured 15 seconds into recovery (Prentice, 1999; Roberts, 2002; Powers & Dodd, 2009).

Co-ordination

The egg carton catch test evaluates eye-hand coordination. The pouches of an empty egg carton were numbered sequentially from one to twelve. While standing, the participants had to flip a coin from pouch to pouch in numerical order. The time taken in seconds to complete this was recorded (Wilson & Falkel, 2004).

For the alternate hand wall toss, participants were asked to stand facing a wall behind a two-metre restraining line, with a ball held in the right hand.   The ball was then tossed against the wall with an under-arm motion and caught in the left hand. The ball was then thrown with the left hand and caught in the right hand. This alternate ball toss was repeated and the number of successful catches in 30 seconds was recorded (du Toit, Kruger, Mahomed, Kleynhans, Jay-du Preez, Govender & Mercier, 2011).

Body composition

Body composition was determined by deriving the BMI from the height and weight, body fat percentage and waist-to-hip ratio. BMI was derived from measures by using a calibrated weight scale and tape measure.

Waist and hip circumferences were measured using a flexible tape measure in centimetres. Subjects stood with their feet together and their arms raised high enough to allow measurements to be taken. Waist measurement was taken at the smallest waist circumference or at the level of the navel if the waist did not have a natural form to it. Waist-to-hip ratio was derived by dividing waist circumference by hip circumference (Powers & Dodd, 2009).

Skin fold measures (6-site skin fold measurement) were recorded by using BodyLogic© calibrated skin fold calipers to measure sub-cutaneous fat at 6 locations on the body (triceps, sub-scapular, abdominal, supra-iliac, thigh and calf). The fat percentage was calculated using gender-specific regression equations (Powers & Dodd, 2009).

Data analysis

Descriptive data were calculated using NCSS^{TM} software. Further analysis of the sample included a comparison (5% level of statistical significance) between men and women using the independent samples t-test and Fischer's exact probability test for categorical data. The risk across training institutions was calculated as a percentage. Correlation coefficients were analyzed using SPSS^{TM} 17.0.

Results

The mean age of the sample was 38.08 years (SD=8.81), comprising 154 women and 169 men. The mean score on the stress index was 7.4 (SD = 1.91). Figure 1 indicates the percentage of subjects that reported family histories of various illnesses. The most highly reported family conditions were hypertension (30.7%), overweight (8.4%), cancer (7.4%), high cholesterol (7.1%), heart disease (4.3%) and lung disease (3.1%). A family history of substance dependence problems was reported by only 1.2% of the subjects, while 8.7% reported that at least one family member had suffered a heart attack.
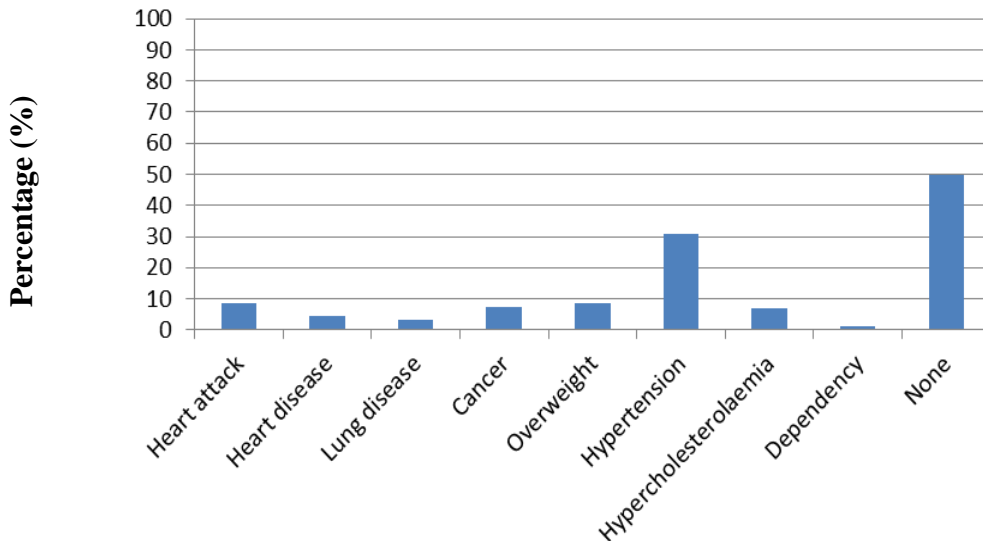
Figure 1: The percentage of subjects reporting a family history of health conditions.

Personal history of health conditions is recorded in Figure 2. Subjects mainly reported a history of hypertension (11.8%), overweight (5.9%) and hypercholesterolemia (3.7%). Heart and lung disease, cancer and substance dependence all fell below 1%, while only 0.3% of the subjects had previously suffered a heart attack.
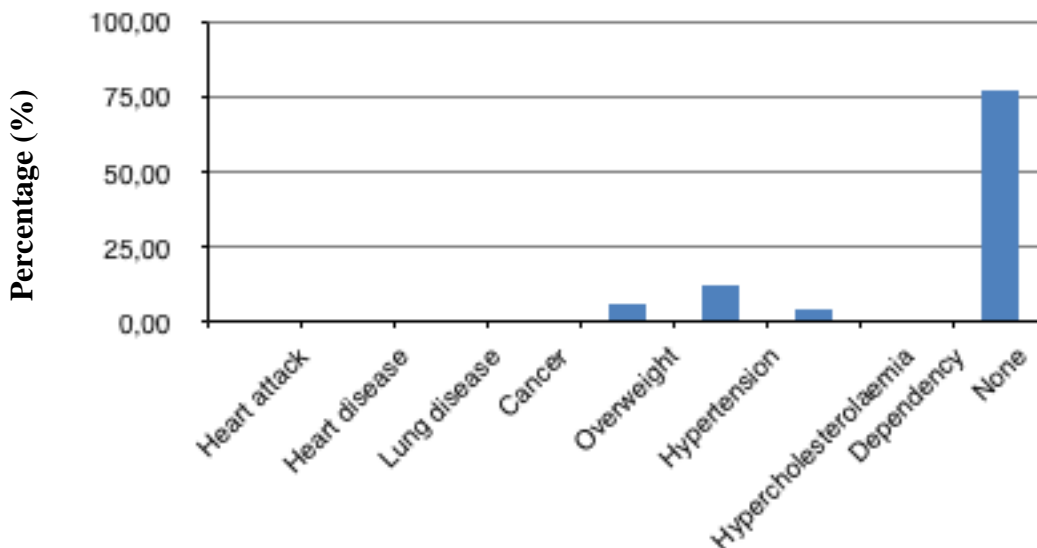

Figure 2: The percentage of subjects reporting a personal history of health conditions.

Heart Health

The results of the heart's health assessment are provided in Table 1. The mean diastolic blood pressure of 82.74 mmHg (SD = 10.94) and the mean systolic blood pressure of 127.40 mmHg (SD = 16.67) are both in the pre-hypertension category according to Joint National Comittee Seventh guidelines (Joint National Committee 2003). In addition, the mean CSI of 33.64% (SD = 25.41) is above the 20% expected for healthy people. However, the heart rate (mean = 82.31 bpm, SD = 15.28) and QRS duration (mean = 80.97 ms, SD = 13.01) reflect healthy heart functions.

Table 1: Results of the heart health assessment (n=323).

Variable	Mean	Std. Deviation
Diastolic blood pressure (mmHg)	82.74	10.94
Systolic blood pressure (mmHg)	127.40	16.67
CSI (%)	33.64	25.41
HR (bpm)	82.31	15.28
QRS duration (ms)	80.70	13.01

Body composition

The mean BMI was for the overweight category was 27.97kg/m^2, SD=8.81. Women had high mean values of percentage body fat (29.82$\pm$5.25) compared to men (14.54$\pm$4.22). The women and men displayed healthy scores on waist-to-hip ratio (mean=0.79, SD = 0.07 and mean = 0.88, SD = 0.07, respectively).

Fitness and coordination

The mean and standard deviations for the fitness and coordination scores are reflected in Table 2. An overall fitness score was calculated using Roberts' equation, which takes into account the results for BMI, waist-to-hip ratio, sit-and-reach, push-ups, crunches and the step test. The equation allows for the categorization of fitness levels into risk profiles. A score of 5 to 8 represents a high risk, 9 to 13 moderate risks and 14-18 indicates that the subject presents no risk (Roberts, 2002).

Table 2: Results of the fitness and coordination tests (n=323).

Variable	Mean	Std. Deviation
Crunches	43.17	19.67
Eye-hand coordination	40.41	28.61
Full push-ups	32.07	17.18
Half push-ups	34.10	16.22
Hand-ball-toss	12.92	8.047
Step test	135.11	56.86

Correlations

Although the data presented a number of significant correlations, these were weak, with two exceptions. CSI and HR (r = 0.623); systolic and diastolic blood pressure (r = 0.68) presented moderately strong positive correlations.

Gender comparisons

A comparison of the men and women on categorical data (family and personal history of disease) revealed only one significant difference: family history of overweight, in which more men reported a family history of the condition. The women were significantly younger and displayed significantly higher body fat percentage; CSI and HR (p<0.05). The men's waist-to-hip ratio was healthier than that of the women. However, men displayed significantly higher systolic blood pressure and diastolic blood pressure (p<0.05). Overall, the men performed better in the fitness tests, with significantly better scores being recorded for the hand-ball-toss ; half push-ups ; full push-ups and the step test (p<0.05). There were no significant differences on BMI (p=0.063); QRS duration (p=0.652); the number of crunches executed (p=0.966); eye-hand coordination on the egg carton catch test (p=0.455) or perceived handling of stress tests (p=0.065).

Institutional risks

The percentages of subjects with heart health, body composition, fitness and stress scores outside the desirable limits were calculated. These are shown as the percentage of subjects requiring intervention and are presented per institution in Table 3. With regard to heart health, Institution 2 exhibits the highest percentage of subjects needing intervention for the cardio stress index (47.1%), HR (59.35%) and QRS duration (5.81%). Institution 3 exhibits the highest percentage of subjects needing intervention for high blood pressure.

Table 3: Comparison of wellness testing risk profiles of the three institutions

Heart health intervention needed (% of subjects tested in institution)			
Variable	Institution 1 n=39	Institution 2 n=156	Institution 3 n=128
CSI	46.15	47.1	37.5
HR	57.90	59.35	35.43
Systolic BP	13.20	16.67	29.03
Diastolic BP	13.20	18.59	39.52
Body composition intervention needed (% of subjects tested in institution)			
Variable	Institution 1 n=39	Institution 2 n=156	Institution 3 n=128
Waist-to-hip ratio (females)	30.4	85.37	92.86
Waist-to-hip ratio (males)	20	81.94	92.96
BMI: females	87.5	96.34	86.27
BMI: males	91.3	91.78	91.3
Fat %: females	6.66	92.68	92.86
Fat %: males	83.34	49.32	52.11
Fitness and coordination intervention needed (% of subjects tested in institution)			
Variable	Institution 1 n=39	Institution 2 n=156	Institution 3 n=128
Coordination	5.4	3.4	6.9%
Overall fitness	60.2	60	9.38%
Stress intervention needed (% of subjects tested in institution)			
Variable	Institution 1 n=39	Institution 2 n=156	Institution 3 n=128
Stress questionnaire results	14.4%	15.4%	37.5%

Concerning body composition, Institution 2 is most in need of intervention for BMI for both men and women. Meanwhile, Institution 3 has the highest percentage of subjects requiring intervention for unhealthy waist-to-hip ratios and body fat

percentages (females). The males from Institution 1 are the most in need of intervention for body fat percentage.

The subjects from all three institutions generally exhibit good coordination, with Institution 3 requiring the highest percentage of intervention for a mere 6.90% of subjects. However, overall fitness is poor for Institutions 1 and 2. Institution 1 requires intervention for 60.20% of the subjects tested and Institution 2 for 60% of subjects.

Few subjects require interventions for stress. Less than 20% of the subjects from Institutions 1 and 2 are in need of assistance. However, Institution 3 needs intervention for 37.5% of its tested members.

Discussion

The aim of this research was to describe the current health status and examine the incidence of risk factors among the members of three armed service training facilities. The results of this study show that subjects in the training facilities are in need of a variety of interventions. Intervention should include institution-specific combinations of diets, physical exercise, as well as emotional and spiritual well-being programmes (Masley, Weaver, Peri & Phillips, 2008).

Promoting and ensuring that members of this sector are in peak physical and mental condition is an important step toward efficient task accomplishment and ultimately, in ensuring the safety of citizens (Drzewiecki, 2002; Nieuwenhuys *et al.,* 2009). The training institutions are, therefore, responsible for teaching task-specific skills and helping members attain or maintain overall well-being. The three institutions investigated in this study all revealed a high need for intervention with regard to heart health, fitness and body composition.

In this study, the low incidence of reported family and personal health conditions is rather misleading. For example, only 5.9% of the sample reported a personal history of overweight, but over 60% of subjects actually exhibited poor results for all body composition parameters measured. Perceived stress handling appears to be fairly good in all institutions. However, the lack of self-knowledge or denial with regard to body composition may also be a factor when subjects were asked how they cope. In effect, there may be a large discrepancy between the subjective perception of stress coping and reality. Men, especially, are known to underreport distress. Given that emotional distress is a strong predictor of clinical outcomes in cardiovascular disease, such denial or minimalizing of symptoms is potentially dangerous (Ketterer, Denollet, Chapp, Thayer, Keteyian, Clark, John, Farha & Deveshwar, 2004).

In this study a startling 130 subjects were overweight and 97 obese. This means that 70% of the sample were overweight and 30% obese. Granted that this statistic is not

at the level of estimated prevalence of obesity of 60% amongst people of African origin in South Africa (Case & Menendez, 2009), but if the recent spate of media reports on the high prevelance of obesity in the country is any indication, South Africa's armed services is ailing under this condition (Nair, 2010; Witness reporters, 2010). Obesity is seen to be one of the latest health scourges of developing countries, where genetics and the Westernization of diets combined with the availability of cheap calorie-rich foods and lack of physical activity are the main factors influencing body composition (Walker, Adam & Walker, 2001; Case & Menendez, 2009).

The overall physical fitness of these armed services personnel is questionable. More than 40% of the sample exhibit poor fitness levels. A good cardio-respiratory fitness may result in some cardio-protective characteristics in people with hypertension (Sui, La Monte & Blair, 2007). Unfortunately, the fitness of 60% of subjects in two of the institutions is poor. The low fitness may partly be a consequence of physical inactivity, which is an added CVD risk factor (Fletcher, 1999).

Further concerns considering the percentage of subjects with heart health risk factors. Poor heart rate variability is a predictor of left ventricular dysfunction following myocardial infarction (Wennerblom, Lurje, Karlsson, Tygesen, Vahisalo & Hjalmarson, 2001) and is associated with coronary artery disease; heart failure; diabetes and hypertension (Umetani, Singer, McCraty & Atkinson, 1998; Burger, Charlamb & Sherman 2009; Pumprla, Howorka, Groves, Chester & Nolan, 2002). Low heart rate variability is seen in 37.5 to 47.1% of the subjects. Also, resting HR is elevated in 35.43 to 59.35% of the subjects. A thought-provoking finding is that only 0.3% of the subjects reported a personal history of heart attack. This may be because of the age of the subjects, who are still fairly young (mean age = 38.081 years, SD=8.810) or that subjects were already being treated for CVD. Unfortunately, the latter was not investigated. The aggregate of risk factors is serious for at least 52 subjects. The 52 subjects (16% of the sample) have a family history of hypertension, suffer from hypertension and are overweight. Of the 52 subjects, 23 are actually obese, which further jeopardizes their risk.

When examining the effects of gender on the risk factors, it is important to note that, despite being significantly younger, the women in this sample exhibit more CVD risk factors than men. Women show significantly higher body fat percentage ($p<0.05$) and waist-to-hip ratio ($p<0.05$) and poorer heart rate variability reflected in a significantly higher CSI ($p<0.05$) than their male counterparts. Although men did display significantly higher blood pressure than women (systolic blood pressure $p<0.05$ and diastolic blood pressure $p<0.01$), this is likely to be at least partially moderated by their relatively superior fitness levels.

Conclusions

It is clear that poor physical fitness, hypertension and unhealthy body composition are significant risk factors in our sample. From an organisational perspective, the risks identified should be used to facilitate individual and management focused intervention programmes and provide a basis for on-going evaluation. Although this study proposes an integrated approach to wellness intervention in this sector, certain information is lacking. For instance, information regarding nutritional habits, energy expenditure and participation in physical fitness activities was not gathered. Such information would enhance the planned intervention and could be used to educate subjects about their lifestyle habits. Furthermore, the effect of smoking was not taken into account in the study. Future studies should include an analysis of kidney function and glucose levels for a more accurate profile of CVD risks and to compare the effects of integrated intervention on the armed services personnel.

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