



National Library
of Canada

Acquisitions and
Bibliographic Services Branch

395 Wellington Street
Ottawa, Ontario
K1A 0N4

Bibliothèque nationale
du Canada

Direction des acquisitions et
des services bibliographiques

395, rue Wellington
Ottawa (Ontario)
K1A 0N4

Your file Votre référence

Our file Notre référence

NOTICE

The quality of this microform is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us an inferior photocopy.

Reproduction in full or in part of this microform is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30, and subsequent amendments.

AVIS

La qualité de cette microforme dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de qualité inférieure.

La reproduction, même partielle, de cette microforme est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30, et ses amendements subséquents.

Canada

Demographic and Psychosocial Components
of Health Behaviour Clusters
in Canadian Military Males

by

Brent Ward Patrick Moloughney

Thesis submitted to
the School of Graduate Studies and Research
in partial fulfilment of the requirements for the
M.Sc. degree in Epidemiology

University of Ottawa



Brent Ward Patrick Moloughney, Ottawa, Canada, 1992



National Library
of Canada

Acquisitions and
Bibliographic Services Branch

395 Wellington Street
Ottawa, Ontario
K1A 0N4

Bibliothèque nationale
du Canada

Direction des acquisitions et
des services bibliographiques

395, rue Wellington
Ottawa (Ontario)
K1A 0N4

Your file Votre référence

Our file Notre référence

The author has granted an irrevocable non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of his/her thesis by any means and in any form or format, making this thesis available to interested persons.

L'auteur a accordé une licence irrévocable et non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de sa thèse de quelque manière et sous quelque forme que ce soit pour mettre des exemplaires de cette thèse à la disposition des personnes intéressées.

The author retains ownership of the copyright in his/her thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without his/her permission.

L'auteur conserve la propriété du droit d'auteur qui protège sa thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

ISBN 0-315-80034-8

Canada



UNIVERSITÉ D'OTTAWA
UNIVERSITY OF OTTAWA

ABSTRACT

Health behaviours have become an important focus for study due to their relationship to population health. Health studies on national as well as more selected populations, have shown that the number of positive health behaviours people perform, as well as the degree to which they are performed, are associated with concurrent and future health status. A desire to improve the understanding of the nature and determinants of health behaviours have followed these findings.

One aspect of health behaviour research which has been explored is whether health behaviours are independent of each other. If health behaviours are not independent of each other, then co-occurrence of behaviours could provide clues towards common determinants of multiple behaviours. Additionally, the presence of co-occurring behaviours might be of significance in planning health promotion interventions. Previous studies in this area have generally found modest correlations between behaviour pairings, and inconsistent clustering of behaviours. However comparison of these studies is difficult due to the diversity of behaviours studied, inconsistency in their measurement and the population under study, the lack of control for demographic variables, as well as the lack of recognition of the relationship between health behaviour performance levels and health risk. On the basis of the literature reviewed, it may well be premature to conclude that the inter-relationships between health behaviours are weak.

This study explored the inter-relationships between health behaviours and their association with demographic and psychosocial measures in a population of

Canadian military males. The objectives of this thesis were to determine first, whether health behaviours are independent of each other and if not, second, whether their inter-relationships vary i) based upon the manner in which the health behaviours are scored; and ii) between demographic sub-groups. The third objective was to determine whether the association between health behaviour clusters and psychosocial measures varied for different clusters of behaviours.

The data used were part of the 1989 Canadian Forces Health and Lifestyle Survey data set administered to regular force military personnel. The health behaviour variables were: tobacco smoking, alcohol consumption, physical activity, sleep, eating breakfast, eating between meals, brushing and flossing teeth, and testicular self-examination. The demographic variables included age, education, marital status, and military rank. Health status was estimated from a single five-choice perceived health status question. Five psychosocial measures were included: life events, social support, self-esteem, personal mastery, and psychological symptoms.

Many of the correlations observed between health behaviours were statistically significant, however this was mainly due to the large sample size. Relationships were of modest magnitude, ($r < 0.30$). The largest correlations were between flossing and brushing teeth ($r = 0.27$), eating breakfast and smoking ($r = 0.24$), and alcohol consumption and smoking, ($r = 0.17$).

Re-coding of health behaviour performance levels was performed to ensure that there was a monotonic relationship between performance levels and health

status. This was done to ensure that correlations were performed on health behaviours in the context of their relationship with health status, and not simply the frequency of the behaviour. Variation in the correlation of some health behaviour pairings did occur after re-coding, particularly for alcohol consumption and smoking. A 20% increase in the correlation between these two variables was observed at the level of the crude population. Other behaviour pairings showed a decrease in the magnitude of correlations after re-coding. Thus failure to re-code health behaviours which have a non-monotonic relationships with health status can result in under- or over-estimation of correlations. Nevertheless, the low correlations observed between health behaviours were not merely due to ordinal scoring.

When the survey population was stratified by demographic variables and the correlation coefficients re-calculated, substantial variation was observed in the magnitude of correlations between strata. Such variations were reflected in different factor solutions when the correlation matrices were submitted to a factor analysis. It is possible that variation in health behaviour inter-relationships is indicative of an underlying variation in the common determinants of health behaviours in different population sub-groups. It is interesting that the largest variation in correlations and factor structure was observed between military rank strata because there are tremendous differences in inter-strata environmental factors. Such differences may assist the development of different patterns of health behaviour determinants. This may explain the observed variation in correlations

between the rank strata. If determinants of health behaviours differ for different population sub-groups, then this has implications for the need for tailoring health promotion programs for different target groups. It also indicates that using crude population correlations for health behaviour pairings is misleading because it masks the variation in correlations likely existing at the level of population sub-groups.

The third objective of this study was to determine the association of psychosocial measures with different health behaviour clusters. The psychosocial measures were not effective discriminators of individuals performing multiple behaviours at a positive level from those who were not. It is possible that the psychosocial measure's J-shaped distributions were the result of a social desirability bias and led to their poor discriminating performance. Consideration should be given towards strategies to avoid or minimize the effect of this bias if further surveys of this population are to be conducted.

Additional analyses were performed exploring the relationship between health behaviours and health status. While individuals reporting excellent health status performed on average twice as many health behaviours at a positive level compared to those reporting poor health, substantial variability in the relationship was observed. This is a reminder that there are many factors other than personal behaviours which influence health status.

ACKNOWLEDGEMENTS

This study would not have been possible without the support and assistance of many individuals. The Directorate of Health Protection and Promotion (formerly DPM) of the Surgeon's General Branch, Canadian Forces was very helpful in providing copies of previous reports involving the 1989 Canadian Forces Health and Lifestyle Survey, as well as allowing me access to the survey data set. Dr. L. Scanlon was of particular assistance in describing the development of the survey, its pretest, and conduct.

My two thesis supervisors, Drs. S. Raman and S. Hotz, were invaluable in helping me crystallize my thoughts, as well as being supportive when at times this project seemed without end.

For my wife, Marie-Andrée, a word of thanks for tolerating my frequent evening disappearances. And to my daughter, Chantal, for putting everything in perspective.

TABLE OF CONTENTS

ABSTRACT	i
ACKNOWLEDGEMENTS	v
LIST OF TABLES	viii
LIST OF FIGURES	x
1. INTRODUCTION	1
2. REVIEW OF LITERATURE	3
2.1 HEALTH AND HEALTH BEHAVIOURS	3
2.2 INTER-RELATIONSHIPS BETWEEN HEALTH BEHAVIOURS	4
2.3 HEALTH BEHAVIOURS AND PSYCHOSOCIAL MEASURES	12
2.4 SUMMARY	18
3. METHODS	20
3.1 DATA SOURCE	20
3.1.1 VARIABLES	20
3.2 MATERIAL	25
3.3 METHODS RELATING TO THE THESIS OBJECTIVES	26
4. RESULTS - DESCRIPTIVE	30
4.1 SURVEY RESPONSE	30
4.2 DEMOGRAPHIC VARIABLES	31
4.3 HEALTH STATUS	32
4.4 HEALTH BEHAVIOURS	32
4.5 PSYCHOSOCIAL VARIABLES	34
4.6 ASSESSMENT OF EFFECT OF MISSING VALUES	35
5. HEALTH BEHAVIOUR INTER-RELATIONSHIPS	37
5.1 HEALTH BEHAVIOUR CORRELATIONS	37
5.2 HEALTH BEHAVIOUR CLUSTERS	44
5.3 DISCRIMINANT ANALYSIS OF HEALTH BEHAVIOURS ...	49
6. FOLLOW-UP ANALYSES	52
6.1 HEALTH BEHAVIOURS AND PERCEIVED HEALTH STATUS	52

6.2 HEALTH BEHAVIOURS AND PSYCHOSOCIAL MEASURES	55
6.3 PSYCHOSOCIAL MEASURES AND HEALTH STATUS	56
7. DISCUSSION OF RESULTS	58
7.1 DATA QUALITY	58
7.2 DESCRIPTIVE RESULTS	60
7.3 HEALTH BEHAVIOUR INTER-RELATIONSHIPS	64
7.4 DISCRIMINANT ANALYSIS OF HEALTH BEHAVIOUR CLUSTERS BY PSYCHOSOCIAL MEASURES	76
7.5 RECOMMENDATIONS	78
7.6 FOLLOW-UP ANALYSIS - HEALTH BEHAVIOURS AND PERCEIVED HEALTH STATUS	80
8. CONCLUSION	83
9. REFERENCES	86
APPENDIX A	115
APPENDIX B	118
APPENDIX C	131
APPENDIX D	132
APPENDIX E	142
APPENDIX F	143
APPENDIX G	146
APPENDIX H	147
APPENDIX I	148
APPENDIX J	149

LIST OF TABLES

Table 1 Demographic distribution of the Canadian Forces, survey target sample and respondents.	93
Table 2 Age distribution of survey respondents, the Canadian Health Promotion Survey and the 1986 Canadian population.	93
Table 3 Education level achieved by survey respondents and Canadian males aged 20-54, (1986 Census).	94
Table 4 Distribution of survey respondents by military rank.	94
Table 5 Distribution of survey respondents and Canadian population* by marital status.	94
Table 6 Distribution of CFHLS and Canadian Health Promotion Survey by perceived health status.	95
Table 7 Distribution of CFHLS and Canadian Health Promotion Survey by self-reported alcohol consumption.	95
Table 8 Cigarette use in the CFHLS and the 1985 General Social Survey. ...	95
Table 9 Distribution of survey respondents by frequency of eating breakfast.	96
Table 10 Distribution of survey respondents by frequency of self-reported eating between meals.	96
Table 11 Distribution of survey respondents by frequency of physical activity to the point of sweating.	96
Table 12 Distribution of survey respondents by frequency of tooth brushing. .	96
Table 13 Distribution of survey respondents by frequency of flossing teeth. ..	97
Table 14 Distribution of survey respondents by the number of hours slept per day.	97
Table 15 Distribution of survey respondents by the frequency of testicular self-examination.	97
Table 16 Logistic regression derived ORs for poor health by level of health behaviours controlling for demographic variables.	101

Table 17 Percentage change in rank correlations of health behaviours after re-ordering health behaviour categories to reflect a monotonic relationship with perceived health status.	102
Table 18 Factor analysis solution of crude and age stratified populations of rank correlated, performance level-coded health behaviours.	103
Table 19 Factor analysis solution of rank correlated, odds ratio re-ordered health behaviours of crude and age-stratified populations.	104
Table 20 Factor analysis solutions for risk-scored behaviours; crude, age and education stratified populations.	105
Table 21 Factor analysis solution of risk-scored behaviours stratified by marital status and military rank.	106
Table 22 Pearson correlations between selected risk-scored health behaviours for crude and rank-stratified populations.	107
Table 23 Sensitivity, specificity and total correct classification following discriminant analysis of dichotomized health behaviours by psychosocial measures.	108
Table 24 Results of discriminant analysis of selected health behaviour clusters by psychosocial measures by age strata.	109
Table 25 Mean number of positive health behaviours by perceived health status category.	110
Table 26 Mean values of psychosocial measures by perceived health status categories.	113
Table 27 Mean values of PSYCHSYM by SLEEP categories.	113

LIST OF FIGURES

Figure 1 Distribution of social support scores.	98
Figure 2 Distribution of personal mastery scores.	98
Figure 3 Distribution of self-esteem scores.	99
Figure 4 Distribution of psychological symptom index scores.	99
Figure 5 Distribution of life events scores.	100
Figure 6 Mean number of positive health behaviours performed by perceived health status.	111
Figure 7 The mean number of behaviours performed at good, moderate and poor levels by category of perceived health.	111
Figure 8 Distribution of the number of positive health behaviours reported by perceived health status categories.	112

1. INTRODUCTION

Health behaviours have become an important focus for study due to their relationship to population health. Although health behaviours are but one determinant of health, substantial interest exists concerning their nature and their determinants. This information is important for health promotion and disease prevention activities.

One aspect of the nature of health behaviours which has been explored is the presence of inter-relationships between health behaviours. Non-independence as demonstrated by significant correlations as well as clustering during factor analysis, could be important as an indicator of common determinants for inter-related behaviours. The co-occurrence of health behaviours also might need to be taken into consideration during the development of health promotion interventions. While both demographic and psychosocial measures have been shown to be associated with health behaviours, it is not clear what relationship, if any, these variables might have with health behaviour inter-relationships. The stability of health behaviour inter-relationships throughout a population, as well as the stability of the association between psychosocial measures and health behaviour clusters in different population sub-groups would provide evidence for the stability of health behaviour determinants throughout a population. Such information is important in determining the need for tailoring health promotion interventions.

This thesis has the following objectives:

Objective 1:

To determine whether health behaviours are independent of each other.

Objective 2:

If health behaviours are not independent, then to determine whether inter-relationships found between behaviours vary between:

- i) different strata of demographic variables (age, education, marital status, military rank);
- ii) different methods of coding health behaviour performance levels, (in addition to using variables ranked by increasing performance levels, health behaviour variables will be re-coded to reflect a monotonic relationship with health status).

Objective 3:

To determine whether psychosocial measures are associated with health behaviour clusters, and whether this association differs between clusters.

2. REVIEW OF LITERATURE

2.1 HEALTH AND HEALTH BEHAVIOURS

The reports of the Alameda County studies^{1,2,3} demonstrated the importance of several health behaviours with respect to concurrent and future health status. These behaviours were: moderate or no alcohol intake, not smoking, regular physical activity, 7-8 hours sleep per night, maintaining proper weight, eating breakfast, and not eating between meals. After 9½ years, men performing all these seven behaviours at a positive level had a mortality rate which was only 28% that of men practising zero to three health behaviours.⁴ A difference in life expectancy between the two groups of more than 11 years was estimated .

Population surveys within⁵ and outside Canada⁶ demonstrated that both the individual levels of health behaviours, as well as the number of behaviours performed at a positive level were associated with improved health status. Although the level of performance of health behaviours in military populations differs from that observed in civilian populations,^{7,8} surveys of U.S. military populations have shown that levels of individual behaviours are associated with the frequency of illnesses experienced in the preceding year.^{7,9}

The consistent associations between health behaviours and health status have motivated health promoters to improve the behaviour profiles of populations. They have also led to theoretical questions regarding the relative independence of health behaviours.

2.2 INTER-RELATIONSHIPS BETWEEN HEALTH BEHAVIOURS

Many investigators have searched for patterns of association between health behaviours. The following section provides a summary of the previous research in this area including a description of the study populations, techniques and findings.

<u>Authors and Date</u>	<u>Population Studied</u>	<u>Health Behaviours Investigated</u>	<u>Results</u>
Williams and Weschler, 1972 ¹⁰	A) 161 randomly sampled women aged 35-64 in Boston. B) 433 parents of 9th Grade Boston students.	A) 27 items; tooth brushing, sleep, smoking, physical activity, plus driving behaviour, carrying an umbrella, medical/dental activities and a number of safety items. B) Women 7 items; toothbrushing, dental check, Pap, medical check, not smoking, take few chances, use seat belts Men 11 items; all women's except Pap with obesity, sleep, physical activity, exercise, limit cholesterol intake	Pearson correlations, principal components factor analysis with varimax rotation (PCVAR). Largest correlations was 0.64 (Women checkup and Pap). Most less than 0.25. Factor loading of 0.4 required as criterion for inclusion in a factor. A) 5 factors; one was a checkup factor, another was risk taking. Other 3 did not have obvious similarity (eg F2: exercise, limit calories, TB skin test) B) 3 factors; F1: cholesterol & limit calories. F2: medical & dental checkup. F3: sleep & exercise.
Langlie, 1977 ¹¹	383 randomly sampled adults in Rockford, Illinois in 1973.	11 additive scales: driving, pedestrian, smoking, hygiene, seat belt use, medical and dental checkups, immunization, screening (hearing, vision and Tb), exercise, nutrition	Principal components factor analysis with oblique rotation. Correlations not given. Factor loading of 0.45 inclusion criterion. 3 factors; F1: medical/dental checkup F2: pedestrian, driving, hygiene F3: Seat belt use, nutrition, dental care
Langlie, 1979 ¹²	(as above)	(as above)	Largest correlation was 0.44 (driving and pedestrian behaviour). Most less than 0.25.
Harris and Guten, 1979 ¹³	842 randomly sampled adults in Cleveland, Ohio in 1976.	30 items including: eat sensibly, get enough sleep, get enough exercise, don't smoke, don't drink, plus a number of safety and other items.	Hierarchical, agglomerative, average-linkage cluster analysis. Association measured with phi coefficients with most less than 0.20. Inclusion in cluster required phi coefficient of approximately 0.2 with other members of cluster. 5 clusters identified by authors; C1: 8 items including sleep, relaxation, and eating behaviours C2: avoid crime and pollution C3: fix things, first aid C4: don't drink, don't smoke C5: medical/dental checkups

Kannas, 1981 ¹³	880 males, 19-20 years old in Finland.	16 item questionnaire collapsed into 9 categories used for analysis. Included food habits, drug use, # of sex partners, hygiene, dental care, sports, bed time, use of traffic reflectors, health info consumption	Factor analysis with unspecified rotation. Largest correlations was 0.42 (alcohol and smoking). Most correlations less than 0.25. Inclusion in factor required minimum weighting of 0.3. 5 factors identified: F1: use of sugar and fat in food F2: alcohol, smoking, sex partners F3: physical activity, nutritive breakfast, health info use, reflector use F4: eating schedule, resting habits F5: dental visits
Tapp and Goldenthal, 1982 ¹⁴	71 patients visiting outpatient clinic. 80% had college education level.	44-items from 8 categories: nutrition, tobacco, alcohol, drug, road/water safety, exercise/activity, rest/relaxation, personal health care.	Pearson correlations. Values not specified. Varimax rotation performed. Loading criterion not stated. 5 factors; F1: nutrition, exercise, rest/relaxation, personal health F2: tobacco, alcohol, road/water safety F3: drug use, -personal health F4: education level F5: # medications taken
Hays, Stacy and DiMatteo, 1984 ¹⁵	A) 226 high New England high school in 1981. B) 199 Californian college students in 1981.	22-item questionnaire with following categories: meal regularity, hard drug use, alcohol, tobacco, exercise, and sleep.	Pearson correlations. Submitted to a Harris-Kaiser Class II rotation factor analysis. Three substance abuse questions were highest inter-correlations for high school and college populations (0.46, 0.52 females). Also formed factor for both populations. Second factor not discussed. In high school, F2 seems to include meal regularity and sleep in males. In college, F2 seems to include alcohol use and exercise.
Turk, Rudy and Salovey, 1984 ¹⁶	A) 50 freshman college students. B) 28 secondary school teachers. C) 33 practical nurses.	Performance of 30 items of Harris and Guten, (1979).	Created response matrices for each population, then performed multi-dimensional scaling based upon Euclidean distances. Two dimensions identified: degree of effectiveness, and amount of effort.
Norman 1985 ¹⁷	A) 286 Newfoundland university students. B) 2nd group of 126.	10 categories: preventive medical checkups, sleep, overeating, 4 food groups, handwashing hygiene, exercise, alcohol, inadequate clothing, smoking, feeling stressed.	Pearson coefficients. Principal components analysis with orthogonal rotation. Loading criterion was 0.4. Low/no smoking and low/no alcohol was the most highly correlated in both groups, (0.29, 0.45). Both groups had these behaviours form a factor. Also common was sleep and low stress. Handwashing was found in factor in both although joined with avoiding chills in the second group. The fourth factor was different in each group.

Stephens 1986 ¹⁶	Canada Health Survey; 17,726 sampled adults in 1978-79.	6 categories for men: alcohol, dental visits, exercise, immunization, seat belt use, smoking. For women there were three additional behaviours: breast self-exam, and professional breast exam and Pap smears.	Age-adjusted Pearson correlations factor analyzed with: oblique rotation for each sex separately. For males, highest correlation was 0.159 (smoking and exercise) and for females was 0.604 (Pap and prof breast exam). Criterion for factor loading was 0.5. Males had two factors: F1: alcohol, smoking, seat belt use F2: exercise, immunization For females, there were 4 factors: F1: Pap test, professional breast exam F2: alcohol, smoking, seat belt use F3: exercise, immunization F4: dental care, breast self-exam
Health and Welfare, 1988 ¹	Canada's Health Promotion Survey; 11,181 sampled adults in 1985.	7 categories for men: BP check, exercise, smoking, alcohol, illicit drug, first aid kit, breakfast. 3 additional behaviours for females were included as per the Canada Health Survey.	Age-adjusted Pearson correlations reported for each sex. Highest correlation between smoking and breakfast ($r=0.156$). No factor analysis reported by author. PCVAR performed by thesis author upon published correlation matrix found three factors (loading criterion 0.4): F1: smoking, drinking, illicit drug use F2: exercise, smoking, breakfast F3: BP check, first aid kit
Vickers et al ¹⁸ , 1990	4 male, U.S. naval populations; 2 sets of recruits, and 2 sets serving shipboard.	40 health "behaviour" items conceptualized into 4 groups: wellness maintenance, accident control, traffic risk, and substance risk. All items scored on a 5-point Likert scale: "not at all like me" -> "very much like me" on shipboard and on different scale for recruits: "disagree strongly" -> "agree strongly".	Performed an exploratory as well as a confirmatory factor analysis. Variable pairing correlations not published. Confirmatory analysis appeared successful in finding the same 4 dimensions in second sample groups. Conceptually different in that most items are attitudinal (eg. "I take more chances doing things than the average person")
Nutbeam, Aaro, and Wold, 1991 ¹⁹	15 year-olds from 9 European countries. Average 1300 subjects per country.	8 categories: smoking, alcohol, coffee, unhealthy food, healthy food, oral hygiene, vitamins, physical activity.	2 Factors were sought and were consistent for most countries (loading criterion not specified): F1: alcohol, smoking, coffee, unhealthy food F2: healthy food, oral hygiene, vitamins, physical activity.

The purpose of these 12 studies (the two Langlie papers are actually the same study) was to detect correlations between health behaviours and to identify any clustering of inter-related behaviours. Across studies, the magnitude of

correlations detected was quite modest, with coefficients usually less than 0.25. Clusters of inter-related behaviours, when identified, differed between studies. Only tobacco and alcohol use appear to consistently cluster, although medical and dental check-ups also tended to cluster when included. The WHO - European study by Nutbeam et al¹⁹ is notable in that it demonstrated consistency in the identified clusters across different populations. This study likely benefitted from using the same items in a very narrow age range of respondents. Furthermore, in the analysis, two factors were specifically sought even though up to four factors were identified for some countries when factors were selected based upon eigen values.

The remaining studies were unsuccessful in identifying consistent patterns of related behaviours which has prompted conclusions that health behaviours are independent events.²⁰ However, in reviewing the literature in this area, a number of conceptual and methodological issues surfaced which could account for the apparent independence of behaviours. These issues are discussed below.

DIVERSITY OF BEHAVIOURS STUDIED

One primary reason that clusters have not been consistently identified is that the behaviours measured have differed considerably between studies. Variables as diverse as having a fire extinguisher, wearing seat belts, going to a dentist, to having one's blood pressure checked have all been surveyed. The inclusion of safety activities, ownership of safety products, visits to health professionals, and health enhancing behaviours has resulted in a clouded picture.

Inconsistent operational definitions of health behaviours between studies is a major reason for the foggy picture.

While the concept of health behaviour has evolved over time, health behaviour remains broadly defined:

The combination of knowledge, practices, and attitudes that together contribute to motivate the actions we take regarding health.²¹

Such a definition, while emphasizing the multiple dimensions which affect health behaviours, and which should be considered in health promotion activities, has the potential to be stretched to include *all* activities performed by human beings. It can also lead to confusion about what is being studied. The study by Vickers¹⁸ although purportedly about health behaviours, actually measured health attitudes and perceptions by asking questions such as: "I take more chances doing things than the average person". The use of conceptually different items makes comparisons between studies difficult.

BEHAVIOUR MEASUREMENT INCONSISTENCY

For those behaviours more frequently studied, measurement methods has often differed. For example, the measurement of physical activity presents a challenge particularly regarding limited space on survey instruments. A variety of physical activity indicators have been used: frequency, duration, intensity, leisure versus all activity, and caloric utilization over a particular time period. It may not be surprising then, that these different indicators yield discrepant results when correlations are measured between behaviours. While most studies measured the

performance of activities, the Vickers et al¹⁸ study measured individuals' agreement with statements such as "I get enough sleep" and "I limit my intake of foods like coffee, sugar, fats, etc.". This is qualitatively quite different from estimating the types and level of activities.

STUDY POPULATION VARIABILITY

The populations surveyed have differed considerably between studies. Relationships between behaviours within a general population are not likely to be the same as those within highly selected populations. In comparing the health behaviour correlation matrix of the national Health Promotion Survey⁵ with a presumably more homogeneous college sample in Normon's study,¹⁷ correlations were higher in the college study particularly for alcohol and tobacco. (0.129 vs. 0.29/0.45). This suggests that correlations between behaviours may be larger in certain sub-populations, making the correlations calculated at a national level but crude averages.

The studies reviewed were performed upon populations scattered across an almost 20-year time period. It is unlikely that relationships between behaviours have remained constant while significant changes in the prevalence of individual behaviours such as alcohol^{22,23} and tobacco^{24,25,26} consumption have occurred. These changes reflect continuing changes in the socio-cultural environment, (eg. health information, health policy).

INFLUENCE OF DEMOGRAPHIC VARIABLES

Despite the recognition that the prevalence of individual health behaviours

shows considerable variation across demographic strata,²⁷ few attempts have been made to correct for these variables when determining the levels of association between behaviours. Substantial variation in correlations could be occurring between demographic strata which would be hidden when observing crude correlation coefficients.

The reviewed studies have made only partial attempts to deal with this issue. Data are often analyzed separately for each sex particularly since female-specific behaviours are often surveyed, (eg. breast self-examination). Also, age-adjusted partial correlations have been used. There has been one attempt to control for income and health status which apparently did not result in significant changes to the magnitude of correlations.⁹⁶ The use of partial correlations however would not allow one to identify interactions between behavioral inter-relationships and demographic variables.

CORRELATING RISK VERSUS PERFORMANCE LEVELS OF BEHAVIOURS

Survey questions on the performance of health behaviours are often structured to create categorical variables representing the frequency of performance of a particular activity. Correlations between these performance-ranked variables are then determined. The interpretation though, is not necessarily straight forward.

Health behaviours are of interest because of their association with health status. Similarly, correlations between behaviours will also be of interest in this

context. For example, individuals who perform two detrimental, positively correlated behaviours at their highest level would be at highest risk for a poor outcome. If these behaviours are significantly correlated, the co-occurrence of the behaviours would likely need to be considered during health promotion efforts. However, it is not necessarily the frequency in which individuals perform activities which is of importance, but rather whether individuals are performing activities which put them at increased risk for poor health outcomes. This is relevant because not all health behaviour performance levels exhibit a monotonic relationship with health status.* Alcohol intake and sleep are two examples of behaviours which have been demonstrated to have non-monotonic relationships, with moderate levels showing the most favourable health outcomes.^{3,4} Therefore the relationship between health status and health behaviour performance levels should be taken into consideration prior to determining correlations between health behaviours. This has not been done in any of the reviewed studies.

The diversity of behaviours studied, inconsistency in their measurement and the population under study, the lack of control for demographic variables, as well as the lack of recognition of the relationship between performance levels and health risk, could all contribute to the under-estimation of relationships between health behaviours, and suggest that it may be premature to conclude that the

*A monotonic relationship is one in which increasing (or decreasing) levels of exposure or performance are associated with increasing (or decreasing) levels of health status. Smoking and lung cancer is an example of a monotonic relationship in which the increasing frequency of smoking is associated with an increasing risk of developing lung cancer.

inter-relationships between health behaviours are weak.

2.3 HEALTH BEHAVIOURS AND PSYCHOSOCIAL MEASURES

This section will discuss findings of previous studies relating multiple health behaviours to psychosocial measures. A brief description of the psychosocial concepts used in this thesis will precede this discussion.

PSYCHOSOCIAL MEASURES

The five psychosocial measures utilized in this thesis are: life events, social support, personal mastery, self-esteem, and psychological symptoms.

Life events are discrete events which challenge individuals to adapt and are a type of stressor.²⁸ Less- than-effective coping results in negative physical and psychological consequences.

Social support has been defined as the presence of others, or the resources provided by them, prior to, during, and following a stressful event.²⁹ One way social support may enhance health or reduce the negative health consequences of stressors is by encouraging changes in behaviour. Persons with viable social support networks may be encouraged to engage in healthful behaviour, receive useful information regarding healthful behaviour, or have such behaviour directly facilitated by supportive others. These supports could be provided prior to the stressful event by preventing exposure or reducing the risk of exposure. Support provided during a stressful event may reduce its severity. Following the event, support could encourage or facilitate recovery behaviours.²⁹

The two self-related concepts, self-esteem and personal mastery, are related

but distinct constructs. They differ in that while self-esteem involves the judgements one makes about one's own self-worth,³⁰ personal mastery refers to the extent to which people see themselves as being in control of the forces that importantly affect their lives.³¹ At least one way these concepts could be related to health behaviours is in defining a psychological environment conducive for self-preservation and improvement. For example, if choices about health behaviours are related to an individual's desire for better health, then one would anticipate that the amount of interest in improvement would be related to whether the individual perceived him/herself as deserving such an investment, (self-esteem), as well as whether the individual felt that personal action could impact one's health, (personal mastery).

Psychological symptoms is the fifth psychosocial measure. It includes symptoms of depression and anxiety. While a possible mental health outcome for stress, it also has the potential to interfere with the ability of individuals to perform and maintain positive health behaviours.^{32,33}

MULTIPLE HEALTH BEHAVIOURS AND PSYCHOSOCIAL MEASURES

The association of certain behaviours with health status has encouraged a search for their determinants. That some psychosocial factors also correlate with health status has led some to explain this through their effects on health behaviours.³⁴ While the studies reviewed in a preceding section have described inter-relationships between behaviours, few attempts have been made to relate psychosocial measures to health behaviour clusters.

The study by Langlie¹² was not only one of the first health behaviour factor analytic studies, it also attempted to associate the clustering pattern of health behaviours with psychosocial measures. The two identified clusters, which were labelled as direct risk (eg. driving/walking recklessly, hygiene, does not pick pimples), and indirect risk (eg. seat belt use, medical/dental checks, immunizations), were correlated with measures of health beliefs and attitudes as well as measures of social networks. Although suggestive, this study suffers from considerable flaws including: the type of behaviours included and their measurement, whether the clusters actually represent direct versus indirect risk, the validity of the crude psychosocial scales used, and the introduction of an unclear concept used to divide subjects based upon "behavioral consistency". Nevertheless, this study was important for introducing the concept of relating psychosocial measures with health behaviour clustering and for demonstrating some possible relationships. None of the other factor analytic studies reviewed attempted to do this.

Additional studies though, have utilized summative scales of health behaviours and determined their relationship with various psychosocial measures. In effect, these studies have treated all health behaviours as a single dimension or cluster.

Using data from Alameda County, Berkman and Syme³⁵ demonstrated an inverse relationship between social networks and subsequent mortality. Although correlations between social networks and a cumulative health behaviour index

were not presented by the authors, using the tabulated data within the paper, a Pearson correlation of 0.11 was calculated.

In the 1979 U.S. National Survey of Personal Health Practices and Consequences,³⁶ a nationally representative sample comprising 3,025 subjects aged 20-64 responded to questions on a social network measure, a 9-item life event scale and a health behaviours index, (five of the seven used in the Alameda studies, excluding the eating behaviours). In males, the health practices were significantly correlated with social network ($r=0.12$) and life events ($r=-0.095$). These two psychosocial measures were treated as potential intermediate variables in a path analysis with income, education and age as the first line independent variables. With the cumulative health behaviour index as the dependent variable, the social network continued to have a significant direct effect on health behaviours ($r=0.11$) although life events did not. However, age, income and life events all had significant indirect correlations with social network, (0.18, 0.10, -0.12).

The positive relationship between social support and health behaviours has also been found in older adults. In a non-random sample of adults aged 55 and above, Riffle et al³⁷ found that a health behaviour scale was positively correlated with a social support measure, $r=0.29$.

A relationship between social support and health behaviours has also been found for behavioral change. Zimmerman and Connor³⁸ studied a worksite-based population of 84 employees, 79% of whom were women. The change in a 4-item

behaviour scale (smoking, salt usage, exercise and fat consumption) after 7 sessions of a health promotion program, was found to be significantly correlated with the supportiveness of change by family, friends and others ($r=0.33$) as well as family support ($r=0.34$) after controlling for demographic variables and a measure of expected support.

Seeman et al³⁹ utilized a one-year, longitudinal study of randomly sampled adults in California to measure the association of personal mastery (in this study: a subscale of a health locus of control scale) and a social networks scale with a summative scale of unspecified preventive health practices. Personal mastery was significantly associated with the preventive practices at the initiation of the study but not after one year, (0.13,0.03). This was despite the lack of any particular intervention.

Muhlenkamp and Sayles³⁴ found that both self-esteem and social support were positively correlated with a lifestyle questionnaire, ($r=0.25$ and $r=0.26$, respectively), in a U.S. city. When introduced into a path analytic model which also included age, education and gender, the path coefficients for self-esteem and lifestyle remained significant, $r=0.21$. However, social support did not have a significant direct effect on lifestyle, but was highly correlated with self-esteem, $r=0.55$. Yarcheski and Mahon⁴⁰ performed a similar analysis using a sample of high school and college students and utilizing a different measure of self-esteem, significant correlations were found between the lifestyle questionnaire and self-esteem ($r=0.42$), and social support ($r=0.34$). In the path analysis, unlike the

findings of Muhlenkamp and Sayles, both variables had significant direct effects on lifestyle, (self esteem: $r=0.29$; social support: $r=0.29$). It is intriguing that different relationships were found for the relative role of social support in the two populations.

Other studies have also demonstrated a relationship between levels of self-esteem and the performance of health behaviours. Duffy⁴¹ found that self-esteem significantly improved the explained variance of health promotion activities after controlling for the effects of chance health locus of control, (R^2 change = 0.06). Using a group of 38 males, Rew⁴² correlated a number of psychosocial measures, including self-esteem with a 48-item health behaviour scale. In a multiple regression analysis, after controlling for the effects of body image and education, self-esteem increased the variance explained in health behaviours from 44% to 51%.

Self-esteem and psychological distress were both demonstrated to be associated with health behaviours in a 16-year panel study by Mechanic and Cleary³² who followed school children to 25-30 years of age at final follow-up. At that time, they found correlations between a summative health behaviour index and psychosocial measures to be 0.15 for self esteem, -0.19 for psychological distress, -0.19 for life problems (not defined or described), and -0.29 with perceived health status.

Stephens observed a correlation of 0.137 between a summative scale of 6 health practices and an affect balance scale among males in the Canada Health

Survey.⁹⁶ Kaplan et al⁴³ found that a depression inventory explained 28% of the variance of an adverse health behaviour scale in adolescents. Parker et al⁴⁴ found that depressive symptoms were associated with increased quantity of alcohol consumed per drinking occasion in employed male and female adults. Similarly Dryman et al⁴⁵ found that heavy alcohol use was associated with psychiatric distress in a community sample.

Life events were shown to have direct effects on health practices in a path analysis of survey data from two engineering companies.⁴⁶ After controlling for the effects of demographic variables and social support, the correlation between life events and health practices was -0.19. Cole et al⁴⁷ found that both the number of life events and perceived stress had a dose-response relationship with alcohol intake. Similarly, Gorman et al⁴⁸ showed that individuals initiating pathologic drinking patterns had significantly more major life events predating this behaviour change. Neff and Husaini⁴⁹ found that the number of life events reported increased with alcohol consumed, but that depressive scores were non-monotonically related to alcohol intake, with moderate intake having the lowest life event scores.

2.4 SUMMARY

Health behaviours have been shown to have inter-correlations of at best, moderate magnitude. A number of methodological issues may have obscured the true nature of these correlations. While consistent relationships of moderate magnitude have been demonstrated between summative health behaviour scales

and several psychosocial measures, few attempts have been reported which associate the clustering of health behaviours with psychosocial factors.

3. METHODS

3.1 DATA SOURCE

The data used in this thesis are part of a data set created by the anonymous, 1989 Canadian Forces Health and Lifestyle Survey⁵⁰ (CFHLS) administered to regular force military personnel. Systematic sampling was carried out upon randomized eligible members identifying 8,281 individuals. Exclusions were made based upon unavailability of personnel due to logistic problems, as well as concerns of anonymity because of unique demographic profiles. Consequently an under-representation of younger members, particularly Junior Officers, was observed in the sample selected.

The survey included questions on health behaviours, health attitudes and health status. A number of psychosocial scales were also included, and the survey was pre-tested in a bilingual format.

The survey was administered to military members at their bases within Canada and Europe by representatives of a consulting firm. Further details on survey development and sampling can be found in Appendix A.

3.1.1 VARIABLES

The following section outlines the variables to be used in this thesis. All questions from which variables are generated for this thesis are included in Appendix B.

HEALTH BEHAVIOURS:

alcohol use, tobacco smoked, hours of sleep, physical activity, eating between meals, eating breakfast, brushing teeth, flossing teeth, testicular self-examination; all categorical variables.

The health behaviours used in this thesis were selected on the basis of meeting the following operational definition:

A health behaviour is a discretionary activity which is likely associated with health status.

HEALTH STATUS:

perceived health status; a categorical variable.

DEMOGRAPHIC:

sex, age, education, military rank, marital status; all categorical variables.

PSYCHOSOCIAL MEASURES:

All these scales were previously developed and published in the psychological literature and are continuous-type variables. Modifications, if any, from original forms will be noted. Available information on the scales' reliability, and validity will be presented. The internal reliability of the survey scales have been calculated⁵¹ and can be found in Appendix C.

Self-esteem: This scale is a 4-point, 10-item instrument developed by Rosenberg.³⁰ According to a recent review of self-esteem measures, the Rosenberg scale is the most popular of such measures, and is often used as the standard by which other scales are compared.⁵² The scale's characteristics are well-

documented, but it appears that the scale used in this survey is a modified version with four of the items removed and the use of a 5-point Likert scale instead of 4. Other authors have also used 5 and 7-point Likert scales although none of the papers reviewed for this work did so. An identical 6-item scale was located in a 1978 article by Pearlin and Schooler,³¹ however the authors did not provide technical information on the scale. Note that these are different from the six-item Rosenberg and Simmons Self-Esteem Scale.³⁰ The following scale characteristics are based upon the 10-item version which may not be truly representative of the 6-item scale used in the CFHLS.

Reliability The coefficient of reliability quoted by Rosenberg was 92%. Cronbach's alpha on adult males in one study was 0.82 to 0.86.⁵³ Two-week test-retest reliability in two college samples by different investigators found $r = 0.85$ and $r = 0.88$.

Validity Convergent validity has been supported through comparisons with self-esteem related constructs. The scale has been correlated with confidence ($r=0.65$), popularity ($r=0.39$), academic self-concept (0.38), and with low-regard concepts including anxiety (-0.64), depression (-0.54), and anomie (-0.43). The scale has also been shown to be correlated to other measures of self-esteem with values for the Coopersmith and Lerner Self-Esteem scales being 0.55 and 0.72 respectively.⁵² Discriminant validity has been demonstrated for grade point averages (0.10), locus of control (-0.04), gender (0.10), age (0.13), work experience (0.07), marital status (0.17), birth order (0.02), and vocabulary (-0.04).⁵²

Personal Mastery: This scale was developed by Pearlin and Schooler as a 7-item Likert 4-point scale.³¹ The scale appears in the survey questionnaire as a 5-point Likert scale. Thus the following scale characteristics may not fully apply to the version in the CFHLS.

Reliability Unidimensionality has been demonstrated via factor analysis. Reich and Zautra used this scale in recently bereaved or disabled adults with controls.⁵⁴ Cronbach's alpha was 0.76 and 1 month test-retest reliability was $r^2 = .65$. Use in married couples found a Cronbach's alpha of 0.75.⁵⁵

Validity Convergent validity was demonstrated with similar constructs in the original work by Pearlin. Using the initial measures, the scale has been correlated with depression (-0.30), self-esteem (0.48), social supports (0.18), education (0.21), and marital status (-0.13). Divergent validity was demonstrated by small correlations with income change (-.05), race (0.01) and occupational rank (-0.04).

Correlations Between Self-Esteem and Personal Mastery

The Rosenberg Self-esteem scale and Pearlin and Schoolers' Personal Mastery Scale have been previously used together. Pearlin et al,²⁸ reported correlations of $r = 0.54$ and $r = 0.48$ at 4-year intervals in a panel study. Folkman et al⁵⁵ reported a correlation of $r = 0.65$.

Social Support: This 15-item, 5-point Likert scale was developed by Turner et al⁵⁶ and appears in the CFHLS as originally published. It was designed to measure several aspects of social support including attachment, social integration, reassurance of worth, reliable alliance, and guidance.

Reliability

The authors utilized this scale in two populations, and observed alpha coefficients of 0.75 to 0.87.

Validity

Convergent validity was demonstrated by strong correlations with other measures of social support including two versions of the Kaplan Scale (both $r=0.62$), a reflected esteem scale (0.37,0.58), and a reflected love scale (0.61). The scale was also shown to be consistently associated with measures of psychological distress with correlations approximating 0.30.

Psychological Symptoms: This 29-item checklist is a shortened version of the Hopkins Symptoms Distress Checklist and was developed by Ilfeld.⁵⁷

Reliability Validations on a community sample showed that the internal consistency as measured by Cronbach's alpha was 0.91. This scale was subsequently translated into French and its internal consistency has been found to range from 0.72 to 0.96.^{58,59} Factor analytic structure appeared the same in both languages.⁵⁸

Validity The scale is able to differentiate those who had sought help for emotional problems, who had a psychiatric admission, and who had used psychotropic medications from those that had not.⁵⁷

Life Events: This is a modified version of a 31-item life event checklist developed by Turner and Avison.^{60,61} The scoring of this 26-item scale was somewhat flawed in the design of the questionnaire in that respondents were merely offered

the opportunity to circle those items that applied. Therefore there was no opportunity to distinguish individuals who were stating that the event did not apply, versus those who were non-responders.

Reliability Since this measure is a summative scale of presumably independent events, one would not anticipate nor desire a high level of internal reliability.

Validity The scale contains major life events which have been included on other major scales. The scale has been shown to be correlated with depression.

PSYCHOSOCIAL MEASURES - SUMMARY

The modifications to the scales have the potential to invalidate their published characteristics. However, the CFHLS scales' Cronbach alpha coefficients indicate that their internal reliabilities have not changed. The scale items themselves have not been altered (except for the dropping of items in the self-esteem scale) so that the validity of the scales should not be altered. Changing 4-point Likert response scale to 5-point Likert response scales may influence the range of responses.

3.2 MATERIALS

The consulting firm entered all the data from the returned questionnaires. The firm then cleaned the data set by replacing non-permitted and impossible responses with missing values. A number of derived variables were created. The data set was created and delivered to DPM, and the original questionnaires were destroyed.

The ASCII data set and variable dictionary were provided by DPM. The

data set was transferred to a SUN SPARC work-station operating under the UNIX system. All subsequent analyses were performed using the BMDP statistical package.⁶²

3.3 METHODS RELATING TO THE THESIS OBJECTIVES

OBJECTIVE 1:

To determine whether health behaviours are independent of each other.

The health behaviour variables are ordinal-type variables which, in their original form, are ranked by performance levels. Spearman rank correlations were calculated for pairs of health behaviour variables.

OBJECTIVE 2:

If health behaviours are not independent, then to determine whether inter-relationships found between behaviours vary between:

- i. different strata of demographic variables (age, education, marital status, rank);
- ii. different methods of coding health behaviour performance levels.

Changes in inter-relationships were observed in two ways: a) by changes in the magnitude of correlation coefficients; b) by changes in the factor solution after the correlation matrices had been submitted to a principal components analysis with varimax rotation.⁶³

Three different methods of coding health behaviour levels were utilized:

* It is recognized that principal components analysis is not exactly the same as factor analysis, but the two will be referred to interchangeably for the remainder of the paper.

i) the original survey derived performance-coded variables, (as shown in Appendix B, survey questions are ordinal-type variables with respect to the frequency of performance of a particular behaviour); ii) re-ordering of the frequency levels (categories) of variables based upon the odds ratio of self-reported poor perceived health for the individual levels; and iii) risk-scoring of categories such that scoring was equivalent to the odds ratio for self-reported poor perceived health.

DETERMINATION OF CORRELATIONS BETWEEN HEALTH BEHAVIOURS

The performance-coded behaviours were stratified by age. Spearman rank correlations were repeated for pairings of health behaviours for each of the age strata.

Analyses with Re-ordered Health Behaviour Variables

The perceived health status variable was dichotomized to form a good, (excellent, very good, good), and a poor, (fair and poor) category. This was treated as a dependent variable and logistic regression was used to determine the odds ratio for poor self-reported health for the performance level of each individual health behaviour controlling for the four demographic variables. The performance levels of each health behaviour were then re-ordered to reflect an increasing risk of poor perceived health.

Spearman rank correlations for health behaviour pairings were then re-calculated for the crude and stratified populations.

Analyses with Risk-scored Health Behaviour Variables

The re-ordered variables were further modified by substituting the actual value of the ORs for poor perceived health, creating risk-scored variables. Theoretically the magnitude of these values could range from one to infinity. Pearson correlations were calculated for health behaviour pairings.

FACTOR ANALYSIS OF CORRELATION MATRICES

The Spearman correlation matrices for the crude and stratified populations were submitted to a principal components analysis with varimax rotation. This was performed for the performance-coded and re-ordered variables. For the risk-scored variables, Pearson correlations were used in the analysis. Factors with a minimum eigen value of 1.0 were selected for each analysis.

OBJECTIVE 3:

To determine whether psychosocial measures are associated with health behaviour clusters and whether this association differs between clusters.

For clusters of behaviours identified in the crude and stratified populations, the behaviours contained in a cluster were dichotomized based upon their odds ratio for poor perceived health. A summative scale of these behaviours was then formed for each cluster. For example, if there were four behaviours within a cluster, then the scale would run from 0 to 4. This scale was then dichotomized to create a group of individuals with most behaviours performed at a positive level and a group with most behaviours performed at a negative level. The five psychosocial measures were then used to attempt to differentiate between the two

groups using a discriminant analysis. In addition to the degree of success of the discrimination, any variation in the association of the psychosocial measures and different clusters was identified.

4. RESULTS - DESCRIPTIVE

The results will be presented in three chapters. The first chapter describes the survey response, the study variables, as well as the role of missing values. The second chapter presents the results pertaining to objectives one through three. Finally, the third chapter contains secondary analyses which were suggested by the planned analyses. All tables and figures which are referred to in the text can be found preceding the appendices.

4.1 SURVEY RESPONSE

Of the 8,281 individuals in the selected sample, responses were received from a total of 6,357 (76.8%). Table 1 shows the demographic breakdown of the regular force, the sample and the respondents. Although the distribution of survey respondents and the survey sample selected appear similar, a statistically significant difference was detected between them.

Females represented only 10% of the sample size. Since multivariate analysis, particularly involving stratification was planned, this sub-group was excluded from further analysis.

The exclusion criteria for the survey resulted in under-representation of the youngest, (<20), age group. Because this group has few respondents, it was excluded from further analysis.

The exclusion of women and the less than 20 age group reduced the number of respondents to 5,727.

4.2 DEMOGRAPHIC VARIABLES

AGE

The age distribution of respondents by number and percentage can be seen in Table 2. The percentage of respondents that had missing values was 1.7%, (96). Age distribution of the Health Promotion Survey, (HPS), and the 1986 Canadian census⁶⁴ for males aged 20-54 are also shown. The survey age groups were slightly different from standard Statistics Canada age categories in that the categories are cut at 24/25 years of age instead of 25/26. The survey respondents were proportionately younger than the Canadian population.

EDUCATION

Table 3 shows the education levels successfully completed by respondents. Missing data accounted for 2.9% (167) of this variable's responses. Comparison with the Canadian population shows that this military sample had proportionately fewer college and university graduates.

MILITARY RANK

Table 4 shows the distribution of military rank of respondents. Missing data accounted for 2.2% (128) of responses for this variable. The majority of respondents were non-commissioned members and most of these were from the junior ranks.

MARITAL STATUS

Table 5 shows the distribution of respondents by marital status. 1986 Canadian Census data for males aged 20-54 are provided for comparison. The

census data has "separated" individuals included with the married group whereas the survey has included them with the "divorced" individuals. There is a large difference in the proportion of single males between the two populations. 2.4% (138) of the respondents had a missing value for this variable.

4.3 HEALTH STATUS

PERCEIVED HEALTH STATUS

Table 6 shows the distribution of respondents by perceived health status. Canadian data from the Health Promotion Survey is included for males 25-54 years of age. Compared to the Canadian population, the military respondents made fewer responses in the extremes of this variable. 0.2% (14) of the cases had a missing value for this variable.

4.4 HEALTH BEHAVIOURS

The name of the survey variable appears in parenthesis alongside the concept it measures. The survey variable name will be used throughout the remainder of this paper to differentiate it from the broader item it is estimating.

ALCOHOL (DRINK)

Table 7 shows the distribution of respondents by self-reported alcohol intake during the preceding week. Ex-drinkers were individuals who had been previous drinkers but had quit at least one year earlier. Appendix B provides additional details regarding how this variable was derived. After combining the three measures from the data set, 12.7% (726) of the respondents had a missing value for this derived variable. The Canadian estimates are taken from the Health

Promotion Survey for males 20-54 years of age. The survey respondents reported a higher frequency of never drinking regularly and of heavy drinkers.

CIGARETTE SMOKING (SMOKE)

Table 8 presents the distribution of smokers from the survey. 1.2% (68) of the cases had a missing value. Data from the 1985 Canadian General Social Survey⁶⁵ is included for comparison purposes for males aged 20-64 years old. The military sample had higher proportions of heavy smokers.

EATING BREAKFAST (EATBRF)

Table 9 presents the frequency of eating breakfast. Missing values accounted for 0.1% (10) of the respondents. The use of the category "On Weekends Only" for this and the following variable does not allow for comparison with other civilian or military surveys.

EATING BETWEEN MEALS (EATBTML)

Table 10 presents the distribution of responses for this variable. 0.2% of the variable was missing.

PHYSICAL ACTIVITY (EXRATE)

Table 11 presents the frequency of vigorous physical activity per week defined as participating in sports or vigorous physical activity during leisure time to the point of sweating. 0.9% of cases had a missing value.

BRUSHING TEETH (BRUSHT)

Table 12 shows the frequency of the brushing of teeth of respondents. 0.3% (18) of the cases had a missing value for this variable.

FLOSSING TEETH (FLOSS)

Table 13 shows the frequency of the flossing of teeth of respondents. 0.4% (23) of the cases had a missing value for this variable.

HOURS OF SLEEP (SLEEP)

The hours of sleep obtained on average by respondents is shown in Table 14. 0.7% (38) of the cases had a missing value.

TESTICULAR SELF EXAMINATION (TESTSLF)

Table 15 shows the distribution of responses for the frequency of testicular self examination. 1.9% (114) of the cases had a missing value.

4.5 PSYCHOSOCIAL VARIABLES

The values reported in this section reflect all available data. Means reported in further sections may differ slightly due to reduced sample size when dealing with multi-variate analysis.

SOCIAL SUPPORT (SOCLSUP)

The distribution of scores for the social support variable can be seen in Figure 1. The mean was 59.7 and the median was 61. The standard deviation was 9.3. The distribution is J-shaped.

PERSONAL MASTERY (PERMAST)

Figure 2 illustrates the distribution of the personal mastery scores. The mean was 28.9 with a standard deviation of 5.2. The median was 30.

SELF-ESTEEM (SLFEST)

Table 15 shows the distribution of the self-esteem scores. The mean and

standard deviation were 27.7 and 9.3. The median was 29.

PSYCHOLOGICAL SYMPTOM INDEX (PSYCHSYM)

Figure 4 shows the distribution of the psychological symptom index scale. The responses had a mean value of 41.5, and a standard deviation of 10. The median was 39.

LIFE EVENTS (LIFEV)

Figure 5 shows the distribution of the life events scale. The responses had a mean of 2.9 with a standard deviation of 2.4. The median score was 3.0.

4.6 ASSESSMENT OF EFFECT OF MISSING VALUES

This section will present a review of the assessment of the effect of missing values within the study data set. Further details may be found in Appendix D.

The proportion of missing values for each variable was under 6% except for DRINK (12.5%) and SOCLSUP (7.3%). The proportion tended to increase with decreasing health status although this was not consistent for all variables. It was not possible to use other variables to interpolate missing values for DRINK or SOCLSUP.

The responses to other variables were explored comparing those who had responded to DRINK to those that had not. No statistically significant difference was detected for the five psychosocial scales using an alpha error of 1%. With the exception of EATBTML, the remaining health behaviours also did not show a significant difference by DRINK's presence. However DRINK non-responders demonstrated higher representation in the 20-25 and ≥ 45 age groups, and lower

levels of completed education, (up to and including completion of high school). These groups had higher proportions of heavy and ex-drinkers in those individuals who did respond to the DRINK questions. It is probable then that DRINK non-responders include higher proportions of heavy and ex-drinkers than responders resulting in an under-estimate of alcohol consumption in respondents.

The impact of DRINK response was explored for health behaviour inter-relationships. Factor analysis of the eight remaining health behaviours was performed on the DRINK responders and non-responders. No substantial difference was noted in the factor solutions. The DRINK score for ex-drinkers was substituted for the missing value code of the non-responders. The factor analysis was repeated using all nine health behaviours and compared to that of a factor analysis with all individuals with missing values removed. No difference was observed in the factor solutions.

In summary, data set missing values are primarily due to missing DRINK values. While this likely results in the underestimation of the proportion of heavy and ex-drinkers in the sampled population, it does not appear to affect the inter-relationships between behaviours detected.

5. HEALTH BEHAVIOUR INTER-RELATIONSHIPS

This chapter will present the results for the determination of the level of association between health behaviours. The discrimination of psychosocial measures for health behaviour clusters will also be presented. Tables and figures referred to in the text can be found preceding the appendices.

5.1 HEALTH BEHAVIOUR CORRELATIONS

This section will address the first two objectives of this thesis. The first objective is to determine whether health behaviours are independent. Correlation matrices will be presented. The second related objective was to determine whether inter-relationships between behaviours vary across demographic strata, and whether inter-relationships also vary according to the coding structure of the behaviours. Correlation matrices will be presented stratified by demographic variables. Matrices will also be presented after behaviour variables have been re-coded.

RANK CORRELATIONS - PERFORMANCE-CODED

Spearman rank correlations were calculated for the performance-coded health behaviours. The rank correlation matrix for the crude population can be seen below:

CRUDE POPULATION

	Smoke	Drink	Exrate	Eatbrf	Eatbtm1	Floss	Brushf	Testslf	Sleep
Smoke	1.0000	0.1673	-0.1289	0.2406	-0.0089	0.0572	0.0767	0.0200	-0.1594
Drink	0.1673	1.0000	-0.0143	0.1330	-0.0111	0.0849	0.0206	-0.0026	-0.1034
Exrate	-0.1289	-0.0143	1.0000	-0.1050	0.0416	-0.1131	-0.1325	-0.0491	0.0101
Eatbrf	0.2406	0.1330	-0.1050	1.0000	0.0349	0.1312	0.1449	0.0431	-0.1532
Eatbt	-0.0089	-0.0111	0.0416	0.0349	1.0000	-0.0375	-0.0375	0.0053	0.0307
Floss	0.0572	0.0849	-0.1131	0.1312	-0.0477	1.0000	0.2703	0.0868	-0.0325
Brushf	0.0767	0.0206	-0.1325	0.1449	-0.0375	0.2703	1.0000	0.0657	-0.0407
Testslf	0.0200	-0.0026	-0.0491	0.0431	0.0053	0.0868	0.0657	1.0000	0.0238
Sleep	-0.1594	-0.1034	0.0101	-0.1532	0.0307	-0.0325	-0.0407	0.0238	1.0000

A table of the tests of significance for each of the above correlations may be found in Appendix E. Of the 36 possible pairings, 22 were significant at a $p < 0.001$ level. Power curves were calculated for the crude and age-stratified populations and are shown in Appendix I. To clarify the nature of the correlations between health behaviours within sub-populations, the data set was initially stratified by age, and the rank correlations were re-calculated. The age category-specific correlations can be seen below:

AGE: 20-25

	Smoke	Drink	Exrate	Eatbrf	Eatbtm1	Floss	Brushf	Testslf	Sleep
Smoke	1.0000	0.2332	-0.1167	0.1786	-0.0028	0.0204	0.0620	0.0257	-0.1816
Drink	0.2332	1.0000	-0.0524	0.1886	-0.0308	0.0872	0.0471	-0.0191	-0.1773
Exrate	-0.1167	-0.0524	1.0000	-0.0848	0.0453	-0.1335	-0.1799	-0.0841	-0.0332
Eatbrf	0.1786	0.1886	-0.0848	1.0000	0.0885	0.1270	0.1553	0.0871	-0.1705
Eatbt	-0.0028	-0.0308	0.0453	0.0885	1.0000	-0.0215	-0.0609	0.0330	0.0374
Floss	0.0204	0.0872	-0.1355	0.1270	-0.0215	1.0000	0.3691	0.1011	-0.0272
Brushf	0.0620	0.0471	-0.1799	0.1553	-0.0609	0.3691	1.0000	0.0658	-0.0628
Testslf	0.0257	-0.0191	-0.0841	0.0871	0.0330	0.1011	0.0658	1.0000	0.0658
Sleep	-0.1816	-0.1773	-0.0332	-0.1705	0.0374	-0.0272	-0.0628	0.0279	1.0000

AGE: 26-34

	Smoke	Drink	Exrate	Eatbrf	Eatbtml	Floss	Brusht	Testslf	Sleep
Smoke	1.0000	0.1761	-0.1133	0.2706	-0.0085	0.0576	0.0940	0.0237	-0.1742
Drink	0.1761	1.0000	-0.0409	0.1183	-0.0004	0.0918	0.0110	0.0142	-0.0855
Exrate	-0.1133	-0.0409	1.0000	-0.1003	0.0565	-0.1094	-0.1312	-0.0503	0.0147
Eatbrf	0.2706	0.1183	-0.1003	1.0000	0.0489	0.1275	0.1406	0.0311	-0.1753
Eatbt	-0.0085	-0.0004	0.0565	0.0489	1.0000	-0.0292	-0.0085	0.0058	0.0053
Floss	0.0576	0.0918	-0.1094	0.1275	-0.0292	1.0000	0.2328	0.0673	-0.0249
Brusht	0.0940	0.0110	-0.1312	0.1406	-0.0085	0.2328	1.0000	0.0382	-0.0223
Testslf	0.0237	0.0142	-0.0503	0.0311	0.0058	0.0673	0.0382	1.0000	-0.0244
Sleep	-0.1742	-0.0855	0.0147	-0.1753	0.0053	-0.0249	-0.0223	-0.0244	1.0000

AGE: 35-44

	Smoke	Drink	Exrate	Eatbrf	Eatbtml	Floss	Brusht	Testslf	Sleep
Smoke	1.0000	0.0964	-0.2075	0.2916	-0.0029	0.1097	0.0541	0.0144	-0.1522
Drink	0.0964	1.0000	0.0008	0.1351	-0.0041	0.0425	0.0265	0.0169	-0.0542
Exrate	-0.2075	0.0008	1.0000	-0.1653	0.0235	-0.1389	-0.0817	-0.0072	0.0642
Eatbrf	0.2916	0.1351	-0.1653	1.0000	0.0659	0.0891	0.1573	0.0252	-0.1169
Eatbt	-0.0029	-0.0041	0.0235	0.0659	1.0000	-0.0148	-0.0480	-0.0339	0.0282
Floss	0.1097	0.0425	-0.1389	0.0891	-0.0148	1.0000	0.2833	0.1261	-0.0059
Brusht	0.0541	0.0265	-0.0817	0.1573	-0.0480	0.2833	1.0000	0.1127	-0.0346
Testslf	0.0144	0.0169	-0.0072	0.0252	-0.0339	0.1261	0.1127	1.0000	0.0195
Sleep	-0.1522	-0.0542	0.0642	-0.1169	0.0282	-0.0059	-0.0346	0.0195	1.0000

AGE: ≥45

	Smoke	Drink	Exrate	Eatbrf	Eatbtml	Floss	Brusht	Testslf	Sleep
Smoke	1.0000	0.0793	-0.1438	0.2301	0.0108	0.1386	0.1282	0.0226	-0.0173
Drink	0.0793	1.0000	0.0122	0.1119	0.0415	0.1330	0.1182	0.0522	-0.0375
Exrate	-0.1438	0.0122	1.0000	-0.1153	0.0909	-0.1402	-0.0788	-0.0167	0.0337
Eatbrf	0.2301	0.1119	-0.1153	1.0000	-0.0658	0.2089	0.1749	0.0602	-0.0769
Eatbt	0.0108	0.0415	0.0909	-0.0658	1.0000	-0.1044	-0.1298	0.0094	0.0376
Floss	0.1386	0.1330	-0.1402	0.2089	-0.1044	1.0000	0.3025	0.0822	-0.0267
Brusht	0.1282	0.1182	-0.0788	0.1749	-0.1298	0.3025	1.0000	0.0653	0.0017
Testslf	0.0226	0.0522	-0.0167	0.0602	0.0094	0.0822	0.0653	1.0000	0.0512
Sleep	-0.0173	-0.0375	0.0337	-0.0769	0.0376	-0.0267	0.0017	0.0512	1.0000

Visual comparisons of the 5 matrices reveals that the correlations between variables are not stable. In other words, the level of association between behaviours changes across different age groups. While the crude rank correlation

between DRINK and SMOKE was 0.17, the age-specific correlations ranged from a low of 0.08 in the ≥ 45 year-old group, to a high of 0.23 in the 20-25 year-old group. Similarly the correlations between BRUSHT and FLOSS showed a range of 0.23 to 0.37 in the age strata while the crude correlation was 0.27. The range of correlation coefficients for SMOKE and SLEEP were -0.02 to -0.18 with a crude correlation of -0.16.

The following section will present the results of the risk-coding of health behaviours based upon risk of poor perceived health status.

ODDS RATIOS-BASED CODING OF HEALTH BEHAVIOUR CATEGORIES

To be able to re-order and risk-code the health behaviour performance levels, the association between behaviour levels and poor perceived health was defined. The perceived health question has 5 items of response which were collapsed into Good and Poor categories as follows:

Good = Excellent + Very Good + Good

Poor = Fair + Poor

Logistic regression was used to determine the ORs for each level using this new dichotomous variable as the dependent variable. Table 16 shows the ORs for poor perceived health for the nine survey health behaviours. The ORs are presented such that the best level was set as the standard category, (OR=1), and the remaining categories demonstrating an increase in risk of poor perceived health.

Many behaviours demonstrate a "dose-response" relationship with perceived health, with increasing performance being associated with risk in a monotonic fashion. For example, with increasing frequency of smoking, there is a corresponding increase in risk of poor perceived health. However, alcohol consumption does not show such a monotonic relationship. Although the "never drink" and "moderate drink" categories do not show much distinction, "heavy drinker" and "ex-drinker" seem to be at increased risk for poor perceived health. The ORs shown in Table 16 were used in two ways:

i) The categories of each health behaviour were re-ordered to reflect increasing risk of poor health. For all behaviours, the first value for the re-ordered variables would be 1.0 and would be whatever category has an OR=1 in Table 16. The subsequent categories would then be ordered with respect to increasing ORs. The variables remain ordinal in type.

ii) The other form of re-coding would require the health behaviour variables to be risk-scored. The actual OR values would be used to score the categories themselves.

The differences between performance level-coding, re-ordering, and risk-scoring are shown below for the DRINK variable:

<u>Performance Level-Coded</u>		<u>Re-ordered</u>		<u>Risk-scored</u>
Never = 1	=>	Never = 1	=>	Never = 1.00
Ex-Drker = 2		Moderate = 2		Moderate = 1.10
Moderate = 3		Heavy = 3		Heavy = 1.61
Heavy = 4		Ex-Drker = 4		Ex-Drker = 1.76

These coding schemes will be utilized in the next sections.

RANK CORRELATIONS - ODDS RATIO RE-ORDERED

Spearman rank correlations were calculated for the re-ordered variables.

The rank correlation matrices are shown below for the crude population as well as for the age strata.

CRUDE POPULATION

	Smoke	Drink	Exrate	Eatbrf	Eatbtm	Floss	Brush	Testslf	Sleep
Smoke	1.0000	0.2009	0.1289	0.2406	0.0041	0.0482	0.0767	0.0200	0.1562
Drink	0.2009	1.0000	0.0154	0.1175	0.0123	0.0548	0.0193	0.0129	0.1029
Exrate	0.1289	0.0154	1.0000	0.1050	0.0406	0.1119	0.1325	0.0491	0.0081
Eatbrf	0.2406	0.1175	0.1050	1.0000	-0.0345	0.1232	0.1449	0.0431	0.1482
Eatbt	0.0041	0.0123	0.0406	-0.0345	1.0000	0.0467	0.0356	-0.0059	0.0240
Floss	0.0482	0.0548	0.1119	0.1232	0.0467	1.0000	0.2681	0.0920	0.0272
Brush	0.0767	0.0193	0.1325	0.1449	0.0356	0.2681	1.0000	0.0657	0.0332
Testslf	0.0200	0.0129	0.0491	0.0431	-0.0059	0.0920	0.0657	1.0000	-0.0148
Sleep	0.1562	0.1029	0.0081	0.1482	0.0240	0.0272	0.0332	-0.0148	1.0000

AGE: 20-25

	Smoke	Drink	Exrate	Eatbrf	Eatbtm	Floss	Brush	Testslf	Sleep
Smoke	1.0000	0.2326	0.1167	0.1786	-0.0001	0.0133	0.0620	0.0257	0.1816
Drink	0.2326	1.0000	0.0491	0.1869	0.0170	0.0610	0.0451	-0.0186	0.1700
Exrate	0.1167	0.0491	1.0000	0.0848	0.0402	0.1330	0.1799	0.0841	-0.0332
Eatbrf	0.1786	0.1869	0.0848	1.0000	-0.0893	0.1236	0.1553	0.0871	0.1705
Eatbt	-0.0001	0.0170	0.0402	-0.0893	1.0000	0.0177	0.0580	-0.0341	0.0378
Floss	0.0133	0.0610	0.1330	0.1236	0.0177	1.0000	0.3665	0.0989	0.0248
Brush	0.0620	0.0451	0.1799	0.1553	0.0580	0.3665	1.0000	0.0658	0.0628
Testslf	0.0257	-0.0186	0.0841	0.0871	-0.0341	0.0989	0.0658	1.0000	-0.0279
Sleep	0.1816	0.1700	-0.0332	0.1705	0.0378	0.0248	0.0628	-0.0279	1.0000

AGE: 26-35

	Smoke	Drink	Exrate	Eatbrf	Eatbtm	Floss	Brush	Testslf	Sleep
Smoke	1.0000	0.2143	0.1133	0.2706	0.0041	0.0453	0.0904	0.0237	0.1742
Drink	0.2143	1.0000	0.0474	0.1115	0.0124	0.0732	0.0066	0.0124	0.1041
Exrate	0.1133	0.0474	1.0000	0.1003	0.0574	0.1056	0.1312	0.0503	0.0147
Eatbrf	0.2706	0.1115	0.1003	1.0000	-0.0443	0.1194	0.1406	0.0311	0.1753
Eatbt	0.0041	0.0124	0.0574	-0.0443	1.0000	0.0302	0.0068	-0.0052	0.0037
Floss	0.0453	0.0732	0.1056	0.1194	0.0302	1.0000	0.2271	0.0749	0.0267
Brush	0.0904	0.0066	0.1312	0.1406	0.0068	0.2271	1.0000	0.0382	0.0223
Testslf	0.0237	0.0124	0.0503	0.0311	-0.0052	0.0749	0.0382	1.0000	0.0244
Sleep	0.1742	0.1041	0.0147	0.1753	0.0037	0.0267	0.0223	0.0244	1.0000

AGE: 36-44

	Smoke	Drink	Exrate	Eatbrf	Eatbtml	Floss	Brush	Testslf	Sleep
Smoke	1.0000	0.1449	0.2075	0.2916	-0.0066	0.0999	0.0541	0.0144	0.1522
Drink	0.1449	1.0000	-0.0321	0.1201	0.0135	0.0211	0.0244	0.0657	0.0762
Exrate	0.2075	-0.0321	1.0000	0.1653	0.0264	0.1299	0.0817	0.0072	0.0642
Eatbrf	0.2916	0.1201	0.1653	1.0000	-0.0726	0.0738	0.1573	0.0252	0.1169
Eatbt	-0.0066	0.0135	0.0264	-0.0726	1.0000	0.0209	0.0448	0.0253	0.0322
Floss	0.0999	0.0211	0.1299	0.0738	0.0209	1.0000	0.2878	0.1489	-0.0051
Brush	0.0541	0.0244	0.0817	0.1573	0.0448	0.2878	1.0000	0.1127	0.0346
Testslf	0.0144	0.0657	0.0072	0.0252	0.0253	0.1489	0.1127	1.0000	-0.0195
Sleep	0.1522	0.0762	0.0642	0.1169	0.0322	-0.0051	0.0346	-0.0195	1.0000

AGE: >45

	Smoke	Drink	Exrate	Eatbrf	Eatbtml	Floss	Brush	Testslf	Sleep
Smoke	1.0000	0.1378	0.1438	0.2301	-0.0181	0.1255	0.1282	0.0226	0.0173
Drink	0.1378	1.0000	-0.0283	0.0581	-0.0093	0.0835	0.0883	0.0786	-0.0058
Exrate	0.1438	-0.0283	1.0000	0.1153	0.0826	0.1442	0.0788	0.0167	0.0337
Eatbrf	0.2301	0.0581	0.1153	1.0000	0.0638	0.2139	0.1749	0.0602	0.0769
Eatbt	-0.0181	-0.0093	0.0826	0.0638	1.0000	0.0865	0.1365	-0.0012	0.0467
Floss	0.1255	0.0835	0.1442	0.2139	0.0865	1.0000	0.2871	0.0542	0.0374
Brush	0.1282	0.0883	0.0788	0.1749	0.1365	0.2871	1.0000	0.0653	-0.0017
Testslf	0.0226	0.0786	0.0167	0.0602	-0.0012	0.0542	0.0653	1.0000	-0.0512
Sleep	0.0173	-0.0058	0.0337	0.0769	0.0467	0.0374	-0.0017	-0.0512	1.0000

In comparison with the rank correlation matrices of the performance level-coded variables, there are substantial changes in the values of the correlations. Table 17 lists the percentage change in the absolute value of the correlation from the performance level-coded variables to the re-ordered variables. Only the four variables in which the ORs required re-ordering of behaviour categories are listed. (Correlations between the behaviours which did not require re-ordering would not change). Underlined values represent changes in performance level-coded correlations which were greater than 0.1. Many of the very large percentage changes are misleading since they involve changes in correlations which were quite

small.

Substantial changes were observed with the correlations between SMOKE and DRINK particularly in the older age groups. In the 35-44 age group, there was a 50.3% increase in the correlation from 0.09 to 0.14. For the ≥ 45 age group, there was a 73.8% increase in the correlation from 0.08 to 0.14. This is primarily due to the higher proportion of heavy and ex-drinkers within these age groups.

The re-ordering also eliminated many of the negative correlations. The remaining negative correlations are quite small.

HEALTH BEHAVIOUR CORRELATIONS - SUMMARY

The preceding sections have presented results which indicate that health behaviours are not entirely independent. The level of correlations found in this data are modest. The magnitude of the correlations vary across age strata. They also vary when the behaviour categories are re-ordered to reflect a monotonic relationship with the risk of poor perceived health.

The next sections will utilize the correlation matrices of the preceding sections to identify health behaviour clusters.

5.2 HEALTH BEHAVIOUR CLUSTERS

The second objective of this thesis was to identify health behaviour inter-relationships and determine if they vary with respect to demographic variables and coding schemes. While correlations have been shown to vary, the following sections will address whether clusters of inter-related behaviours also vary.

FACTOR ANALYSIS - PERFORMANCE-CODED VARIABLES

The performance level-coded rank correlation matrices were submitted to a principal components analysis with varimax rotation. Table 18 presents the identified factors and their loadings for the crude and age-stratified populations. An arbitrary threshold of 0.4 was utilized for consideration of membership within a factor.

Three factors were identified with eigen values greater than 1.0 in the crude population. Negative loadings are likely due to inconsistency in the ordering of behaviour categories with respect to health status. The two dental behaviours were clustered together with exercise. Smoking and drinking also clustered together with eating breakfast and hours of sleep. Eating between meals formed a separate cluster.

Age stratification resulted in some changes in the cluster patterns. While three factor solutions were found in the crude and two youngest age groups, four factors were identified in the two oldest age groups. The "SMOKE-DRINK-EATBRF-SLEEP" cluster is maintained until the oldest age group. For the ≥ 45 age group, DRINK no longer clusters with the three other behaviours. This is due to the diminishing correlations with increasing age between DRINK and the other variables particularly SMOKE.

In the 20-25 year old age group, EATBRF is loaded on two separate clusters, Factor 2 and 3. These clusters are orthogonal to each other suggesting that, for this age group, there is evidence of two separate dimensions to this

behaviour.

Factor 2 of the 35-44 year old age group comprised "FLOSS-BRUSHT-TESTSLF". These behaviours are all active disease preventive activities.

The next section will explore whether changes in correlations due to re-ordering of health behaviour categories affects the observed clustering of behaviours.

FACTOR ANALYSIS - ODDS RATIO RE-ORDERED VARIABLES

The rank correlations previously calculated were used as a measure of association for a principal components analysis with varimax rotation. The rank coding of the behaviours differs from the performance level-coding in that they reflect an increasing risk of poor perceived health. Only loadings of at least 0.4 were considered. Table 19 lists the factor solutions for the crude and age-stratified populations.

Compared to the preceding performance level-coded behaviours' factor analysis, there were fewer negative loadings. While many of the identified clusters were quite similar to the clusters observed for the performance-coded behaviours, variation is seen with the DRINK variable. Unlike the performance level-coded factor analysis, the ≥ 45 age group in the re-ordered behaviours has a 3 factor solution. The relationship between SMOKE and DRINK also re-appears due to the increase in the correlations due to re-ordering. In addition, DRINK is found in two orthogonal factors. In factor 3, DRINK is associated with a negatively loaded SLEEP variable which had been positively associated with the behaviours in

Factor 1 throughout the other age strata. This suggests that the relationships between these variables is quite different within this age strata.

The next section will present the results of the factor analysis of OR risk-scored health behaviours.

FACTOR ANALYSIS - ODDS RATIO RISK-SCORED VARIABLES

The re-ordered health behaviour categories were further modified by substituting the actual odds ratio value for the ordinal value. Thus, each variable was transformed from a performance level-coded ordinal variable to one that was ranked and weighted with respect to the odds of poor perceived health status and, theoretically, could contain any value from one to infinity.

A Pearson correlation matrix was calculated using the nine health behaviours. The matrix was then subjected to a principal components analysis with varimax rotation. The arbitrary threshold for factor score loading remained at 0.4. Table 20 lists the identified clusters and their factor loadings for the crude, age- and education-stratified populations.

For the crude population, there was no difference in the identified clusters for the risk-scored behaviours compared to the re-ordered behaviours. The youngest three age groups are also similar although the oldest age group, ≥ 45 , does exhibit differences from both the performance-coded and re-ordered solutions. While DRINK was loaded on two separate factors for the re-ordered behaviours, SMOKE has loaded on two factors for the risk-scored behaviours.

When the population was stratified by education level, the dominant

categories were seen in most strata. However, DRINK does not load on any of the factors for the University stratum. In addition, testicular self-examination becomes associated with other active preventive activities in the two upper education strata.

Table 21 presents the factors identified after analyzing the marital status and rank strata. The differences across marital status strata are less striking. In the divorced/separated stratum, DRINK loads on two factors. In addition to its usual association with SMOKE, EATBRF, and SLEEP, DRINK also loads with the dental activities. Therefore heavy/ex-drinking, not brushing teeth, and not flossing form a cluster of inter-related behaviours.

In the military rank strata, there is a clear distinction in the clustering of behaviours. Military rank is a strong socio-economic status measure. Not only does it determine financial remuneration, it determines power, autonomy, status, and privilege. The commissioned officers, both senior (Generals, Colonels, Majors) and junior (Captains, Lieutenants, Cadets), have quite different clusters from the senior (Warrant Officers and Sergeants) and junior (Corporals and Privates) non-commissioned ranks. Table 22 shows the correlations for the crude and rank-stratified populations for behaviour pairings with a correlation greater than 0.1. (The Pearson correlation matrices for the crude and rank-stratified populations are provided in Appendix J). It is evident that there is substantial variation in the magnitude of correlations across the strata. The crude correlation is closest in magnitude to that of the junior non-commissioned members, as they are the largest group. The number of correlations greater than 0.2 was different for each

stratum. While the senior officer stratum had 7 correlations greater than 0.2, the crude and junior non-commissioned member strata had only 2 and 1 respectively. The association between heavy drinking and heavy smoking is smaller in both officer groups which is reflected in their not clustering together in the factor analysis. Numerous other examples exist in which the correlations are quite different between strata, often with the largest correlations being within the senior officer stratum.

HEALTH BEHAVIOUR CLUSTERS - SUMMARY

Health behaviours clustered into 3 or 4 factors. Changes in the composition of clusters was greater across demographic strata than with different coding types.

5.3 DISCRIMINANT ANALYSIS OF HEALTH BEHAVIOURS

The following sections will present the relationships between health behaviours and the five psychosocial measures: self-esteem, personal mastery, life events, social support, and psychological distress. The ability of these psychosocial measures to discriminate between positive and negative levels of behaviours will be explored for individual behaviours as well as health behaviour clusters. This is the third objective of the thesis.

DISCRIMINANT ANALYSIS: UNIVARIATE HEALTH BEHAVIOURS

Each of the nine health behaviours were dichotomized based upon the odds of poor perceived health status for each behavioral category, (see Table 16). The dichotomized variables were then treated as dependent variables with the five psychosocial variables as independent variables in a discriminant analysis. A

discriminant function was determined and a classification matrix formed. Table 23 shows the sensitivity, specificity, and total correct classification for each of the health behaviours.

The five psychosocial measures do not discriminate between positive and negative levels of behaviours at a level appreciably better than chance. Although the mean values of the independent variables do differ between the two groups, the only reason they are significantly different is because of the large sample size. While differences are in the appropriate direction, (ie increased life events is associated with negative levels of behaviours), the magnitude of the differences between group means are negligible. (eg. for SMOKE, mean life events for positive category was 2.8, whereas the mean for negative category was 3.1).

The next section will present the results of the discriminant analyses of health behaviour clusters.

DISCRIMINANT ANALYSIS: HEALTH BEHAVIOUR CLUSTERS

Health behaviour clusters which were identified in the factor analysis of the risk-scored behaviours were utilized. Demographic variables for which the most variation in the contents of clusters across strata were selected. For a particular cluster, the health behaviours were dichotomized as per the preceding section and Table 16. A summative scale was then created using the dichotomized variables within the cluster. This summative scale was dichotomized forming a dichotomous dependent variable.

Table 24 lists the results of the discriminant analysis by age category and

cluster. Similar to the univariate behaviours, the psychosocial variables did not effectively discriminate between the dichotomized clusters. Even when just the first and fourth quartiles were compared, the discrimination did not substantially improve. Similar results were found for clusters in other demographic strata and can be found in Appendix F.

In summary, the psychosocial measures were unable to effectively discriminate between those performing positive and negative levels of individual behaviours or clusters of inter-related behaviours.

6. FOLLOW-UP ANALYSES

The preceding results chapter presented the results of the analyses to determine the level of inter-relationships between health behaviours and their clustering, and to determine the level of association between health behaviour clusters and psychosocial measures. This chapter will explore the relationships between health behaviours and health status, health behaviours and psychosocial measures, as well as psychosocial measures and health status. Tables and figures may be found immediately following those of the preceding chapters preceding the appendices.

6.1 HEALTH BEHAVIOURS AND PERCEIVED HEALTH STATUS

A summative scale of the nine dichotomized health behaviours was created. Dichotomization of the behaviours was based upon the ORs for poor perceived health status found in Table 16. The mean number of positive behaviours performed by health status was determined and are shown in Table 25.

As perceived health status improves, the mean number of positive health behaviours performed increases so that the "excellent" group performs on average more than twice as many positive behaviours as those who self-rate their health as poor. A one-way analysis of variance was performed which found the mean values to be significantly different, ($p < 0.0000$). The numeric trend is even more striking when viewed graphically. Figure 6 shows the relationship between the number of positive behaviours performed and perceived health status. Although health status

is an ordinal variable, a trend line has been shown to highlight the monotonic relationship.

To determine if this relationship persists across demographic strata, the mean number of positive health behaviours for each strata was calculated. The category means are shown in Table 25. The trend towards a decreasing number of positive behaviours as perceived health status diminishes is maintained. A few strata did not show any difference between the "fair" and "poor" categories. This supports combining these two categories in the dichotomization of perceived health status. Also, the sample size in the poor category gets quite small in some cells. None of the senior officers rated their own health as "poor".

The mean number of positive behaviours is not constant though within perceived health categories. The number of behaviours performed by those self-rated as "excellent" increases with increasing rank and education.

In an attempt to identify a dose-response relationship between the level of health behaviours performed and perceived health status, categories for each health behaviour were collapsed into three categories, (trichotomized). The decision as to which behaviour level fell into the moderate category was somewhat arbitrary but was based upon the ORs calculated in Table 16. For some behaviours the level was taken from the positive side, and in others from the negative side of the dichotomized behaviours. The number of behaviours for each of these categories was then calculated for each study subject. The mean number of behaviours for each category of perceived health was then calculated for the

data set. These means are shown in Figure 7.

The monotonic relationship between the number of positive health behaviours and perceived health status is maintained. Similarly, the number of behaviours performed at a negative level is inversely related to perceived health status. While the mean number of positive and negative health behaviours complement each other for each level of perceived health status, the number of behaviours performed at a moderate or intermediate level remains stable across perceived health status levels.

Individuals who self-rated themselves as being of "fair" or "poor" health status performed on average a greater number of negative behaviours, (averaged greater than 6 out of 9 behaviours at a negative level when behaviours were dichotomized). What is not evident from such a result is whether individuals are performing these behaviours in any particular pattern or that the behaviours are being performed in an independent fashion.

The study population was dichotomized according to perceived health status, (fair and poor together). A Pearson correlation matrix for risk-scored health behaviours was calculated for each group, (matrices in Appendix G). The correlations observed in the "fair/poor" group were reduced for many of the pairings compared to the remainder of the respondents.

It has been stated that "smokers do more than just smoke".⁶⁶ To pursue whether smokers were performing health behaviours differently from those who had never smoked, the mean number of positive behaviours performed for these

two groups were determined. While statistically different, the "ever-smoked" group performed on average only 0.4 behaviours less, (3.0, 3.4). Similarly, the data set was dichotomized for non and moderate drinkers, and heavy/ex drinkers. Only a small difference was observed in the mean number of behaviours performed, (2.2, 2.7).

The values shown in Table 25 and the subsequent figures are based upon the mean number of behaviours. They do not necessarily mean that all or even most of the individuals who are experiencing excellent positive health are performing 4 or more behaviours at a positive level. To pursue this, a frequency distribution was calculated for each category of health status for possible scores on the summative scale. The five frequency distributions are shown in Figure 8. A substantial amount of overlap is evident in the number of behaviours performed for each perceived health status category.

6.2 HEALTH BEHAVIOURS AND PSYCHOSOCIAL MEASURES

The psychosocial measures were not useful discriminators of levels of individual or groups of behaviours. Measurement and bias issues will be pursued in the discussion chapter. Previous studies have measured correlations between psychosocial measures and summative health behaviour scales and this was explored for this population. A health behaviour summative scale of dichotomized health behaviours was created and treated as a continuous dependent variable. A step-wise linear regression was performed and all five independent variables entered into the equation with the smallest F to enter being 4.21.

The psychological symptom index contributed the most to the regression explaining 3.2% of the variance. The four other variables increased the R^2 to 0.04. Log transformation of all but the life events variable did not improve the variance explained.

6.3 PSYCHOSOCIAL MEASURES AND HEALTH STATUS

The relationship between perceived health status and the psychosocial measures was explored. Table 26 shows the results of one-way ANOVAs performed for each of the psychosocial measures. The anticipated trend in all the psychosocial variables with respect to perceived health was observed.

A discriminant analysis was performed utilizing the psychosocial measures as independent variables, and the dichotomized perceived health status as the dependent variable. The discriminant function correctly classified 78.7% of the subjects who self-rated themselves as having "poor" or "fair" health. However, classification of the much larger group of "good" health or better was only 46.9%. Thus the total correct classification was 49.7%. This was improved when only the extreme excellent and fair/poor categories were used. The discriminant function then correctly classified 61.7% of the fair/poor group, and 84.9% of the excellent group with a total correct percentage of 75.5%. However this reduced the sample size to only 700.

The monotonic relationship between sleep and health status differed from the non-monotonic associations found in the Alameda County study. The mean scores for psychological distress calculated for each sleep category are shown in

Table 27. They were statistically significant with the middle category, (7 or 8 hours) having the lowest scores.

7. DISCUSSION OF RESULTS

7.1 DATA QUALITY

Although not specifically a data quality issue, the data utilized in this thesis are cross-sectional in nature and therefore can not be used to determine causation for associations observed between variables.

REPRESENTATIVENESS

Eligibility criteria resulted in a loss of 19% of the regular force population primarily affecting service members on training who were less than 20 years of age. Therefore survey results may not be generalizable to this age group.

Statistically significant differences were found between the age and rank distribution of the survey target sample and the survey respondents, (Table 1). Nevertheless, the distributions appear quite similar and are only statistically significant because of the large sample size. Such small differences are unlikely to be of importance.

EXCLUSIONS - AGE AND GENDER

The less than 20 year-old age group and females were excluded prior to any further analysis due to small group sizes. Combining the less than 20 year-old age group with the 20-25 year-old age group was deemed unsatisfactory because of the likely differences between the two groups.

Females are a substantial minority in the Canadian Forces (CF). While the sample proportionately represented the distribution of females within the CF and

would be adequate for descriptive statistics, the 606 female respondents were felt to be too small a group for the proposed methodology.

The exclusion of these two groups possibly limits the generalizability of findings to males older than 19 years of age.

SURVEY NON-RESPONSE

The Canadian Forces Health and Lifestyle Survey (CFHLS) obtained a 76% response rate. As per Table 1, the demographic distributions of the sample and respondents are quite similar. Although exact reasons for non-response are unavailable, it appears that the majority of individuals were unavailable due to operational requirements. The CF population is extraordinarily mobile and even though the survey was purposely administered during a relatively quiet part of the year, substantial numbers of members were away from their home units.

DATA SET MISSING VALUES

The variables selected for use in this thesis resulted in a loss of almost 20% of the data set. Non-response in itself indicates that an individual differs from those who responded. This was reflected in the increased proportion of missing values as self-reported perceived health status diminished, (Appendix D).

The DRINK variable was responsible for the majority of the missing values and was evaluated for its role in biasing results if included in analysis. While the prevalence of heavy and ex-drinkers was likely under-estimated due to missing values, DRINK non-response did not appear to alter health behaviour clustering.

7.2 DESCRIPTIVE RESULTS

HEALTH BEHAVIOURS

The CFHLS had a number of questions concerning various aspects of behaviour related to health. Since one of the weaknesses of previous research in health behaviour clustering was the variety of behaviours chosen for study, a narrower focus on eligible health behaviours was chosen. Unlike the Alameda County studies which included a weight-for-height measure, a similar measure was not included as a "behaviour" since it is not a personal activity, but an outcome for many factors which may include health behaviours such as physical activity and nutritional intake. Although previous studies have frequently included a measure of health professional visits, this would not be appropriate for this setting as many such visits are organizationally mandated in the study population. Seat-belt use was also not included as it is a legislated activity in most Canadian provinces.

The very nature of survey research determines that measurements are self-reports. No particular efforts were made to validate these measures for this population. However, for the majority of behaviours, there is no real gold standard of measurement. The exception to this is the measurement of cotinine levels in smokers which has found that self-reports underestimated smoking status by 4% in young adults.⁶⁷ Other behaviours have no such objective measure. Assessments of the validity of alcohol self-reports have been hampered by deficiencies with the techniques used as standards themselves.⁶⁸

Self-reported alcohol intake (Table 7) showed lower levels of consumption

than the population surveyed by the Health Promotion Survey. With a younger age distribution it is reasonable that there would be fewer "ex-drinkers" and possibly more individuals who had never drank regularly. While the Canadian Forces has an active alcohol rehabilitation program which includes medical treatment and a series of incremental administrative actions (including release from the CF) for those who are found to misuse alcohol,⁶⁹ under-reporting is a likely phenomenon co-existing with higher intakes in those for which this variable was a missing value. For those individuals who did respond, the "never drank" group may have been inflated by the wording of one of the questions which asked when individuals started to drink "regularly". If this was misinterpreted, this would have resulted in misclassification of respondents leading to under-estimation of intake. Comparisons between U.S. military and civilian populations have found that military members reported higher proportions of "any drinking" and "heavy drinking" than civilian populations for all age groups.⁸

The CFHLS respondents self-reported higher proportions of very heavy smokers, (Table 8), than the Health Promotion Survey. Only 35% of respondents reported eating breakfast daily which is comparable to males in the U.S. military.⁷

HEALTH STATUS

Health is a multi-dimensional concept and thus its measurement is challenging. It has been suggested that the type of measure be dictated by the question to be answered possibly by concentrating on only one of health's dimensions.⁷⁰ Nevertheless, a simple single question of self-perceived health has

been used in previous studies and found to be predictive of current and future morbidity and mortality.^{71,72,73,74,75} However, since it is but one question with only five allowable responses, (six if you count not answering), precision in estimating health suffers.⁷⁶ In addition, a five-item ordinal type variable creates limitations in the types of analyses possible. The CFHLS did not provide an alternative measurement tool for estimating health status.

The level of perceived health status was self-reported as good or better by 91% of the respondents. This proportion is comparable to the results of the Health Promotion Survey. The latter had more frequent responses in the "excellent" and "very good" categories than did the CFHLS.

DEMOGRAPHIC VARIABLES

All demographic variables used in this study were designed as categorical-type variables. This resulted in a loss of information for the AGE variable. The use of non-standard age categories also made it difficult to compare observed behaviour frequencies with those from previously published surveys.

Despite the loss of junior members on training, the demographic distribution of survey respondents was younger than the Canadian population. Respondents also had achieved a proportionally lower level of education, and were more likely to be married or separated. Thus, caution is required in extrapolating any findings to other populations.

PSYCHOSOCIAL MEASURES

While all the scales included in the CFHLS were previously developed in

the psychological literature, all but the social support scale were modified in some way for this survey. Nevertheless, modifications were mainly limited to the number of response choices and the internal reliabilities of all the scales were maintained.

The univariate distribution of all five psychosocial measures shown in Figures 1 through 5 exhibited striking J-shaped distributions. The tendency for individuals to provide responses at the positive end of scales likely represents a social desirability bias, which is a tendency to select items that are recognizable as socially more desirable or acceptable than others.⁷⁷ This is believed to be related to an individual's need for self-protection, avoidance of criticism, social conformity, and social approval. Despite attempts at reassuring respondents that information would be confidential and anonymous, military populations tend to be suspicious of the motivations and use of information requested particularly when it is derived from questions of a personal nature. This was reflected in the comments of several respondents who were concerned that they would be identified because of their demographic profiles. One individual affiliated with military intelligence commented that they tracked people with much less information than requested on the survey.⁷⁸ Such concerns likely influenced responses to the survey. In addition, the Rosenberg Self-Esteem Scale has been noted to be susceptible to this type of bias.⁵² The consequence of this phenomenon is that with minimal spread of values, these scales will exhibit limited ability to differentiate between individuals.

7.3 HEALTH BEHAVIOUR INTER-RELATIONSHIPS

OBJECTIVE 1

The first objective was to determine whether health behaviours were independent of each other. Spearman rank correlations were used for the ordinal health behaviour variables and a number of statistically significant correlations were observed. Statistical power was adequate to detect very small correlation coefficients, (Appendix I). Overall, the correlations were small. Tables 7 through 15 demonstrated reasonable frequency distributions for the health behaviour variables so that the small correlations were not due to highly skewed distributions.

The largest correlation was between FLOSS and BRUSHT ($r=0.27$). The correlation between SMOKE and DRINK was 0.17. This compares with the Health Promotion Survey (0.12),⁵ the Canada Health Survey (0.11),⁹⁶ and Canadian university students (0.29).¹⁷ The observed correlation between SMOKE and EXRATE was 0.13. This is similar to that observed in the Health Promotion Survey (0.10), the Canada Health Survey (0.16), and Canadian university students (0.16).

The magnitude of correlations were of modest size which is comparable to those reported in a review of the literature.²⁰ Comparability is not surprising as the methodology used was similar to previous studies. The low correlations, however, were the reason for examining objective 2.

OBJECTIVE 2

The second objective was to determine whether the inter-relationships observed between health behaviours would change when different methods of coding health behaviour levels were used, and whether inter-relationships would vary between demographic strata. Inter-relationships were measured using correlation coefficients with the underlying structure identified using factor analysis.

RE-CODING OF HEALTH BEHAVIOUR PERFORMANCE LEVELS

The health behaviour variables were re-coded in two ways: i) by re-ordering performance levels to reflect a monotonic relationship with health status; and ii) by risk-scoring behaviour levels by replacing ordinal scoring with the actual value of the OR for poor perceived health status.

Use of Odds Ratio for Re-coding Health Behaviours

Previous health behaviour studies have shown that different performance levels of behaviours exhibited different levels of association with health status.^{1,6,79} Previous surveys have not contained exactly the same behaviour questions nor always used ORs as a measure of association. Therefore ORs were calculated using the CFHLS responses. A data-directed approach has the advantage that the ORs used are appropriate for the population from which they are calculated, however they are susceptible to spurious fluctuations in the magnitude of ORs by chance alone.

The ranking of ORs for poor perceived health status for individual health

behaviour levels shown in Table 16 were mostly consistent with previous reports. Most behaviours demonstrated a monotonic relationship between performance and risk of poor perceived health. The ORs for DRINK however, demonstrated a non-monotonic relationship with moderate and non-regular drinkers having the lowest ORs. The OR for ex-drinkers (1.76) was slightly more than that of the heavy drinkers (1.61). The Alameda studies did not differentiate between "never drank" and "ex-drinker" in the abstinent category.³ While the Health Promotion Survey did record a "former drinker" category, data within the technical report⁵ does not allow for calculation of ORs. However, data from the 1985 General Social Survey⁶⁵ provided age-stratified data for alcohol intake and perceived health status. Age-adjusted ORs for poor perceived health were calculated, (see Appendix H). Similar to the findings of this report, the "former drinkers" had the highest risk of self-reported poor health, (2.74 with current drinkers as reference category).

It is possible that the "ex-drinkers" category comprised individuals who were previously heavy drinkers and because of medical, social, or occupational reasons became ex-drinkers. Thus a higher risk of poor perceived health seems reasonable.

Previous studies^{1,6,79} have reported a non-monotonic relationship for the number of hours of sleep and health status with individuals reporting a moderate amount of sleep having the best health outcomes. In this study the OR for poor perceived health for "7 or 8 hours" was slightly greater than the "9 or more hours" category, (1.10, 1.00). In a group of applicants for group medical coverage in St.

Louis, Reed also found that individuals reporting 9 or more hours of sleep had better age and sex-adjusted odds than any of the other categories.⁸⁰ Despite these findings, one possible reason for the association of increased sleep with poor health status in population studies is the association of hypersomnolence with depression.⁸¹ This was supported by the follow-up analysis which showed that the "7 or 8 hours of sleep" category had the lowest mean score for PSYCHSYM.

Re-ordered Health Behaviour Performance Levels

While it is common practice to "reflect" behaviour categories to give the majority of health behaviour inter-correlations a positive value, none of the studies reviewed re-ordered health behaviour performance levels to reflect a monotonic relationship between health behaviour categories and health status prior to calculating the correlations. Part of objective 2 was to determine whether such a re-ordering would alter the magnitude of the correlations.

Table 17 showed that many of the correlations did substantially change. The correlation between DRINK and SMOKE showed a 20% increase at the crude level which was due to substantial changes of 50% and 74% at the two oldest age groups. If this population had been older, there would have been an even greater increase in the crude correlation coefficient. These changes were due to a re-ordering of the performance levels of the DRINK variable which involved moving the "ex-drinker" from the second position to the fourth. Since, the association between smokers and "ex-drinkers" is prominent in the older age groups, an increase in the correlation between these variables was observed in

these strata. Because this data is cross-sectional though, it is not possible to view the younger age groups as being representative of the older groups 20 years earlier. Not only is this due to a cohort effect, but there is also attrition throughout a potential 25 year career. Reasons for leaving the Canadian Forces would include problematic heavy drinking. Not all changes in the magnitude of correlations were increases. The correlations between DRINK and EATBRF decreased for the crude population and most age strata.

Use of factor analysis

Factor analysis is based upon the assumption that some underlying factors, which are smaller in number than the number of observed variables, are responsible for the covariation among the observed variables.⁸² Factor analysis in this thesis was used to identify clusters of related behaviours and then determine the association of psychosocial measures with these clusters, (objective 3). This was an exploratory factor analysis as the reviewed literature had insufficient detail and consistency to allow for the prediction of clustering *a priori* required for a confirmatory factor analysis.

While factor analysis has been the most commonly used statistical technique to identify clustering of health behaviours, its use on ordinal-type survey data violates the assumption that factor analysis be performed upon variables which are measured at the interval level. The consequences of performing a factor analysis on ordinal-type data are not easily predictable. However according to Kim and Mueller⁸³ if one views the ordinal-type variables as i) representing clumping

of responses from an underlying continuous distribution, ii) the correlations between variables are less than 0.6, and iii) the factor analysis is used as a means of finding general clustering of variables, then factor analysis can be utilized. The work in this thesis satisfies all three of these criteria and factor analysis was felt to be justified to meet the stated objectives of this thesis.

Comparison of the observed clusters with previous reports is hampered by the fact that none of the previous studies included the same behaviours as this study. However, the frequent clustering of SMOKE and DRINK together is consistent with previous factor analytic studies.²⁰

While some variation in the magnitude of correlations was observed with re-ordering, no substantial change was observed in the factor structure. Only two of the nine variables had their performance levels re-ordered, and while the correlations changed, they did not alter the underlying structure of the inter-relationships.

The use of ordinal scoring results in a loss of information in that not all health behaviours have an equal effect on health status, nor is there an equivalent dose effect from one category to another within as well as between behaviours. The use of OR values for health behaviour category scoring allowed for the weighting of distance between categories. Nevertheless, the clustering observed for the crude and age-specific populations did not substantially differ from what was observed for the other two scoring techniques. The use of weights for categories has also been found not to be useful in scaling research.⁸⁴

Role of re-coding

While some changes in the magnitude of correlations were observed with re-ordering of behaviour categories, such changes did not dramatically increase the magnitude of the correlations, and they remained modest in size. Similarly, risk-scoring of variables had no effect. It must be concluded that the low correlations observed between health behaviours are not merely due to the ordinal scoring of the behaviour variables.

STRATIFICATION BY DEMOGRAPHIC VARIABLES

The purpose of stratification was to detect any changes in the magnitude of correlations across strata. Age-stratification of the performance-coded health behaviours demonstrated variation in the values of Spearman correlations for health behaviour pairings. The changes in correlations across age-strata were generally greater than those due to re-ordering which was reflected in greater variation of cluster patterning across age-strata. In addition to the changes seen when stratifying by age, variation in the observed clustering was also identified across the education and rank strata. Noticeable differences were related to whether post-secondary education had been completed. Table 22 showed substantial variation in the magnitude of correlations across the rank strata.

Variation in Health Behaviour Inter-relationships

What is the significance of the variation in correlations and clustering observed after stratification? Are the differences merely due to chance and/or "noise", and thus unimportant? Or are these variations an aspect of the nature of

health behaviours? And if so, of what consequence?

In comparing the rank strata, the range of correlations between sleeping and drinking was from 0.003 to 0.147. Between tooth-brushing and smoking, the range was from 0.045 to 0.240. It is unlikely that these variations are due to chance alone because the sample sizes for all groups range from at least a few hundred to over a thousand. Similarly it is unlikely that by chance alone one would observe 7 correlations greater than 0.2 in one strata (senior officer) and only one in another, (junior NCM). Some form of bias might exist which would alter the manner in which some groups might interpret and answer questions compared to others, however this is difficult to imagine since it occurs for specific pairings of behaviour variables, yet not when these variables are paired with other variables.

Assuming that the variation of correlations are occurring, is the amount of variation observed substantive? In my opinion, the answer is yes. While the magnitude of correlations remained small, the range in values were impressive.

The small correlations observed in this study at the crude population level were due to the largest sub-group, junior NCM, having the lowest correlations for most behaviour pairings. The measurement of correlations at crude population levels mask the variation in correlations occurring in population sub-groups. While the senior officer stratum is a sub-group, obviously it too could be considered to be a crude population compared to its sub-groups. It may be that there continue to be variations in correlations with further stratifications. This was not performed

for this study because of the rapid diminishment of cell sizes. If variation is observed with each successive stratification, then the magnitude of correlations for at least some groups will increase.

The variation in correlations observed in this study were observed despite the fact that these health behaviour variables were derived from self-reports of frequencies rather than actual direct observation. Multi-dimensional, complex behavioral constructs (ie physical activity) were estimated with single ordinal-type questions. Even assuming an underlying two-dimensional frequency distribution for a behaviour, substantial information was lost when this was reduced to only four or five categories.

If two or more behaviours are co-occurring and it is not due to chance or bias, then something is causing them to co-occur. This suggests that these behaviours may have common determinants. The correlations observed were modest to moderate in magnitude, suggesting that the determinants might not be strong, but does not preclude their existence. Variation in the pattern of inter-relationships between health behaviours suggests that their determinants are also varying.

The largest amount of variation in correlations and clustering was observed between rank strata. This suggests that the determinants of health behaviour inter-relationships also might have the largest variation between these strata compared to other demographic strata. Current theoretical models (self-efficacy,⁸⁵ health belief model,⁸⁶ theory of reasoned action⁸⁷) concerning the determinants of

health behaviour emphasize the importance of situationally specific factors in determining behaviour. These would include an individual's attitudes, intentions, and expectancies towards a specific behaviour in a specific situation. These factors though, do not exist in isolation as environmental factors will influence the development and expression of individual behaviour determinants. As previously stated, the impact of rank in the military can not be under-estimated. The differences between being commissioned or not are substantial. Initial selection to one category or the other depends heavily upon education and career goals. Continued existence within the military would tend to accentuate initial differences. The two groups live in separate quarters, eat in separate messes, and are often trained in separate locations. That they do these very basic activities apart is not the only difference. The actual environment will be very different whether it be differences in dress code, furnishings, or expectations of acceptable/desirable behaviour. In addition to these very fundamental differences, distinctions with respect to salary, privilege, autonomy and privacy are notable. It would then seem reasonable that the environmental influences on individuals are likely different for different rank categories, which would be exhibited in different patterns of health behaviour determinants. Thus, different patterns of health behaviour inter-relationships would also be expected. This is what was observed. Of the rank strata, the senior officer stratum had generally larger observed correlations. To become a senior officer, these individuals have been exposed to similar environmental influences over many years and have been viewed to be

successful and fit to lead the rest of the organization. It would seem reasonable that this is a more homogeneous group than the other rank categories. It is perhaps because of their extended exposure to similar influences as well as a selection process for admission to this group, and a selective loss to unsuccessful others, that the senior officer stratum had larger correlations due to more common determinants.

If determinants for health behaviours are not global, but rather dependent to a significant degree upon an individual's environment, then determinant directed health promotion programming may not be successful at a global level. From this study it is not clear to what level targeting would be required, however, it would seem that some form of tailoring should be given consideration. Health behaviours within the junior NCM stratum demonstrate lower correlations for most health behaviour pairings. With all but one pairing having a correlation less than 0.2, these behaviours are almost completely random. Therefore there would not appear to be any evidence of a common reasoned process driving the performance of these behaviours. This would include a concern for one's health. It may be that individuals within the junior NCM stratum are unaware of the health consequences of some of the studied behaviours. Or, even if aware, they may not be at a point in which they are actively thinking about their behaviour. The senior officer stratum demonstrated higher correlations which may indicate that age and education may assist the development of behaviour patterns, but so may their prolonged exposure to the military environment. These hypotheses are not

answerable from this survey, but could form the basis of future work with this population. In addition, it would seem that more immediate determinants of health behaviours need to be included in future work. In this way, individual's attitudes, intentions, and expectancies surrounding behaviours could be determined. This would not only allow for the comparison of determinants of a behaviour between individuals, but would also allow for the comparison of determinants between different behaviours. Such information would help determine how precise health promotion efforts will need to be in tailoring their messages to target populations. The results from this study suggest that differences in common determinants exist between major demographic sub-groups. Further exploration would necessitate multiple stratification which would require much larger sample sizes than was available for this study, and likely ever available for this particular population. Exploration of one or more of the large national survey data bases would be a reasonable step to exploring health behaviour inter-relationships in more precise sub-populations.

If further evidence of variation in the determinants of health behaviours throughout a population becomes available, then this has implications for the type and complexity of survey instruments, as well as the need for a range of interventions for different target groups. In some ways, the process has already begun with the emergence of comprehensive, community-wide interventions.⁸⁸

7.4 DISCRIMINANT ANALYSIS OF HEALTH BEHAVIOUR CLUSTERS BY PSYCHOSOCIAL MEASURES (OBJECTIVE 3)

The third and last objective was to determine the association between psychosocial measures and the clusters of health behaviours identified by factor analysis. The psychosocial measures were not substantially better than chance in discriminating between individuals performing several behaviours at a positive level versus those who were not. This was unfortunate, as it would have been very interesting if the psychosocial measures had been found to be associated with the different health behaviour clusters in different patterns. This would have provided additional support for health behaviours having different determinants in different population sub-groups. The observed result though, suggests that either there is no relationship between behaviours and psychosocial measures within this population, or that errors in the measurement of these concepts were responsible.

The use of discriminant analysis necessitates assumptions which require that discriminating variables are measured at the interval level and that each group has been drawn from a population with a multivariate normal distribution for the discriminating variables.⁸⁹ While the five** psychosocial measures used in this thesis were interval variables, considering the shape of their distributions, it is unlikely that a multivariate normal distribution existed. Violation of this assumption can result in inaccuracy in the classification of individuals.⁸⁹

**life events, self-esteem, personal mastery, social support, psychological symptoms.

Normalization was attempted using a log transformation, however this did not improve the scales' performance, (results not shown).

Measurement difficulties were likely experienced with the psychosocial variables. With respondent scores clumped towards the positive end of scales, discrimination between groups based on these scores was difficult. As previously discussed, a social desirability bias is likely responsible for the scales' distributions.

The relationship between the psychosocial measures and health behaviours was pursued using multiple linear regression. A summative scale comprised of the nine health behaviours (dichotomized) was used as the dependent variable with the five psychosocial scales as independent variables. Only 4% of the variance of the health behaviour scale was explained by the five scales. This is low in comparison to many other studies which have found psychosocial measures to have higher correlations to summative health behaviour scales. Muhlenkamp and Sayles³⁴ and Yarcheski and Mahon⁴⁰ observed relatively large correlations between a lifestyle questionnaire and self-esteem ($r=0.25$, $r=0.42$) and social support ($r=0.26$, $r=0.34$). Similarly, Mechanic and Cleary³² observed higher correlations between a health behaviour index and psychological distress and life problems, (-0.19 , -0.19). Seeman et al³⁹ also observed a correlation of 0.13 between personal mastery and a health behaviour scale.

Considering the existing literature on the association of psychosocial measures and health behaviours, and the likely bias in scale responses, the objective of determining whether psychosocial measures discriminate between the

poles of health behaviour clusters remains unresolved. If the scale responses had demonstrated more variation, then this third objective could have been more appropriately addressed. Similarly, in the follow-up analysis, the psychosocial measures were unable to discriminate a dichotomized perceived health status variable.

7.5 RECOMMENDATIONS

The following recommendations result from the preceding discussion. While the first five apply primarily to further work in the Canadian Forces, the remainder of the recommendations are more generalizable.

1. Use standard (Statistics Canada) categories for demographic variables like age.
2. Avoid changing the scoring and structure of established scales as it may lead to challenges of the established evidence of their validity and reliability.
3. Avoid too many identifying variables. This may have been a factor in eliciting a social desirability bias for the psychosocial scales.
4. Consideration should be given to including a social desirability scale in future surveys, particularly those which include psychosocial measures. Not only may this be useful in detecting if this bias is occurring, it also may be of use as a covariate during analysis.⁹⁰
5. If the objectives of future survey work involve a search for the determinants of health behaviours, the behaviours themselves should

be narrowed from their broad multidimensionality, and determinants which are more consistent with current health behaviour theories should be included. These might include attitudes, expectancies, and intentions towards specific behaviours in specific situations.

6. If correlations between behaviours are to be calculated, consideration should be given to whether a monotonic relationship with health status exists for each behaviour. If not, re-coding should be performed. Otherwise the correlation may be distorted.
7. The description of correlations between health behaviours for total populations should be discouraged. It is an average value which may be quite different compared to the correlations in population sub-groups.
8. The possibility of co-occurrence of health behaviours should be considered particularly in circumstances of homogeneous populations.
9. Data sets with larger sample sizes should be explored to determine if multiple stratification results in: i) continued variation in correlations between health behaviours as populations become more homogeneous; ii) an increase in the magnitude of correlations; and iii) an increased stability in the patterns of health behaviour clustering.

7.6 FOLLOW-UP ANALYSIS - HEALTH BEHAVIOURS AND PERCEIVED HEALTH STATUS

The association between the number of health behaviours and perceived health status was readily confirmed in this population by the striking monotonic relationship between the mean number of positive health behaviours performed by perceived health status category, (Figure 6). Collapsing health behaviour performance levels to three categories demonstrated that it was the number of behaviours performed at the extremes of risk which changed across the perceived health status categories. Although the data are cross-sectional in nature, these findings support the concept that health behaviours are very important correlates, if not, determinants of health status. However, the issue is to what extent do behaviours influence health?

While Figure 6 shows a plot of the average number of positive behaviours performed for each level of perceived health status, these averages are but the central tendencies of a distribution of health behaviours as shown in Figure 8. Although not in direct conflict with the information in Figure 6 which is derived from it, the impression given by the two graphs is quite different. While a possible hypothesis from Figure 6 might be that increasing the number of positive behaviours performed might increase one's health status, Figure 8 suggests that this is too simplistic. What is actually happening is that the distribution of behaviours performed is being shifted slightly with changes in perceived health status. The result is a tremendous overlap in the number of behaviours performed

between health status categories.

Previous studies have found that the association between health behaviours and health status is not particularly large. Abood and Milton⁴⁶ used a path analytic model which incorporated demographic, behavioral and psychosocial measures and found that health behaviours explained 2.5% of the variance of the dependent health status variable. Riffle et al³⁷ found that a health promoting lifestyle explained 4.8% of the variance of a health status measure without controlling for other factors. Gottlieb and Green³⁶ found that health behaviours explained less than 1% of the variance of self-rated health in a national U.S. sample of males after controlling for demographic and psychosocial variables. These studies support the lack of a strong association between health behaviours and health status. It is still difficult to reconcile these small relationships when there appears to be a strong monotonic relationship, (Figure 6). Part of the problem may be the crudeness of the measures for both the health behaviours and health status. It is also important not to lose sight of the fact that health behaviours are not the only determinant of health status. Many other determinants including factors within the physical and social environment, public policy, the health care system, and individual biologic endowment are all important factors.⁹¹ Another consideration is that of the "prevention paradox"^{***} described by Rose.⁹² Changes in the number of health behaviours performed may not dramatically alter the health

^{***}A preventive measure which brings much benefit to the population offers little to each participating individual.

status of individuals, but a change in the average number of behaviours performed by a population could shift the whole distribution of the population so that the health status on average was improved. This concept is illustrated by the data from the CFHLS although it is limited in being cross-sectional in nature. Such differences in the effects of health behaviours performed by populations versus individuals has been previously described.^{93,94}

The individuals who self-reported their health status as fair or poor, performed on average a greater number of health behaviours at a negative level. It was intriguing though to discover that the magnitude of inter-correlations between behaviours actually decreased when comparing the poor/fair group with the remainder of the study respondents. This suggests that despite an increased number of behaviours performed at a negative level, there exists no particular pattern to their "self-destructiveness" or "self-neglect". An understanding of why the frequency of negative behaviours increase without any particular pattern to which behaviours are performed would lend insight into the relationship between behaviours and health status.

8. CONCLUSION

This thesis has explored the nature of inter-relationships between health behaviours in a population of Canadian military males. The first objective of this study was to determine if health behaviours were independent of each other. Spearman rank correlations were calculated and their magnitude were found to be modest in size. This is similar to what has been observed in previous studies. Most of the correlations were statistically significant, but this was primarily due to the large sample size.

The second objective was to determine whether variation would be observed in the correlations between health behaviours when different coding strategies for health behaviour variables were employed, as well as when the population was stratified by demographic variables. Variation in the magnitude of correlations were observed when health behaviour performance levels were re-ordered so that a monotonic relationship between performance levels and perceived health status was achieved. Nevertheless, the low correlations observed between health behaviours are not merely due to ordinal coding.

Greater amounts of variation in the magnitude of correlations between health behaviours were observed when correlations were re-calculated following stratification by demographic strata. This was reflected in variation in the structure of health behaviour clusters identified by factor analysis. The largest amount of variation was observed between military rank strata. It is possible that the

variation in health behaviour inter-relationships across strata is indicative of variation in common determinants of health behaviours. Inter-strata variation in health behaviour determinants would seem reasonable since individuals within different rank strata are exposed to different environmental influences which could lead to the development of different patterns of health behaviour determinants. This may explain the observed variation in correlations between the rank strata. If determinants of health behaviours differ for different population sub-groups, then this has implications for the need for tailoring of health promotion programs for different target groups. It also indicates that using crude population correlations for health behaviour pairings is misleading because it masks the variation in correlations likely existing at the level of population sub-groups. Further work on larger survey data bases might lead to a better understanding of health behaviour clustering in more homogeneous population sub-groups.

The third objective of this study was to determine the association of psychosocial measures with different health behaviour clusters. The psychosocial measures were not effective discriminators of individuals performing multiple behaviours at a positive level from those who were not. It is possible that the psychosocial measure's J-shaped distributions were the result of a social desirability bias and led to their poor performance as discriminators. Consideration should be given towards strategies to avoid or minimize the effect of this bias if further surveys of this population are to be conducted.

Additional analyses were performed exploring the relationship between

health behaviours and health status. While individuals reporting excellent health status performed on average twice as many health behaviours at a positive level compared to those reporting poor health, substantial variability in the relationship was observed. This is a reminder that there are many factors other than personal behaviours which influence health status.

9. REFERENCES

1. Belloc NB, Breslow L: Relationship of physical health status and health practices. *Prev Med* 1972; 1: 409-421.
2. Belloc NB: Relationship of health practices and mortality. *Prev Medic* 1973; 2: 67-81.
3. Wiley JA, Camacho TC: Life-style and future health: evidence from the Alameda County study. *Prev Medic* 1980; 9: 1-21.
4. Breslow L, Enstrom JE: Persistence of health habits and their relationship to mortality. *Prev Medic* 1980; 9: 469-483.
5. Health and Welfare Canada. Canada's health promotion survey. Ottawa: Supply and Services Canada, 1988.
6. Brock BM, Hefner DP, Noble DS: Alameda County Redux: replication in Michigan. *Prev Med* 1988; 17: 483-493.
7. Ballweg JA, Li Li MS: Comparison of health habits of military personnel with civilian populations. *Public Health Rep* 1989; 104: 498-509.
8. Bray RM, Marsden ME, Peterson MR: Standardized comparisons of alcohol, drugs, and cigarettes among military personnel and civilians. *Am J Public Health* 1991; 81: 865-869.
9. Marsden ME, Bray RM, Herbold JR. Substance use and health among U.S. military personnel: findings from the 1985 worldwide survey. *Prev Med* 1988; 17: 366-376.
10. Williams AF, Wechler H: Interrelationship of preventive actions in health and other areas. *Health Services Reports* 1972; 87: 969-976.
11. Langlie JK: Social networks, health beliefs, and preventive health behavior. *J Hlth and Social Behav* 1977; 18: 244-260.
12. Langlie JK: Interrelationships among preventive health behaviors: a test of competing hypotheses. *Public Health Reports* 1979; 94: 216-225.
13. Harris DM, Guten S: Health-protective behavior: an exploratory study. *J Health and Social Behav* 1979; 20: 17-29.
14. Tapp JT, Goldenthal P: A factor analytic study of health habits. *Prev Med* 1982; 11: 724-728.

15. Hays R, Stacy AW, DiMatteo MR: Covariation among health-related behaviors. *Addictive Behaviors* 1984; 9: 315-318.
16. Turk DC, Rudy TE, Salovey P: Health Protection: attitudes and behaviors of LPNs, teachers, and college students. *Health Psych* 1984; 3: 189-210.
17. Norman RMG: Studies of the interrelationships amongst health behaviours. *Can J Public Health* 1985; 76: 407-410.
18. Vickers RR, Conway TL, Hervig LK. Demonstration of replicable dimensions of health behaviors. *Prev Med* 1990; 19: 377-401.
19. Nutbeam D, Aaro L, Wold B: The lifestyle concept and health education with young people: results from a WHO international study. *Wld hlth statist quart* 1991; 44: 55-61.
20. Health and Welfare Canada. The nature and correlates of health behaviour. Ottawa: Health and Welfare, ? (date not provided).
21. Last J, editor. A dictionary of epidemiology. 2nd ed. Toronto: Oxford University Press, 1988.
22. Strohmenger C, Peron Y. Alcohol consumption in Canada - recent trends. *Chron Dis Canada* 1983; 4: 15-19.
23. U.S. Department of Health and Human Services: Alcohol and health. Rockville: PHS, 1990.
24. Kaiserman MJ, Collishaw NE. Trends in Canadian tobacco consumption, 1980-1990. *Chron Dis Canada* 1991; 19: 50-55.
25. Health and Welfare Canada. Canadians and smoking: an update. Ottawa: Supply and Services Canada, 1991.
26. Novotny TE et al: Trends in smoking by age and sex, United States, 1974-1987: the implications. *Prev Med* 1990; 19: 552-561.
27. Rakowski W: Predictors of health practices within age-sex groups: national survey of personal health practices and consequences, 1979. *Public Health Rep* 1988; 103: 376-386.
28. Pearlin LI, Lieberman MA, Menaghan EG, Mullan JT: The stress process. *J Health and Soc Behav* 1981; 22: 337-356.
29. Ganster DC, Victor B: The impact of social support on mental and physical health. *Br J Med Psych* 1988; 61: 17-36.

30. Rosenberg M. *Conceiving the self*. New York: Basic Books, 1979.
31. Pearlin LI, Schooler C: The structure of coping. *J Health and Soc Behav* 1978; 19: 2-21.
32. Mechanic D, Cleary PD: Factors associated with the maintenance of positive health behaviors. *Prev Med* 1980; 9: 805-814.
33. Finnegan DL, Suler JR: Psychological factors associated with maintenance of improved health behaviours in postcoronary patients. *J Psychol* 1985; 119: 87-94.
34. Muhlenkamp AF, Sayles JA: Self-esteem, social support, and positive health practices. *Nursing Research* 1986; 35: 334-338.
35. Berkman LF, Syme SL: Social networks, host resistance, and mortality: A nine-year follow-up study. *Am J Epidemiol* 1979; 109: 186-204.
36. Gottlieb NH, Green LW: Life events, social network, life-style, and health: an analysis of the 1979 national survey of personal health practices and consequences. *Health Educ Quart* 1984; 11: 91-105.
37. Riffle KL, Yoho J, Sams J: Health-promoting behaviours, perceived social support, and self-reported health of Appalachian elderly. *Public Health Nurs* 1989; 6: 204-211.
38. Zimmerman RS, Connor C: Health promotion in context: the effects of significant others on health. *Health Educ Quart* 1989; 16: 57-75.
39. Seeman M, Seeman T, Sayles M: Social networks and health status: a longitudinal analysis. *Social Psych Quart* 1985; 48: 237-248.
40. Yarcheski A, Mahon NE: A causal model of positive health practices: the relationship between approach and replication. *Nursing Research* 1989; 38: 88-93.
41. Duffy ME: Determinants of health promotion in midlife women. *Nursing Research* 1988; 37: 358-392.
42. Rew L: Correlates of health-promoting lifestyle and sexual satisfaction in a group of men. *Issues Mental Health Nurs* 1990; 11: 283-295.
43. Kaplan SL, Landa B, Weinhold, Shenker IR: Adverse health behaviors and depressive symptomatology in adolescents. *J Amer Acad Child Psych* 1984; 23: 595-601.
44. Parker DA, Parker ES, Harford TC, Farmer GC: Alcohol use and depression symptoms among employed men and women. *Am J Public Health* 1987; 77: 704-707.

45. Dryman A, Anthony JC, DePaulo JR: Relationship between psychiatric distress and alcohol use: finding from the Baltimore mental health survey. *Acta Psychiatr Scand* 1989; 80: 310-314.
46. Abood DA, Milton S. A path analytic model for investigating the relationship among stress, illness, social support, and health practices. *Health Educ* 1988; August/September: 22-26.
47. Cole G, Tucker L, Friedman CM: Relationships among measures of alcohol drinking behavior, life-events and perceived stress. *Psych Rep* 1990; 67: 587-591.
48. Gorman DM, Peters TJ: Types of life events and the onset of alcohol dependence. *Br J Addiction* 1990; 85: 71-79.
49. Neff JA, Husaini BA: Life events, drinking patterns and depressive symptomatology. *J Stud Alcohol* 1982; 43: 301-317.
50. Directorate of Preventive Medicine. 1989 Canadian Forces Health and Lifestyle Survey. DND/PDB-360-03327, 1989.
51. Tousignant M. La sante mentale dans l'enquete de la defense nationale. Montreal, 1990.
52. Bascovich J, Tomaka J. Measures of self-esteem. In: Robinson JP, Shaver PR, Wrightsman LS, editors. *Measures of personality and social psychological attitudes*. San Diego: Academic Press, 1990: 115-160.
53. Ferketich SL, Mercer RT: Men's health status during pregnancy and early fatherhood. *Res Nurs Health* 1989; 12: 137-148.
54. Reich JW, Zautra AJ: A perceived control intervention for at-risk older adults. *Psych and Aging* 1989; 4: 415-424.
55. Folkman S, Lazarus RS, Gruen RJ, DeLongis A: Appraisal, coping, health status, and psychological symptoms. *J Personal & Soc Psych* 1986; 50: 571-579.
56. Turner RJ, Frankel BG, Levin DM: Social support: conceptualization, measurement, and implications for mental health. *Research in Community Health* 1983; 3: 67-111.
57. Ilfeld FW: Further validation of a psychiatric symptom index in a normal population. *Psych Rep* 1976; 39: 1215-1228.
58. Martin F, Sabourin S, Gendreau P: Les dimensions de la detresse psychologique: analyse factorielle. *Int J Psych* 1989; 24: 571-584.

59. Valiquette M, Lecomte C, Sabourin S: L'intimité sexuelle en psychothérapie. *Revue québécoise de psychologie* 1990; 11: 52-75.
60. Turner RJ, Avison WR: Gender and depression: assessing exposure and vulnerability to life events. *J Nervous & Mental Dis* 1989; 177: 443-455.
61. Avison WR, Turner RJ: Stressful life events and depressive symptoms: disaggregating the effects of acute stressors and chronic strains. *J Health and Soc Behav* 1988; 29: 253-264.
62. BMDP Statistical Software Inc. Volumes 1 and 2. Los Angeles, 1990.
63. Dunteman GH. Principal components analysis. Sage university paper series on quantitative applications in the social sciences, series no. 07-069. Beverly Hills, 1989.
64. Statistics Canada. The nation: population and dwelling characteristics - age, sex, and marital status. Ottawa: Statistics Canada, 1989.
65. Statistics Canada. General Social Survey analysis series, health and social support, 1985. Ottawa: Statistics Canada, 1987.
66. Castro FG, Newcomb MD, McCreary C, Baezconde-Garbanati L: Cigarette smokers do more than just smoke cigarettes. *Health Psychol* 1989; 8: 107-129.
67. Wagenknecht LE et al. Misclassification of smoking status in the CARDIA study: a comparison of self-report with serum cotinine levels. *Am J Public Health* 1992; 82: 33-36.
68. Midanik L: The validity of self-reported alcohol consumption and alcohol problems: a. *Br J Addiction* 1982; 77: 357-382.
69. Department of National Defence. Canadian Forces Administrative Order 19-31.
70. Patrick DL, Bergner M: Measurement of health status in the 1990s. *Ann Rev Public Health* 1990; 11: 165-183.
71. Mossey JM, Shapiro E: Self-rated health: a predictor of mortality among the elderly. *Am J Public Health* 1982; 72: 800-808.
72. Weinberger M et al: Self-rated health as a predictor of hospital admission and nursing home placement in elderly public housing tenants. *Am J Public Health* 1986; 76: 457-459.
73. Kaplan G, Camacho T: Perceived health and mortality: a nine-year follow-up of the human population laboratory. *Am J Epidemiol* 1983; 117: 292-304.

74. Idler EL, Kasl SV, Lemke JH: Self-evaluated health and mortality among the elderly in New Haven. *Am J Epidemiol* 1990; 131: 91-103.
75. Singer E, Garfinkel R, Cohen SM, Srole L: Mortality and mental health: evidence from the midtown manhattan restudy. *Soc Sci Med* 1976; 10: 517-525.
76. Bergner M, Rothman ML: Health status measures: an overview and guide for selection. *Ann Rev Public Health* 1987; 8: 191-210.
77. Anastasi A. Self-report inventories for psychological testing. 6th ed. New York: MacMillan, 1988.
78. Price Waterhouse. National Defence 1989 Health and Lifestyle Survey final report on survey administration. Ottawa, 1989.
79. Segovia J, Bartlett RF, Edwards AC: The association between self-assessed health status and individual health practices. *Can J Public Health* 1989; 80: 32-37.
80. Reed WL: Physical health status as a consequence of health practices. *J Comm Health* 1983; 8: 217-228.
81. American Psychiatric Association. Diagnostic and statistical manual for mental disorders, third edition. Washington: APA, 1980.
82. Kim J, Mueller CW. Introduction to factor analysis: what it is and how to do it. Sage University Paper Series on Quantitative Applications in the social sciences, series no. 17-013, Beverly Hills, 1978.
83. Kim J, Mueller CW. Factor analysis: statistical methods and practical issues. Sage University Paper Series on Quantitative Applications in the social sciences, series no. 17-014, Beverly Hills, 1978.
84. Nunnally JC. Psychometric theory. Toronto: McGraw-Hill, 1967.
85. Strecher VJ, DeVellis BM, Becker MH, Rosenstock IM: The role of self-efficacy in achieving health behavior change. *Health Education Quarterly* 1986; 13: 73-91.
86. Rosenstock IM, Strecher VJ, Becker MH: Social learning theory and the health belief model. *Health Education Quarterly* 1988; 15: 175-183.
87. Fishbein M, Ajzen I. Belief, attitude, intention and behavior: an introduction to theory and research. Boston: Addison-Wesley, 1975.

88. Jackson C. A community based approach to preventing heart disease: the Stanford experience. In: Chamberlin RW, ed. *Beyond individual risk assessment: community wide approaches to promoting the health and development of families and children*. Washington: National Centre for Education in Maternal and Child Health, 1988.
89. Klecka WR. *Discriminant Analysis*. Sage University Paper Series on Quantitative Applications in the social sciences, series no. 17-019, Beverly Hills, 1980.
90. Streiner DL, Norman GR. *Health measurement scales: a practical guide to their development and use*. New York: Oxford University Publications, 1989.
91. Premier's Council on Health Strategy. *Nurturing health: a framework on the determinants of health*. Toronto: Council, 1991.
92. Rose G. Strategy of Prevention: lessons from cardiovascular disease. *Brit Med J* 1981; 282: 1847-1851.
93. Rose G. Sick individuals and sick populations. *Int J Epidemiol* 1985; 14: 32-38.
94. Jeffrey RW. Risk behaviors and health: contrasting individual and population perspectives. *Amer Psychol* 1989; 9: 1194-1202.
95. Kannas L: The dimensions of health behaviour among young men in Finland. *Int J Health Educ* 1981; 24: 146-155.
96. Stephens T: Health practices and health status: evidence from the Canada Health Survey. *Am J Prev Med* 1986; 2: 209-215.

Table 1 Demographic distribution of the Canadian Forces, survey target sample and respondents.

<u>Demographic Variables</u>	<u>Canadian Forces</u>	<u>Survey Target Sample</u>	<u>Survey Respondents</u>
SEX			
Male	77634 (90.3)	7546 (91.1)	5658 (89.0)
Female	8328 (9.7)	735 (8.9)	606 (11.0)
AGE			
<20	5852 (6.8)	45 (0.3)	28 (0.4)
20-25	21529 (25.0)	2386 (28.8)	1625 (25.6)
26-34	35771 (41.6)	3761 (45.4)	2854 (44.9)
35-44	16824 (19.6)	1410 (17.0)	1165 (18.3)
≥45	5986 (7.0)	679 (8.2)	588 (9.2)
RANK			
Senior Offic	11794 (13.6)	929 (11.2)	762 (12.3)
Junior Offic	6080 (7.0)	208 (2.5)	130 (2.1)
Senior NCM	18309 (21.1)	1719 (20.8)	1387 (22.4)
MCpl, Cpl	33858 (38.9)	3843 (46.4)	2970 (47.8)
Ptc	16921 (19.5)	1582 (19.1)	963 (15.5)
<u>Comparison</u>	<u>Sex</u>	<u>Age</u>	<u>Rank</u>
Survey Sample vs Respondents	$\chi^2=2.72$ (1df) p=0.09	$\chi^2=22.1$ (4df) p=0.0002	$\chi^2=37.8$ (4df) p<0.0000

Table 2 Age distribution of survey respondents, the Canadian Health Promotion Survey and the 1986 Canadian population.

<u>Age</u>	<u>20-25</u>	<u>26-34</u>	<u>35-44</u>	<u>≥45</u>
<u>Count</u>	1424	2493	1127	587
<u>% (Resp)</u>	25.2	44.1	19.9	10.4
<u>% (Canada)</u>	21.1	31.1	28.1	19.7
<u>% (HPS)</u>	18.6	34.4	27.4	19.5

Table 3 Education level achieved by survey respondents and Canadian males aged 20-54, (1986 Census).

<u>Education</u>	<u>< HS</u>	<u>High School</u>	<u>College</u>	<u>University</u>
<u>Count</u>	1734	2728	558	540
<u>% (Resp)</u>	31.2	49.1	10.0	9.7
<u>% (Canada)</u>	25.9	32.2	20.1	21.8

(HS=High School)

Table 4 Distribution of survey respondents by military rank.

<u>Rank</u>	<u>Jnr NCM</u>	<u>Snr NCM</u>	<u>Jnr Off</u>	<u>Snr Off</u>
<u>Count</u>	3444	1334	553	268
<u>% (Resp)</u>	61.5	23.8	9.9	4.8

Table 5 Distribution of survey respondents and Canadian population* by marital status.

<u>Marital Status</u>	<u>Married/ComLaw</u>	<u>Div/Sep/Wid</u>	<u>Never Married</u>
<u>Count</u>	4159	604	826
<u>% (Resp)</u>	74.4	10.8	14.8
<u>% (Canada)</u>	68.1	3.5	28.5

Table 6 Distribution of CFHLS and Canadian Health Promotion Survey by perceived health status.

<u>Perceived Health Status</u>	<u>Excellent</u>	<u>Very Good</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>
<u>Count</u>	721	2110	2372	474	36
<u>% (Resp)</u>	12.6	36.9	41.5	8.3	0.6
<u>% (HPS)</u>	26.5	37.7	26.4	7.8	1.6

Table 7 Distribution of CFHLS and Canadian Health Promotion Survey by self-reported alcohol consumption.

<u>DRINK</u>	<u>Never</u>	<u>Ex-Drinker</u>	<u>≤2 per day</u>	<u>> 2 per day</u>
<u>Count</u>	639	204	3347	811
<u>% (Resp)</u>	12.8	4.1	66.9	16.2
<u>% (HPS)</u>	3.3	7.1	74.4	15.2

Table 8 Cigarette use in the CFHLS and the 1985 General Social Survey.

<u>Smoking</u>	<u>Never Smoked</u>	<u>Ex-smoker</u>	<u>≤1 pk/day</u>	<u>≥2 pk/day</u>
<u>Count</u>	1630	1762	2096	171
<u>% (Resp)</u>	35.1	25.9	26.8	12.2
<u>% (Canada)</u>	32.9	25.1	34.9	7.1

Table 9 Distribution of survey respondents by frequency of eating breakfast.

<u>Eating Breakfast</u>	<u>Daily</u>	<u>Sometimes</u>	<u>Rarely/Never</u>	<u>Weekends Only</u>
<u>Count</u>	2006	1481	1532	698
<u>% (Resp)</u>	35.1	25.9	26.8	12.2

Table 10 Distribution of survey respondents by frequency of self-reported eating between meals.

<u>Eating Between Meals</u>	<u>Daily</u>	<u>Sometimes</u>	<u>Rarely/Never</u>	<u>Weekends Only</u>
<u>Count</u>	1202	2963	1435	113
<u>% (Resp)</u>	21.0	51.9	25.1	2.0

Table 11 Distribution of survey respondents by frequency of physical activity to the point of sweating.

<u>Physical Activity</u>	<u>≥3/wk</u>	<u>1-2/wk</u>	<u><1/wk</u>
<u>Count</u>	1952	1571	2151
<u>% (Resp)</u>	34.4	27.7	37.9

Table 12 Distribution of survey respondents by frequency of tooth brushing.

<u>Brushing</u>	<u>>2/day</u>	<u>2/day</u>	<u>1/day</u>	<u><1/day</u>
<u>Count</u>	1004	2417	2075	213
<u>% (Resp)</u>	17.6	42.3	36.3	3.7

Table 13 Distribution of survey respondents by frequency of flossing teeth.

<u>Flossing</u>	<u>Daily</u>	<u>3-6/wk</u>	<u>1-2/wk</u>	<u><1/wk</u>	<u>Never</u>
<u>Count</u>	694	760	1122	1797	1331
<u>% (Resp)</u>	12.2	13.3	19.7	31.5	23.3

Table 14 Distribution of survey respondents by the number of hours slept per day.

<u>Sleep</u>	<u>≤6 hrs/night</u>	<u>7-8 hrs/night</u>	<u>≥9 hrs/night</u>
<u>Count</u>	1492	3924	273
<u>% (Resp)</u>	26.2	69.0	4.8

Table 15 Distribution of survey respondents by the frequency of testicular self-examination.

<u>Testicular Self-Exam</u>	<u>≥1/month</u>	<u>every 2-3 months</u>	<u>less often</u>	<u>Never</u>
<u>Count</u>	829	381	734	3669
<u>% (Resp)</u>	14.8	6.8	13.1	65.4

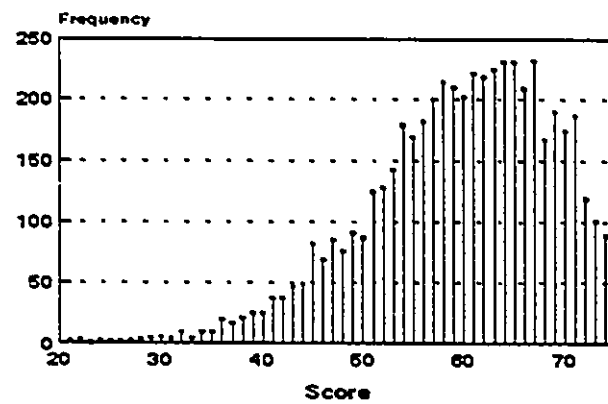


Figure 1 Distribution of social support scores.

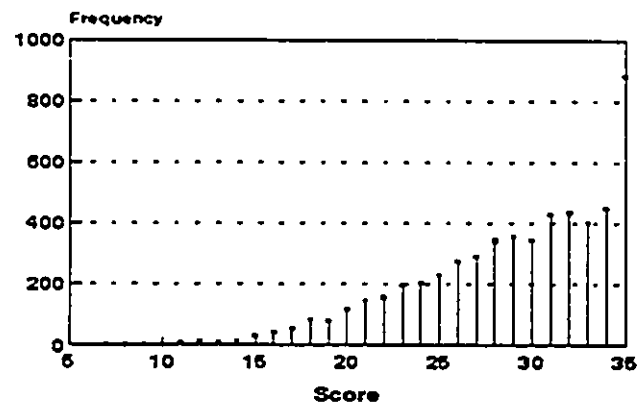


Figure 2 Distribution of personal mastery scores.

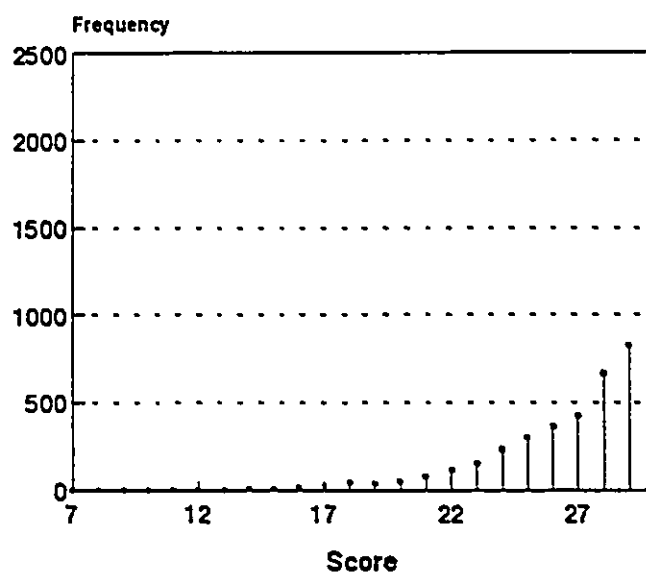


Figure 3 Distribution of self-esteem scores.

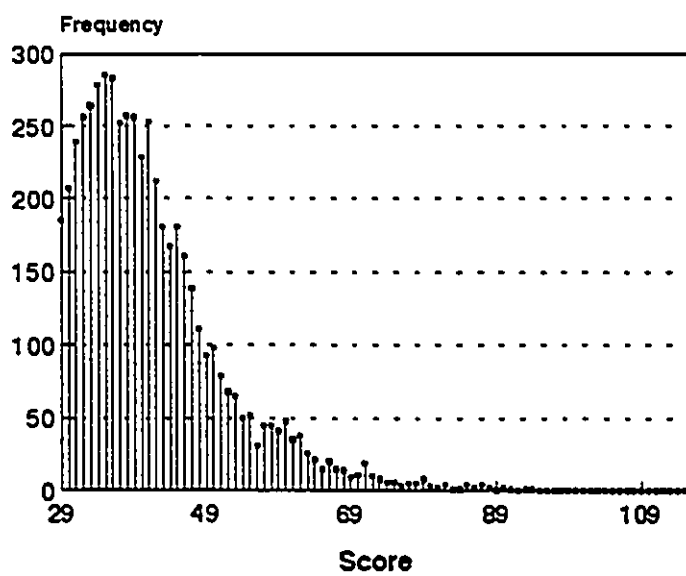


Figure 4 Distribution of psychological symptom index scores.

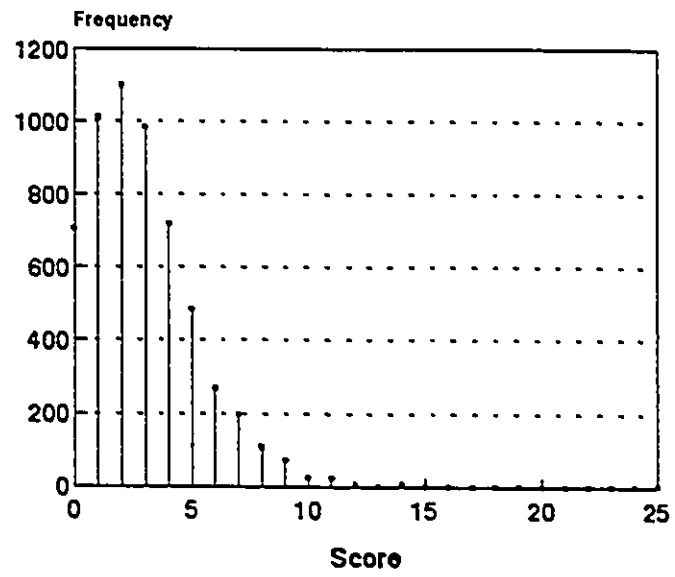


Figure 5 Distribution of life events scores.

Table 16 Logistic regression derived ORs for poor health by level of health behaviours controlling for demographic variables.

<u>Behaviour</u>	<u>OR Poor Health</u>	<u>Behaviour</u>	<u>OR Poor Health</u>
DRINK		BRUSHT	
Never	1.00 G	>2/day	1.00 G
Ex-Drker	1.76 P	2/day	1.22 P
Moderate	1.10 G	1/day	1.83 P
Heavy	1.61 P	<1/day	2.64 P
SMOKE		FLOSS	
Never	1.00 G	Daily	1.17 G
Ex-Smker	1.22 P	3-6/wk	1.00 G
Moderate	1.96 P	1-2/wk	1.22 P
Heavy	4.20 P	<1/wk	1.78 P
EXRATE		SLEEP	
High	1.00 G	≤6 hrs	1.83 P
Moderate	2.01 P	7 or 8	1.10 G
Low	3.95 P	≥9 hrs	1.00 G
EATBRF		TESTSLF	
Daily	1.00 G	1/month	1.00 G
Sometime	1.63 P	1/2-3mon	2.01 P
Rarely	1.96 P	Sometime	1.94 P
Weekends	2.22 P	Never	1.88 P
EATBTML			
Daily	1.35 P		
Sometime	1.30 P		
Rarely	1.00 G		
Weekends	1.11 G		

For future dichotomization of behaviours, the level of each behaviour has been coded as Good (G) or Poor (P).

Table 17 Percentage change in rank correlations of health behaviours after re-ordering health behaviour categories to reflect a monotonic relationship with perceived health status.

<u>Crude</u>	Smoke	Drink	Exrate	Eatbrf	Floss	Brushf	Testslf	Sleep
Drink	<u>20.1</u>	----	7.7	<u>-11.7</u>	-35.5	-6.3	396.2	<u>-0.4</u>
Eatbtml	-53.9	10.8	-2.4	-1.1	24.5	-5.1	11.3	-21.8
Floss	-15.7	-35.5	<u>-1.1</u>	<u>-6.1</u>	----	<u>-0.8</u>	5.9	-16.3
Testslf	0.0	396.2	0.0	0.0	5.9	0.0	----	-37.8
<u>20-25</u>								
Drink	<u>0.3</u>	----	6.3	<u>0.9</u>	30.0	4.2	2.6	<u>4.1</u>
Eatbtml	96.4	44.8	11.3	0.9	17.7	4.8	-3.3	-1.1
Floss	34.8	30.0	<u>1.8</u>	<u>2.7</u>	----	<u>0.7</u>	<u>2.2</u>	8.8
Testslf	0.0	2.6	0.0	0.0	<u>2.2</u>	0.0	----	57.6
<u>26-34</u>								
Drink	<u>21.7</u>	----	15.9	<u>-5.7</u>	-20.3	-40.0	-12.7	21.8
Eatbtml	-51.8	3000.0	1.6	-9.4	3.4	-20.0	-10.3	-30.2
Floss	-21.4	-20.3	<u>-3.5</u>	<u>-6.4</u>	----	<u>-2.4</u>	11.3	7.2
Testslf	0.0	-12.7	0.0	0.0	11.3	0.0	----	0.0
<u>35-44</u>								
Drink	50.3	----	3912.5	<u>-11.1</u>	-50.4	-7.9	288.8	40.6
Eatbtml	127.6	229.3	12.3	10.2	41.2	-6.7	-25.4	14.2
Floss	-8.9	-50.4	<u>-6.5</u>	-17.2	----	<u>1.6</u>	<u>18.1</u>	-13.6
Testslf	0.0	288.8	0.0	0.0	<u>18.1</u>	<u>0.0</u>	----	0.0
<u>≥45</u>								
Drink	73.8	----	131.9	<u>-48.1</u>	<u>-37.2</u>	<u>-25.3</u>	50.6	-84.5
Eatbtml	67.6	-77.6	-9.1	-3.0	<u>-17.1</u>	<u>5.2</u>	-87.2	24.2
Floss	<u>-9.5</u>	<u>-37.2</u>	<u>2.8</u>	<u>2.4</u>	----	<u>-5.1</u>	-34.1	40.1
Testslf	0.0	50.6	0.0	0.0	40.1	0.0	----	0.0

Table 18 Factor analysis solution of crude and age stratified populations of rank correlated, performance level-coded health behaviours.

Crude Population:

<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>
Brush 0.69	Smoke 0.67	Eatbtml 0.86
Floss 0.69	Eatbr 0.59	
-Exrate -0.48	Drink 0.55	
	-Sleep -0.59	

Age: 20-25

<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>
Brush 0.76	Smoke 0.66	Eatbtml 0.78
Floss 0.73	Eatbr 0.65	Testslf 0.55
-Exrate -0.52	Drink 0.51	Eatbr 0.43
	-Sleep -0.61	

Age: 26-34

<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>
Smoke 0.70	Brush 0.71	Eatbtml 0.93
Eatbr 0.60	Floss 0.68	
Drink 0.52	-Exrate -0.45	
-Sleep -0.59		

Age: 35-44

<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>	<u>Factor 4</u>
Smoke 0.71	Floss 0.71	Eatbtml 0.89	Drink 0.85
Eatbr 0.64	Brush 0.68		Exrate 0.47
-Exrate -0.54	Testslf 0.57		
-Sleep -0.48			

Age: ≥45

<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>	<u>Factor 4</u>
Floss 0.63	Smoke 0.74	Drink 0.74	Sleep 0.76
Brush 0.72	Eatbr 0.63	Exrate 0.52	Testslf 0.65
-Eatbtml -0.62	-Exrate -0.53	Eatbtml 0.47	

Table 19 Factor analysis solution of rank correlated, odds ratio re-ordered health behaviours of crude and age-stratified populations.

<u>Crude Population:</u>			
<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>	
Brush 0.70	Smoke 0.69	Eatbtm 0.88	
Floss 0.69	Eatbr 0.56	-Testslf -0.41	
Exrate 0.47	Drink 0.58		
	Sleep 0.57		
<u>Age: 20-25</u>			
<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>	
Brush 0.76	Smoke 0.66	Eatbtm 0.77	
Floss 0.74	Eatbr 0.66	-Testslf -0.55	
Exrate 0.51	Drink 0.66	-Eatbr -0.42	
	Sleep 0.62		
<u>Age: 26-34</u>			
<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>	
Smoke 0.72	Brush 0.70	Eatbtm 0.88	
Eatbr 0.58	Floss 0.67	Exrate 0.41	
Drink 0.56	Exrate 0.41		
Sleep 0.57			
<u>Age: 35-44</u>			
<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>	<u>Factor 4</u>
Smoke 0.72	Floss 0.74	Drink 0.81	Eatbtm 0.89
Eatbr 0.68	Brush 0.67	Exrate -0.50	Sleep 0.43
Exrate 0.49	Testslf 0.58		
Sleep 0.44			
<u>Age: ≥45</u>			
<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>	
Smoke 0.76	Brush 0.64	Testslf 0.53	
Eatbr 0.60	Floss 0.58	-Sleep -0.64	
Drink 0.40	Eatbtm 0.64	Drink 0.50	

Table 20 Factor analysis solutions for risk-scored behaviours; crude, age and education stratified populations.

<u>CRUDE POPULATION</u>				
	<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>	
	Smoke 0.67 Drink 0.55 Sleep 0.60 Eatbrf 0.57	Brushf 0.70 Floss 0.70 Exrate 0.49	Eatbtm1 0.83 -Testslf -0.54	
<u>AGE</u>				
<u>Factors</u>	<u>20-25</u>	<u>26-34</u>	<u>35-44</u>	<u>≥ 45</u>
F1	Drink 0.65 Sleep 0.65 Smoke 0.63 Eatbrf 0.54	Smoke 0.69 Sleep 0.63 Eatbrf 0.58 Drink 0.54	Smoke 0.70 Eatbrf 0.69 Exrate 0.51 Sleep 0.45	Brushf 0.79 Floss 0.69 Eatbtm1 0.41
F2	Brushf 0.76 Floss 0.75 Exrate 0.52	Brushf 0.71 Floss 0.69 Exrate 0.49	Floss 0.74 Brushf 0.68 Testslf 0.55	Drink 0.69 Smoke 0.58 -Eatbtm1 -0.54
F3	Eatbtm1 0.77 -Testslf -0.60	Eatbtm1 0.88 -Testslf -0.33	Drink 0.84 -Exrate -0.41	Sleep 0.77 Smoke 0.42
F4			Eatbtm1 0.89 Exrate 0.43	Testslf 0.82 Exrate 0.60
<u>EDUCATION</u>				
<u>Factors</u>	<u><Gr12</u>	<u>High School</u>	<u>College</u>	<u>University</u>
F1	Smoke 0.68 Eatbr 0.62 Sleep 0.60 Drink 0.55	Brushf 0.76 Floss 0.69 Exrate 0.47	Drink 0.65 Smoke 0.64 Eatbrf 0.53 Sleep 0.63	Smoke 0.67 Sleep 0.66 Eatbrf 0.58
F2	Floss 0.74 Brush 0.69 Exrate 0.49	Smoke 0.67 Sleep 0.59 Eatbrf 0.55 Drink 0.49	Floss 0.70 Brushf 0.66 Testslf 0.46	Brushf 0.56 Testslf 0.71 Floss 0.48
F3	Testslf 0.74 -Eatbtm1 -0.65	Eatbtm1 0.83 -Testslf -0.49	Eatbtm1 0.87 Exrate 0.43	Eatbtm1 0.76 Exrate 0.57 Floss 0.48

Table 21 Factor analysis solution of risk-scored behaviours stratified by marital status and military rank.

<u>MARITAL STATUS</u>				
<u>Factors</u>	<u>Mar'd/Com Law</u>	<u>Div/Sep</u>	<u>Never Married</u>	
F1	Smoke 0.68 Sleep 0.57 Eatbr 0.57 Drink 0.52	Sleep 0.70 Eatbr 0.66 Smoke 0.64 Drink 0.45	Drink 0.65 Smoke 0.64 Sleep 0.64 Eatbr 0.54	
F2	Brush 0.71 Floss 0.71	Brush 0.78 Floss 0.76 Drink 0.42	Brush 0.74 Floss 0.69 Exrate 0.57	
F3	Eatbtml 0.94	Testslf 0.76 Exrate 0.64	Eatbtml 0.72 -Testslf -0.64	
F4		Eatbtml 0.91		
<u>RANK</u>				
<u>Factors</u>	<u>Snr Offic</u>	<u>Jnr Offic</u>	<u>Snr NCM</u>	<u>Jnr NCM</u>
F1	Floss 0.68 Brush 0.63 Testslf 0.54 Drink 0.51 Eatbrf 0.46	Floss 0.64 Brush 0.60 Exrate 0.54 Eatbrf 0.53 Smoke 0.50	Eatbr 0.65 Smoke 0.63 Sleep 0.60 Exrate 0.42	Smoke 0.66 Sleep 0.63 Drink 0.58 Eatbr 0.57
F2	Smoke 0.75 Sleep 0.61 Exrate 0.51 Eatbrf 0.49	Sleep 0.66 -Testslf -0.62 Drink 0.43	Floss 0.74 Brush 0.72 Testslf 0.42	Brush 0.73 Floss 0.69 Exrate 0.52
F3	Eatbtml 0.86 -Testslf -0.43	Eatbtml 0.87 -Eatbr -0.41	Drink 0.73 -Eatbtml -0.59	Eatbtml 0.82 -Testslf -0.54

Table 22 Pearson correlations between selected risk-scored health behaviours for crude and rank-stratified populations.

<u>Behaviour Pairing</u>	<u>Crude</u>	<u>Snr Off</u>	<u>Jnr Off</u>	<u>Snr NCM</u>	<u>Jnr NCM</u>
Smoke-Drink	0.180	0.138	0.118	0.149	0.195
Brush-Drink	0.024	0.182	0.089	0.024	0.015
Floss-Drink	0.055	0.103	0.126	0.034	0.055
Eatbrf-Drink	0.096	0.124	0.078	0.051	0.117
Sleep-Drink	0.112	0.003	0.100	0.057	0.147
Brush-Smoke	0.086	0.240	0.137	0.045	0.077
Floss-Smoke	0.061	0.072	0.148	0.061	0.026
Eatbrf-Smoke	0.228	0.353	0.199	0.219	0.198
Exrate-Smoke	0.125	0.217	0.221	0.156	0.102
Sleep-Smoke	0.165	0.219	0.131	0.115	0.178
Floss-Brush	0.270	0.290	0.227	0.285	0.282
Eatbrf-Brush	0.143	0.258	0.157	0.129	0.129
Exrate-Brush	0.136	0.067	0.136	0.087	0.153
Sleep-Brush	0.040	0.134	0.032	0.011	0.034
Testslf-Brush	0.035	0.120	0.053	0.050	0.026
Eatbrf-Floss	0.124	0.235	0.193	0.121	0.087
Exrate-Floss	0.114	0.102	0.202	0.090	0.101
Testslf-Floss	0.069	0.147	0.018	0.084	0.071
Exrate-Eatbrf	0.098	0.100	0.114	0.107	0.087
Sleep-Eatbrf	0.170	0.161	0.078	0.187	0.177
Testslf-Eatbrf	-0.006	-0.114	0.007	0.021	-0.024
Exrate-Sleep	0.026	0.120	0.070	0.055	0.003
Number of pairings with correlation greater than 0.2	2	7	3	2	1

Table 23 Sensitivity, specificity and total correct classification following discriminant analysis of dichotomized health behaviours by psychosocial measures.

<u>Behaviour</u>	<u>Sensitivity</u>	<u>Specificity</u>	<u>Total % Correct</u>
Drink	62.3	49.5	59.7
Smoke	65.2	41.6	48.6
Exrate	63.2	46.2	52.7
Eatbrf	61.1	47.6	52.4
Eatbtml	61.0	47.0	50.8
Brusht	61.2	50.5	52.3
Floss	59.5	48.4	51.2
Sleep	63.7	46.6	59.5
Testslf	59.7	52.3	53.4

Table 24 Results of discriminant analysis of selected health behaviour clusters by psychosocial measures by age strata.

<u>AGE</u>	<u>Behaviour</u>	<u>Sensitivity</u>	<u>Specificity</u>	<u>Total % Correct</u>
20-25	Smoke Eatbrf Sleep Drink	68.7	51.6	61.4
	Floss Brush Exrate	61.7	54.6	55.9
26-34	Smoke Eatbrf Sleep Drink	64.7	47.9	59.2
	Floss Brush Exrate	64.5	51.3	53.4
35-44	Smoke Eatbrf Sleep Exrate	63.7	43.9	50.6
	Floss Brush Testslf	59.2	45.7	47.3
≥45	Brush Floss Eatbtml	64.4	54.9	57.4

Table 25 Mean number of positive health behaviours by perceived health status category.

<u>Perceived Health Category</u>	<u>Mean Number of Positive Behaviours Performed</u>
Excellent	4.3
Very Good	3.7
Good	3.1
Fair	2.6
Poor	2.1

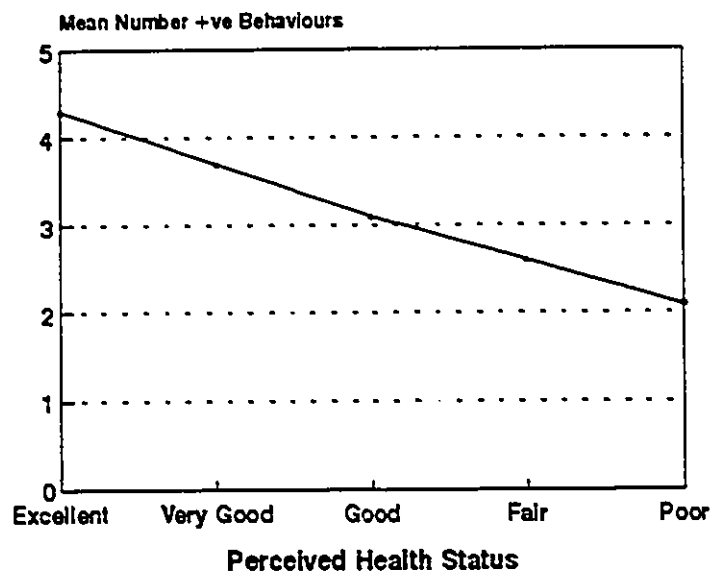


Figure 6 Mean number of positive health behaviours by perceived health status.

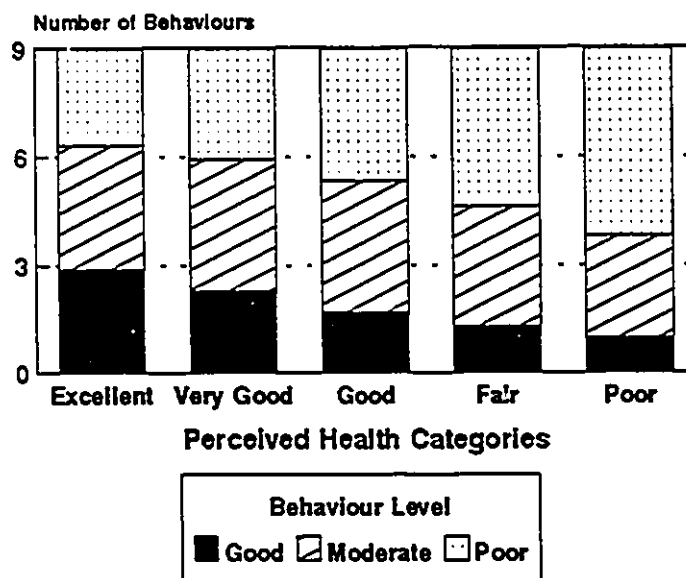


Figure 7 The mean number of behaviours performed at good, moderate and poor levels by category of perceived health.

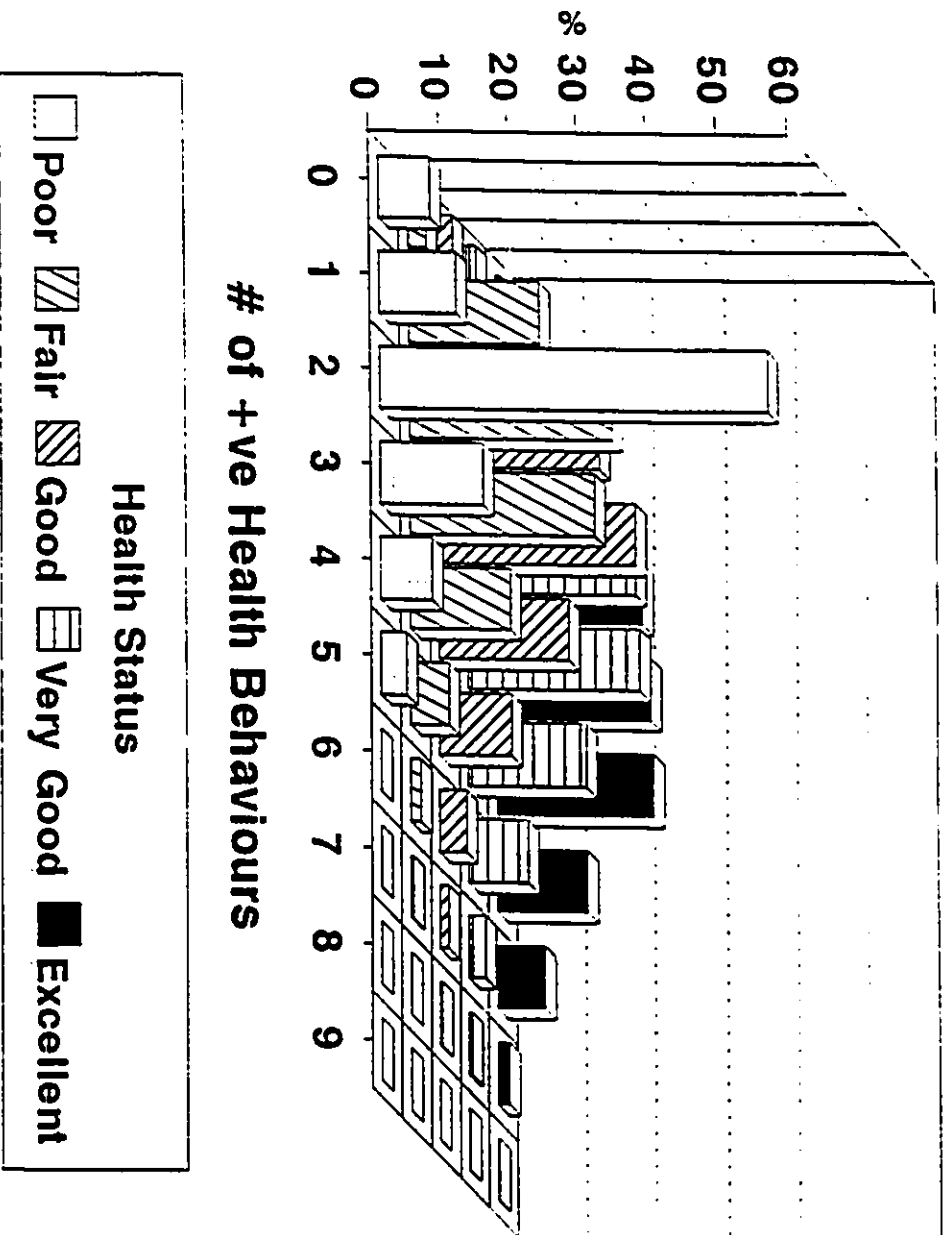


Figure 8 Distribution of the number of positive health behaviours by perceived health status category.

Table 26 Mean values of psychosocial measures by perceived health status categories.

<u>Variable</u>	<u>Perceived Health</u>				
	<u>Excel</u>	<u>VGood</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>
Mastery	30.26	29.71	28.39	27.16	24.96
SocSup	62.12	60.94	58.74	55.85	52.29
Selfest	28.81	28.32	27.40	25.95	24.58
Psychsym	37.98	40.17	42.07	48.25	57.92
Lifevents	2.63	2.94	3.06	3.28	5.04

ANOVAs were statistically significant for all 5 variables, ($p < 0.0000$).

Table 27 Mean values of PSYCHSYM by SLEEP categories.

<u>SLEEP</u>	<u>≥9 hrs/night</u>	<u>7-8 hrs/night</u>	<u>≤6 hrs/night</u>
<u>PSYCHSYM</u>	41.4	40.7	43.3

Mean values were statistically different, $p < 0.0000$.

APPENDICES

APPENDIX A - Survey development

The CFHLS was developed to give information on the health behaviours, attitudes and health status of military personnel. The survey was developed within the Directorate of Preventive Medicine (DPM) and borrowed heavily from the Canada Health Promotion Survey, Canada Health Survey, Canada Fitness Survey, Santé Québec Survey, the U.S. Department of Defense Worldwide Survey, as well as the 1982 CF Alcohol and Drug Survey.

A number of psychosocial measures were also included. All were existing measurement scales previously developed and published in the psychological and population survey literature. A bilingual psychologist's assistance was secured to assure appropriate translation of the psychological scales.

The instrument was pre-tested in a bilingual format to 187 volunteers. A much greater number of scales (12) were included in the pre-test than were expected to be used in the final version. Scales selected for final inclusion in the survey were chosen based on their reliability, their relative independence from other scales, and their variability so that differentiation between respondents

Table 1 Pre-test Cronbach alpha reliability coefficients for entire sample, English and French versions.

<u>Scale</u>	<u>Entire Sample</u>	<u>English</u>	<u>French</u>
Self-Esteem	.8018	.7941	.7878
Mastery	.7878	.7812	.7941
Social Support	.8309	.7781	.8856
Psychological Symptoms	.9163	.9153	.9163

would be possible. No substantial difference in reliability was detected between the English and French versions of the scales, (table 1).

A consulting firm formatted the final version of the survey and published it in a bilingual, bound, professional-looking document which was 47 pages long and comprised over 350 items.

SAMPLING FRAME

While it was desirable for the survey to be representative of active Canadian Forces personnel who were members of the regular force, for logistic reasons, individuals meeting any of the following criteria were excluded:

- A. Those in locations with less than 100 personnel.
- B. Those in locations outside Canada and the two German bases during the time of the survey.
- C. Those on leave, temporary attachments, or training during the time of the survey.

These exclusions reduced the target population from an effective strength of 85,962 to 69,970. The remaining individuals were blocked by the last digit of their social insurance number. Systematic sampling was then carried out at a 1:8 ratio to generate 8,743 individuals. Demographic profiles were reviewed and those which might compromise anonymity were eliminated. This group constituted 461 individuals. Thus the final sample size was 8,281.

Table 2 shows the demographic distribution of regular force members in 1989, the eligible population and the sample selected. While the regular force and the eligible population distributions are reasonably similar, there are notable under-representations in the youngest age group, as well as the junior officers. This was reflected in the sampling and is likely due to exclusion "C" which removed young personnel on training courses including university training plans. Comparison of the eligible population with the survey sample shows very similar proportions. Chi-squared statistics were calculated comparing the regular force versus the eligible population, as well as the eligible versus the survey sample for sex, age, and rank. These are also shown in table 2. It would seem that the Chi-squared statistics are exceedingly sensitive in detecting differences between these populations as the differences in proportions between the sampling frame and the survey sample do not appear very important.

INTERVIEW PROCESS

DPM provided names of members selected as well as their home units and bases to the consulting firm. The questionnaires were completed primarily^{*} at sit-down sessions organized by a military liaison officer and the consulting firm's monitors. Detailed instructions were provided to the monitors prior to the sessions. Monitors were responsible for ensuring that only members who had been selected participated^{**} and that the questionnaires were appropriately delivered

^{*} There were also re-scheduled sessions as well as a mail-out of the questionnaire to unavailable members. Please see "Response Rate" section for more details.

^{**} Some units unable to provide the selected member attempted to substitute a "similar" replacement.

Table 2 Distribution and proportion of 1989 regular force members, sampling population, and survey target population. Comparisons by demographic variables using Chi-squared statistics are included.

<u>Demographic Variables</u>	<u>Canadian Forces</u>	<u>Eligible Population</u>	<u>Sample Selected</u>
SEX			
Male	77634 (90.3)	63327 (91.0)	7546 (91.1)
Female	8328 (9.7)	6643 (9.0)	735 (8.9)
AGE			
<20	5852 (6.8)	406 (0.6)	45 (0.3)
20-25	21529 (25.0)	17013 (24.3)	2386 (28.8)
26-34	35771 (41.6)	29688 (42.4)	3761 (45.4)
35-44	16824 (19.6)	16007 (22.9)	1410 (17.0)
≥45	5986 (7.0)	6856 (9.8)	679 (8.2)
RANK			
Senior Offic	11794 (13.6)	9951 (14.2)	929 (11.2)
Junior Offic	6080 (7.0)	1739 (2.5)	208 (2.5)
Senior NCM	18309 (21.1)	17258 (24.7)	1719 (20.8)
MCpl, Cpl	33858 (38.9)	29712 (42.5)	3843 (46.4)
Pte	16921 (19.5)	11310 (16.2)	1582 (19.1)
<u>Comparison</u>	<u>Sex</u>	<u>Age</u>	<u>Rank</u>
Regular Force vs Sampling Population	$\chi^2=1.67$ (1df) p=0.19	$\chi^2=4313.4$ (4df) p<0.0000	$\chi^2=2168.5$ (4df) p<0.0000
Sampling Population vs Survey Target	$\chi^2=3.32$ (1df) p=0.07	$\chi^2=209.6$ (4df) p<0.0000	$\chi^2=160.4$ (4df) p<0.0000

back to the study centre.

Early difficulties in interpreting some of the questions were rectified and the appropriate responses were distributed to all monitors prior to further sessions.

APPENDIX B - Survey Questions

STUDY VARIABLES

DEMOGRAPHIC VARIABLES

SEX

What is your sex?

Male	1
Female	2

AGE

To what age group do you belong?

Younger than 20	1
20-25	2
26-34	3
35-44	4
45 years or older	5

RANK

What is your military rank?

LCol or above	1
Maj	2
Capt	3
Lt,2Lt,or OCdt	4
CWO,MWO,WO	5
Sgt	6
Mcpl, Cpl	7
PteT,PteB,PteR	8

MARITAL STATUS

Are you currently:

Married and living with your spouse	1
Living with someone as a couple but not married	2
Separated (legally or not) and not living with someone as a couple	3
Divorced and not living with someone as a couple	4
Widow (widower) and not living with someone as a couple	5
Never been married, but having lived with someone as a couple in the past	6
Never having been married and never having lived with someone as a couple	7

EDUCATION

What is the highest level of education you have successfully completed?

Grade 9	1
Grade 10	2
Grade 11	3
Grade 12	4
Grade 13	5
Community College, Technical Institute or CEGEP	6
University Degree	7
Post-graduate Degree	8

HEALTH STATUS

In general, compared to other persons your age, would you say your health is...

Excellent	1
Very Good	2
Good	3
Fair	4
Poor	5

HEALTH BEHAVIOURS**EATBRF**

How often do you eat breakfast?

Everyday	1
Sometimes	2
Rarely or never	3
On weekends only	4

EATBTML

How often do you eat between meals?

Everyday	1
Sometimes	2
Rarely or never	3
On weekends only	4

SLEEP

About how many hours do you usually sleep every day?

_____ number of hours

BRUSHT

How often do you brush your teeth?

More than twice a day	1
Twice a day	2
Once a day	3
Less than once a day	4

FLOSS

How often, if ever, do you use either dental floss or a waterpick?

Every day	1
3-6 times a week	2
1-2 times a week	3
Less than once a week	4
Never	5

TESTSLF

How often do you examine your own testicles?

At least once a month	1
Once every 2-3 months	2
Less often	3
Never	4

EXRATE

(this derived variable was provided with the data set)

High	vigorous exercise 3 or more times weekly
Moderate	vigorous exercise 1 or 2 times weekly
Low	vigorous exercise less than weekly

<u>Coding</u>	High	2
	Moderate	1
	Low	0

Original survey question:

How often in the past four months, during your leisure time, did you participate in sports or vigorous activity to the point of sweating?

Not at all	1
Less than once a month	2
About once a month	3
About two or three times a month	4
About once or twice a week	5
Three or more times a week	6

SMOKE

(this derived variable was created combining two questions together)

Question 1: labelled "Evrs smoke"

Have you ever smoked cigarettes?

Yes, and I still smoke	1
Yes, but I no longer smoke	2
No, never	3

Question 2: labelled "Smokfreq"

On average, how much have you smoked during the past 30 days? (1 pack = 20 cigarettes)

None at all	1
Less than 1 cigarette per day	2
1 to 5 cigarettes per day	3
About 1/2 pack per day	4
About 1 pack per day	5
About 2 packs per day	6
More than 2 packs per day	7

Scoring:

If evrsmoke eq 3 then SMOKE eq 1
 If evrsmoke eq 2 then SMOKE eq 2
 If evrsmoke eq 1 and smokfreq le 5 then SMOKE eq 3
 If evrsmoke eq 1 and smokfreq ge 6 then SMOKE eq 4

DRINK

(this variable was derived from the responses to three questions)

Question 1: labelled "firstdrk"

How old were you when you first drank beer, wine or liquor regularly?

Age 13 or below	1	
Age 14 to 17	2	
Age 18 to 19	3	
Age 20 or over	4	
Never drank regularly	5 ----->	skip next questions

Question 2: labelled "lastdrk"

How long has it been since your most recent drink of beer, wine or liquor?

Today	1	
1 to 7 days	2	
8 to 14	3	
15 to 30 days	4	
1 to 3 months	5	
4 to 12 months	6	
More than 1 year	7----	skip next
Never drank	8---	questions

Question 3: labelled "drkfreq"

Starting with yesterday, how many drinks of alcoholic beverages have you taken in the past seven days? Please circle the appropriate number for each day listed below. Please note that 14+ refers to 14 or more drinks.

a Yesterday	0 1 2 3 4 5 6 7 8 9 10 12 13 14+
b 2 days ago	0 1 2 3 4 5 6 7 8 9 10 12 13 14+
c 3 days ago	0 1 2 3 4 5 6 7 8 9 10 12 13 14+
d 4 days ago	0 1 2 3 4 5 6 7 8 9 10 12 13 14+
e 5 days ago	0 1 2 3 4 5 6 7 8 9 10 12 13 14+
f 6 days ago	0 1 2 3 4 5 6 7 8 9 10 12 13 14+
g 7 days ago	0 1 2 3 4 5 6 7 8 9 10 12 13 14+

variable "alcons" created to give average daily intake;
which was the sum of (a to g)/7.

Scoring:

if firstdrk eq 5 or lastdrk eq 8 then DRINK eq 1
if lastdrk eq 7 then DRINK eq 2
if firstdrk le 4 and alcons le 2 then DRINK eq 3
if firstdrk le 4 and alcons gt 2 then DRINK eq 4

PSYCHOSOCIAL MEASURES

Self-esteem (SLFEST)

For each of the following statements please circle the number of the category that describes how strongly you agree or disagree with each statement.

		Strongly Agree	Mildly Agree	Neither Agree Nor Disagree	Mildly Disagree	Strongly Disagree
a)	I feel that I have a number of good qualities.....	1	2	3	4	5
b)	I feel that I'm a person of worth at least equal to others.....	1	2	3	4	5
c)	I am able to do things as well as most other people.....	1	2	3	4	5
d)	I take a positive attitude toward myself.....	1	2	3	4	5
e)	On the whole I am satisfied with myself.....	1	2	3	4	5
f)	All in all, I'm inclined to feel that I'm a failure.....	1	2	3	4	5

Social Support (SOCLSUP)

The following statements are about your relationships with other people. For each statement, please circle the number of the category that best describes you.

	Very Much Like Me	Much Like Me	Some- what Like Me	Not Very Much Like Me	Not At All Like Me
a) When I'm with my friends I feel completely able to relax and be myself.....	1	2	3	4	5
b) I share the same approach to life that most of my family and friends do.....	1	2	3	4	5
c) People who know me trust me and respect me.....	1	2	3	4	5
d) No matter what happens, I know that my family will always be there for me should I need them.....	1	2	3	4	5
e) When I want to go out to do things, I know that many of my friends would enjoy doing these things with me.....	1	2	3	4	5
f) I have at least one person that I could tell anything to.....	1	2	3	4	5
g) Sometimes I'm not sure if I can completely rely on my family and friends.....	1	2	3	4	5
h) People close to me let me know they think I'm a worthwhile person.....	1	2	3	4	5
i) I feel very close to some of my friends.....	1	2	3	4	5
j) People in my family have confidence in me.....	1	2	3	4	5
k) There are some problems that I can't share with anyone.....	1	2	3	4	5
l) People close to me provide help in finding solutions to my problems.....	1	2	3	4	5
m) My friends would take the time to talk over my problems, should I ever want to.....	1	2	3	4	5
n) I know my family will always stand by me.....	1	2	3	4	5
o) Even when I am with my friends I feel alone.....	1	2	3	4	5

Psychological Symptoms (PSYCHSYM)

How you felt last week could be different from how you felt during the past year. Please tell us how often, during the past week, did you. . .

	Never	Once in a While	Fairly Often	Very Often
a) Feel low in energy or slowed down?.....	1	2	3	4
b) Feel faint or dizzy?.....	1	2	3	4
c) Have your heart pound or race when not physically active?.....	1	2	3	4
d) Have trouble concentrating?.....	1	2	3	4
e) Feel hopeless about the future?.....	1	2	3	4
f) Feel lonely?.....	1	2	3	4
g) Have your mind go blank?.....	1	2	3	4
h) Lose sexual interest or pleasure?.....	1	2	3	4
i) Sweat when not working hard or overheated?.....	1	2	3	4
j) Feel downhearted or blue?.....	1	2	3	4
k) Feel tense or under pressure?.....	1	2	3	4

(continued)		Never	Once in a While	Fairly Often	Very Often
l)	Lose your temper?.....	1	2	3	4
m)	Have an upset or sour stomach?.....	1	2	3	4
n)	Feel bored or have little interest in things?.....	1	2	3	4
o)	Notice your hands trembling?.....	1	2	3	4
p)	Feel fearful or afraid?.....	1	2	3	4
q)	Have trouble remembering things?.....	1	2	3	4
r)	Have trouble going to sleep or staying asleep?.....	1	2	3	4
s)	Cry easily or feel like crying?.....	1	2	3	4
t)	Feel short of breath?.....	1	2	3	4
u)	Have a poor appetite?.....	1	2	3	4
v)	Have to avoid certain things, places, activities because they frightened you?.....	1	2	3	4
w)	Feel nervous or shaky inside?.....	1	2	3	4
x)	Have any thoughts about possibly ending your life?.....	1	2	3	4
y)	Feel critical of others?.....	1	2	3	4
z)	Feel easily annoyed or irritated?.....	1	2	3	4
aa)	Get angry over things that are not too important?.....	1	2	3	4
bb)	Have difficulty making decisions?.....	1	2	3	4
cc)	Have tightness or tension in your neck, back or other muscles?.....	1	2	3	4

Personal Mastery (PERSMAST)

- For each of the following statements, please circle the number of the category that describes how strongly you agree or disagree with each statement.

	Strongly Agree	Mildly Agree	Neither Agree Nor Disagree	Mildly Disagree	Strongly Disagree
a) I have little control over the things that happen to me.....	1	2	3	4	5
b) There is really no way I can solve some of the problems I have.....	1	2	3	4	5
c) There is little I can do to change many of the important things in my life.....	1	2	3	4	5
d) I often feel helpless in dealing with problems of life.....	1	2	3	4	5
e) Sometimes I feel that I am being pushed around in life.....	1	2	3	4	5
f) What happens to me in the future mostly depends on me.....	1	2	3	4	5
g) I can do just about anything I really set my mind to.....	1	2	3	4	5

Life Events (LIFEV)

The following items are experiences that people sometimes have. Some of these things happen to most people at one time or another, while some happen to only a few people. For each of these indicate those that have happened to you in the **past 12 months** by circling the appropriate number.

CIRCLE AS MANY AS APPLY

- a) a serious accident or injury 1
- b) a serious illness 2
- c) a marital separation or divorce 3
- d) continuous financial worries 4
- e) a major financial crisis 5
- f) trouble with the law 6
- g) a pregnancy (for yourself or partner/spouse) 7
- h) an abortion, miscarriage or still birth (for yourself or partner/spouse) 8
- i) a child died 9
- j) a spouse died 10
- k) a close family member died 11
- l) a close friend died 12
- m) a close relationship was broken off 13
- n) been downgraded or demoted at work 14
- o) started a completely different type of work 15
- p) experienced a big change in the people, duties or responsibilities at work 16
- q) had troubles or arguments or other difficulties with people at work 17
- r) got together again after a marital separation 18
- s) had increasing serious arguments with your spouse or other household member 19
- t) had serious problems in your relationship with a close friend, relative or neighbour not living in your home 20

u)	had problems with the behaviour of one of your parents	21
v)	had problems with the behaviour of your spouse	22
w)	the behaviour of one of your children was a problem for you	23
x)	a marriage engagement ended	24
y)	separated from someone else close to you	25
z)	moved to a new neighbourhood or to a new town	26

APPENDIX C - Internal reliability of psychosocial scales

<u>Scale</u>	<u>Cronbach's alpha</u>
Self-esteem	0.81
Social Support	0.87
Personal Mastery	0.79
Psychological Distress	0.92

From: Tousignant M. La sante mentale dans l'enquete de la defense nationale.
Montreal, 1990.

APPENDIX D - Assessment of the effect of missing values

This section will present greater detail on the assessment of missing values within the data set. Tables and Figures referred to in the text may be found at the end of this appendix preceding Appendix E.

For each of the variables used in this thesis, the proportion missing was calculated, (Table 1). The frequency of missing values is quite low for the majority of the variables with the exception of DRINK and SOCLSUP. The extent to which these missing values were not random events was explored.

To determine whether missing values were related to the level of perceived health, the proportions were recalculated by PERHEALTH category, (Table 2). Some of the variables demonstrated a trend to increasing numbers of missing values as the level of PERHEALTH moved from Excellent → Poor. This is not particularly surprising as one might expect less compliance as an individual's perceived health status lowers. Nevertheless, it should be noted that the "poor" category has a very small size of only 36 respondents. Thus missing just 6 responses results in a missing value proportion of 16.7%. When this is taken into consideration, the differences in percentage of missing data by PERHEALTH are not quite as striking.

The two variables with the most missing values are DRINK and SOCLSUP. DRINK is a composite variable derived from a series of questions dealing with regularity of drinking, time of last alcoholic beverage consumed, as well as a daily intake inventory for the seven days preceding the survey. Although losses occurred cumulatively with each question, the majority (79%) of sample size losses occurred with the daily inventory question with most respondents leaving most or all of the 7 items blank.

INTERPOLATION OF MISSING VALUES FOR THE SOCLSUP AND DRINK VARIABLES

It would be desirable to avoid the potential loss of up to 20% of the data set due to missing values. Because the DRINK and SOCLSUP variables are responsible for the bulk of this loss, an assessment was made as to whether using other variables in the data set could accurately estimate values for these variables and thus allow for their interpolation.

SOCLSUP is a continuous-type variable. Stepwise linear regression was used with SOCLSUP as the dependent variable to derive a regression equation which would allow for the estimation of missing values of SOCLSUP where the other variables were present. This assumes that the population containing a SOCLSUP coding is not too different from those missing a SOCLSUP response. Demographic, health behaviour, and remaining psychosocial measures were used as independent variables in the regression. Unfortunately, only 30% of the variance of the dependent variable was explained. Therefore interpolation of the SOCLSUP variable was not feasible.

While DRINK is a categorical variable, its coding depends primarily upon the average daily intake of alcohol which is a continuous variable. Similar to the SOCLSUP analysis, alcohol intake was treated as a dependent variable and the previous independent variables were reused. Only 8.5% of the variance was explained in the analysis.

Therefore estimation of missing values for these variables was not possible. An assessment of the impact of losing part of the data set due to missing values was conducted. DRINK will be concentrated upon because it is the predominant variable suffering from high levels of missing values.

ROLE OF THE DRINK VARIABLE

Because the inclusion of DRINK in any multivariate analysis will eliminate a part of the data set, it is important to clarify the differences between those who responded to the DRINK questions versus those who did not.

As a first step, percentages of missing values for variables other than DRINK were examined based on presence or absence of DRINK, (Table 3). Most variables showed a twofold increase in missing values when DRINK was also missing. This is not surprisingly, since one would expect that subjects unwilling to self-disclose alcohol related questions might feel similarly about other behaviours as well as personal information.

To determine if there is any clear distinction between DRINK responders versus non-responders, responses of non-DRINK responders who did answer other questions, were compared with those who did respond. Results of t-tests performed for the continuous-type psychosocial scales on these two groupings can be found in Table 4. Because of the large sample size, the alpha error was set at 0.01. There were no statistically significant differences found. The actual mean differences were quite small.

For the ordinal-type demographic and health behaviours, 2XN type tables were created and chi-squared statistics calculated. Again, the alpha level was set at 0.01. Only one health behaviour variable, EATBTML, indicated a significant difference between the DRINK and non-DRINK groups. The distribution of these variables is shown in figures A, B, and C. For the demographic variables, AGE ($p=.005$) and EDUC ($p<.0000$), demonstrated significantly different distributions by DRINK coding. Since military rank is highly dependent upon age and education, RANK was statistically significant, $p=.0001$.

Non-DRINK responders demonstrated higher representation in the 20-25 and ≥ 45 age groups. DRINK non-responding was also associated with lower levels of education, (up to and including completion of high school). Since a primary reason for non-response might be that individuals tend to consume above average quantities of alcohol, the quantity of alcohol self-reported by these demographic groups was reviewed. Bi-variate tables were created for DRINK and the three demographic variables: AGE, EDUC, and RANK. Distribution of DRINK by AGE and EDUC are shown in figures D and E.

The younger age groups have a higher proportion of heavy drinkers, and the oldest groups have a higher proportion of ex-drinkers. Among individuals who have not completed high school, there were higher proportions of heavy drinkers and ex-drinkers. The strata which included higher proportions of heavy drinking and ex-drinking are the same as those with increased proportions of non-response for the DRINK variable.

Therefore, it seems probable that the non-responders for the DRINK variable may represent a population sub-group notable for current or previous excessive alcohol intake. The consequences of this include the under-estimation of heavy drinking within the study population. The effect at a multivariate level particularly at the level of correlation between behaviours however, is not as clear. Two possible ways of exploring this effect are:

- 1) to compare the inter-relationships between behaviours in the population which are coded for the DRINK variable versus those that are not; and
- 2) to perform a sensitivity analysis such that individuals which are missing a DRINK coding will be coded as heavy or ex-drinkers and then comparing the level of inter-relationships between behaviours with this re-coding in place versus one which excludes cases with the missing variable.

FACTOR ANALYSIS - COMPARISON OF GROUPS DEFINED BY PRESENCE OR ABSENCE OF CODING FOR "DRINK" VARIABLE

Pearson correlations were calculated between the eight health behaviours in those cases without a DRINK coding. A principal components analysis was performed on this correlation matrix. Three factors were identified and are shown in Table 5. A threshold loading of 0.4 was used to consider behaviours members of factors.

For the remainder of the data set, (those with a DRINK coding), the Pearson correlations were calculated between the same eight health behaviours. Three factors were identified and are also shown in Table 5. Note that the only difference in the behaviours loaded is the placement of testicular self examination. Visual comparison of the correlation matrices finds very few differences between them.

SENSITIVITY ANALYSIS - IMPACT OF CODING "DRINK" MISSING VALUES

Previous analysis suggested that non-DRINK responders may be overly represented by heavy/ex-drinkers. Therefore, all cases which had a missing value for the DRINK variable were re-coded with the highest OR calculated for poor health. A Pearson correlation matrix using all 9 behaviours was then created and a principal components analysis performed. The factor solution is shown in table 6.

Comparison with the identified factors for the crude population which would exclude all cases without a DRINK coding, shows exactly the same factor structure as above. Therefore no difference in the pattern of inter-relationships between health behaviours is observed when DRINK missing values are replaced with ex-drinkers codes.

MISSING VALUES - SUMMARY

The percentage of missing values varies for different variables. Simultaneous usage of all the variables results in a loss of 20% of the data set. The DRINK variable is responsible for the majority of this loss. It is likely that non-DRINK responders contain a higher proportion of heavy and ex-drinkers. However, the factor structure of health behaviours in non responders compared to responders does not differ appreciably. Assuming all non-responders are heavy drinkers does not change the factor structure at all.

Table 1 Frequency of missing values of study variables.

PERHEALTH	0.2
AGE	1.6
EDUC	2.8
RANK	2.1
MARSTAT	2.3
DRINK	12.5
SMOKE	1.0
SLEEP	0.6
EATBRF	0.1
EATBTML	0.2
BRUSHT	0.2
FLOSS	0.3
EXRATE	0.8
TESTSLF	1.9
PERMAST	2.1
SOCLSUP	7.3
SLFEST	1.3
PSYCHSYM	5.3

Table 2 Percentage of missing values for study variables by PERHEALTH category.

	<u>PERHEALTH CATEGORY</u>				
<u>Behaviour</u>	<u>Excel</u>	<u>VGood</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>
AGE	1.0	1.2	1.5	1.9	2.8
EDUC	2.5	2.3	2.6	2.9	11.1
RANK	1.7	1.7	2.1	1.9	5.6
MARSTAT	1.4	2.3	1.9	3.2	5.6
DRINK	13.4	12.7	11.6	0.8	16.7
SMOKE	0.7	1.0	1.0	1.9	0.0
SLEEP	0.4	0.6	0.5	0.2	8.3
EATBRF	0.1	0.1	0.1	0.0	0.0
EATBTML	0.4	0.1	0.2	0.0	0.0
BRUSHT	0.3	0.2	0.1	0.2	2.8
FLOSS	0.4	0.1	0.3	0.2	2.8
EXRATE	0.6	0.7	0.7	0.4	2.8
TESTSLF	0.8	1.7	1.8	2.9	0.0
PERMAST	1.3	1.8	1.9	2.3	5.6
SOCLSUP	5.6	6.9	7.4	8.4	11.1
SLFEST	0.7	1.2	1.0	1.1	2.8

Table 3 Distribution of missing values by the presence or absence of DRINK coding.

<u>Variable</u>	<u>Not Coded</u>	<u>Coded</u>
PERHEALTH	0.0	0.2
AGE	3.4	1.3
EDUC	5.2	2.4
RANK	4.2	1.8
MARSTAT	4.6	1.9
SMOKE	2.2	0.9
SLEEP	1.3	0.5
EATBRF	0.1	0.2
EATBTML	0.3	0.2
BRUSHT	0.3	0.2
FLOSS	0.4	0.3
EXRATE	1.2	0.7
TESTSLF	3.5	1.6
PERMAST	3.4	1.9
SOCLSUP	11.2	6.7
SLFEST	2.5	1.1
PSYCHDIST	8.1	4.9

Table 4 Mean difference in psychosocial variable scores by the presence or absence of DRINK coding.

<u>Variable</u>	<u>Mean-coded</u>	<u>Mean-noncod</u>	<u>p-value</u>
SLFEST	27.72	27.54	0.12
PERSMAST	28.95	28.46	0.02
LIFEV	2.96	2.84	0.20
SOCLSUP	59.75	59.39	0.32
PSYCHDIST	41.39	42.18	0.06

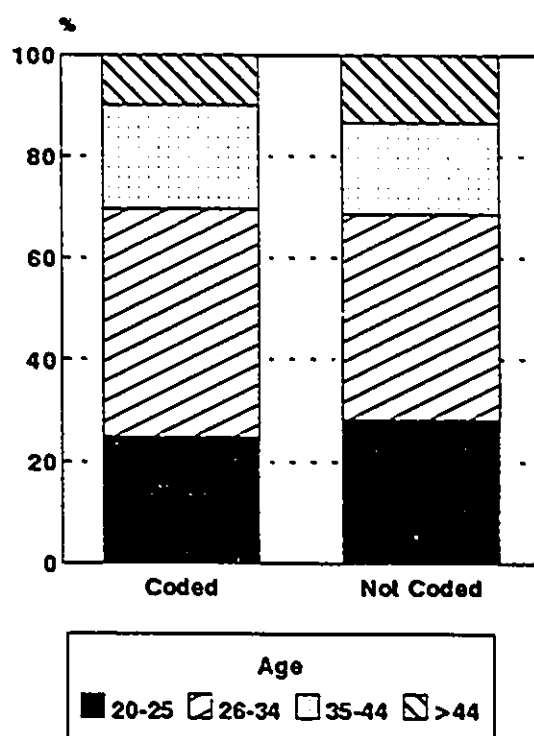


Figure A - Age distribution of cases grouped by presence or absence of coding for DRINK variable.

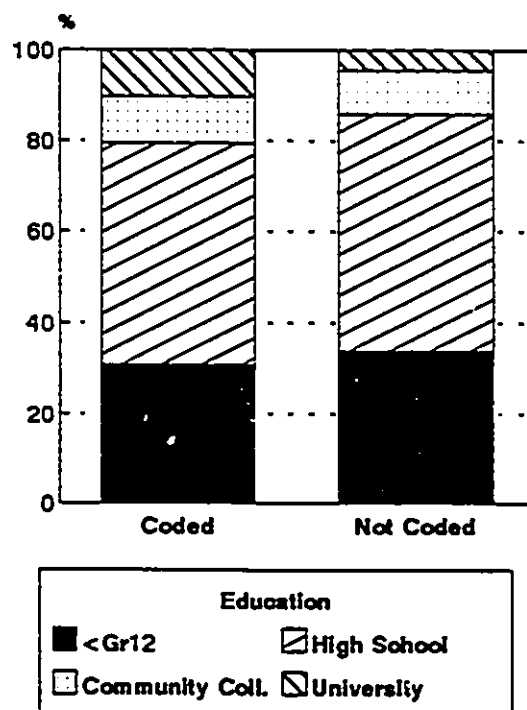


Figure B - Distribution of education levels by presence of coding for the DRINK variable.

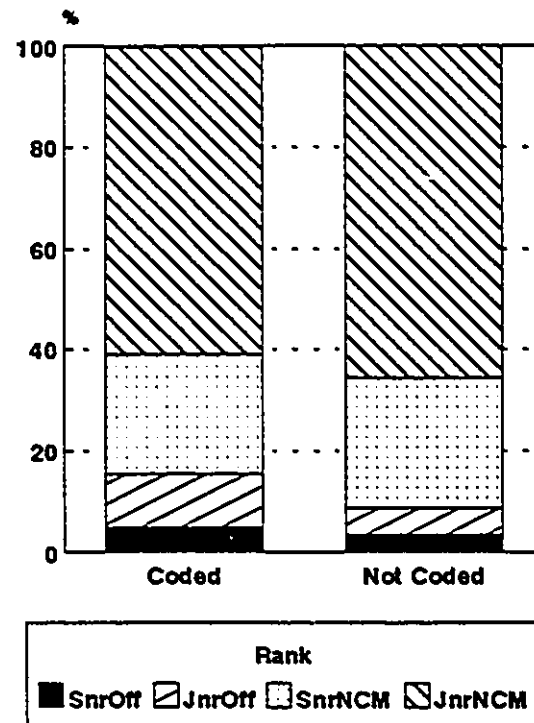


Figure C - Distribution of military rank by presence or absence of coding for the DRINK variable.

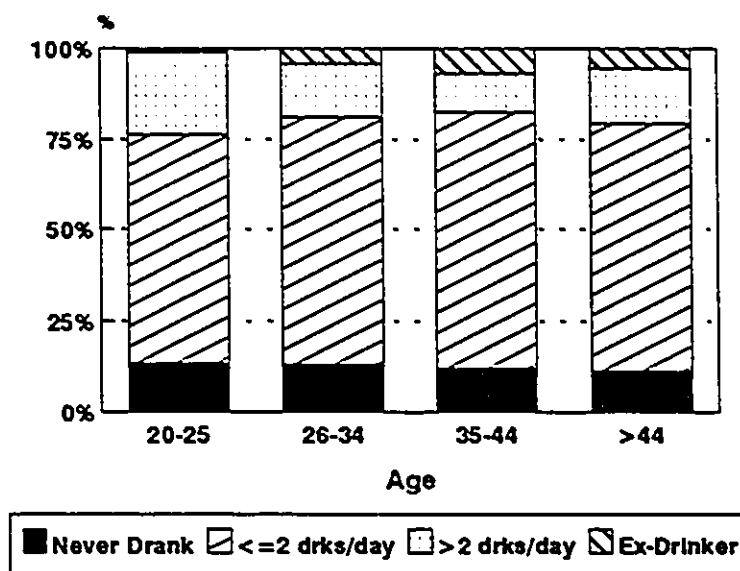


Figure D - Frequency distribution of DRINK categories by age groups.

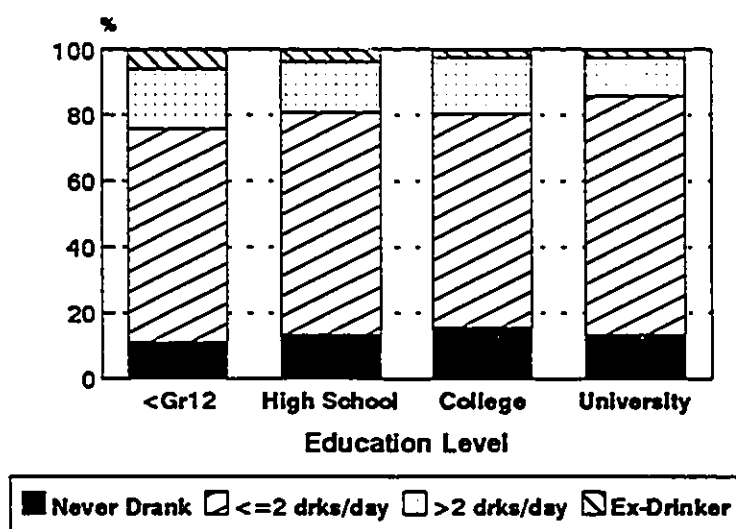


Figure E - Frequency distribution of DRINK categories by education groups.

Table 5 Factor solutions of 8 health behaviours for populations defined by response to the DRINK variable.

DRINK Non-responders

<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>
Brusht	Sleep	Eatbtml
Floss	Eatbrf	
Exrate	Smoke	
	-Testslf	

DRINK Responders

<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>
Brusht	Sleep	Eatbtml
Floss	Eatbrf	-Testslf
Exrate	Smoke	

Table 6 Factor solution following re-scoring of DRINK missing values with "ex-drinkers" OR for poor perceived health.

<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor 3</u>
Brusht	Sleep	Eatbtml
Floss	Eatbrf	-Testslf
Exrate	Smoke	
	Drink	

APPENDIX E - Probabilities of tests of significance of rank correlations of performance-ranked health behaviours.

	Smoke	Drink	Exrate	Eatbrf	Eatbtm1	Floss	Brush1	Testslf
Drink	<0.001							
Exrate	<0.001	0.142						
Eatbrf	<0.001	<0.001	<0.001					
Eatbt	0.386	0.140	0.002	0.016				
Floss	<0.001	<0.001	<0.001	<0.001	<0.001			
Brush1	<0.001	0.108	<0.001	<0.001	<0.001	<0.001		
Testslf	0.149	0.224	<0.001	<0.001	0.268	<0.001	<0.001	
Sleep	<0.001	<0.001	0.264	<0.001	0.051	0.049	0.009	0.152

APPENDIX F - Additional discriminant analysis of selected health behaviour clusters by psychosocial measures.

<u>Education Level</u>	<u>Behaviour</u>	<u>Sensitivity</u>	<u>Specificity</u>	<u>Total % Correct</u>
<High School	Smoke Eatbrf Sleep Drink	66.3	47.4	55.9
	Floss Brusht Exrate	64.2	50.4	52.4
High School	Smoke Eatbrf Sleep Drink	66.5	49.3	60.4
	Floss Brusht Exrate	67.8	54.0	56.6
College	Smoke Eatbrf Sleep Drink	64.2	49.0	58.1
	Floss Brusht Testslf	49.1	66.5	64.3
Univer	Smoke Eatbrf Sleep	65.1	54.3	61.7
	Brusht Testslf Floss	*		

* None of the psychosocial measures were sufficiently associated with the cluster.

Results of discriminant analysis of selected health behaviour clusters by psychosocial measures by military rank.

<u>Military Rank</u>	<u>Behaviour</u>	<u>Sensitivity</u>	<u>Specificity</u>	<u>Total % Correct</u>
Senior Officers	Floss Brush Test Drink Eat	66.7	42.8	52.0
	Smoke Sleep Exercise Eat	68.5	48.6	59.7
Junior Officers	Floss Brush Exercise Eat Smoke	72.8	39.2	51.0
Senior NCM	Eat Smoke Sleep Exercise	65.3	45.3	52.2
	Floss Brush Test Exercise	62.4	54.2	55.1
Junior NCM	Smoke Sleep Drink Eat	66.7	49.0	58.6
	Brush Floss Exercise	66.1	53.4	55.4

Results of discriminant analysis of selected health behaviour clusters by psychosocial measures by marital status.

<u>Marital Status</u>	<u>Behaviour</u>	<u>Sensitivity</u>	<u>Specificity</u>	<u>Total % Correct</u>
Married	Smoke Sleep Eatbrf Drink	65.9	48.0	59.7
	Brusht Floss	66.8	52.4	53.8
Separat/ Divorced	Sleep Eatbrf Smoke Drink	59.8	50.8	54.5
	Brusht Floss Drink	61.1	54.9	56.5
	Teststf Exrate	*		
Never Married	Drink Smoke Sleep Eatbrf	67.6	42.7	57.6
	Brusht Floss Exrate	65.8	54.6	57.2

* None of the psychosocial measures were sufficiently associated with the cluster.

APPENDIX G - Correlation matrices for health behaviour pairings for population dichotomized by perceived health status.

Health Status: Good (Excellent, Very Good, Good)

	Drink	Smoke	Brush	Floss	Eatbrf	Eatbtml	Exrate	Sleep
Drink	1.000							
Smoke	0.197	1.000						
Brush	0.016	0.069	1.000					
Floss	0.045	0.053	0.260	1.000				
Eatbrf	0.097	0.230	0.137	0.118	1.000			
Eatbtml	0.002	0.003	0.035	0.040	-0.017	1.000		
Exrate	0.007	0.107	0.126	0.108	0.085	0.045	1.000	
Sleep	0.124	0.158	0.029	0.027	0.170	0.021	0.022	1.000
Testslf	-0.012	-0.001	0.032	0.072	-0.010	-0.010	0.048	-0.025

Health Status: Poor (Fair, Poor)

	Drink	Smoke	Brush	Floss	Eatbrf	Eatbtml	Exrate	Sleep
Drink	1.000							
Smoke	0.054	1.000						
Brush	0.039	0.115	1.000					
Floss	0.107	0.045	0.305	1.000				
Eatbrf	0.043	0.152	0.138	0.128	1.000			
Eatbtml	-0.008	-0.099	0.003	0.071	-0.030	1.000		
Exrate	-0.033	0.087	0.099	0.035	0.066	-0.010	1.000	
Sleep	-0.002	0.151	0.084	-0.003	0.106	0.035	-0.079	1.000
Testslf	-0.024	0.029	0.015	-0.056	0.019	0.025	-0.045	-0.015

APPENDIX H - Age-adjusted ORs for poor perceived health status. Calculated from raw tabulated data, 1985 General Social Survey.

AGE: 15-24

	<u>Poor</u>	<u>Good</u>
<u>Never</u>	98	506
<u>Former</u>	26	98
<u>Occasional</u>	109	672
<u>Current</u>	314	2462

AGE: 25-44

	<u>Poor</u>	<u>Good</u>
<u>Never</u>	87	511
<u>Former</u>	74	347
<u>Occasional</u>	183	1186
<u>Current</u>	557	5072

AGE: 45-64

	<u>Poor</u>	<u>Good</u>
<u>Never</u>	210	418
<u>Former</u>	169	195
<u>Occasional</u>	225	661
<u>Current</u>	542	2389

<u>Type of Drinker</u>	<u>Odds Ratio for Poor Perceived Health</u>
Never	1.81
Former	2.74
Occasional	1.41
Current	1.00

APPENDIX I - Power curves for correlation coefficients

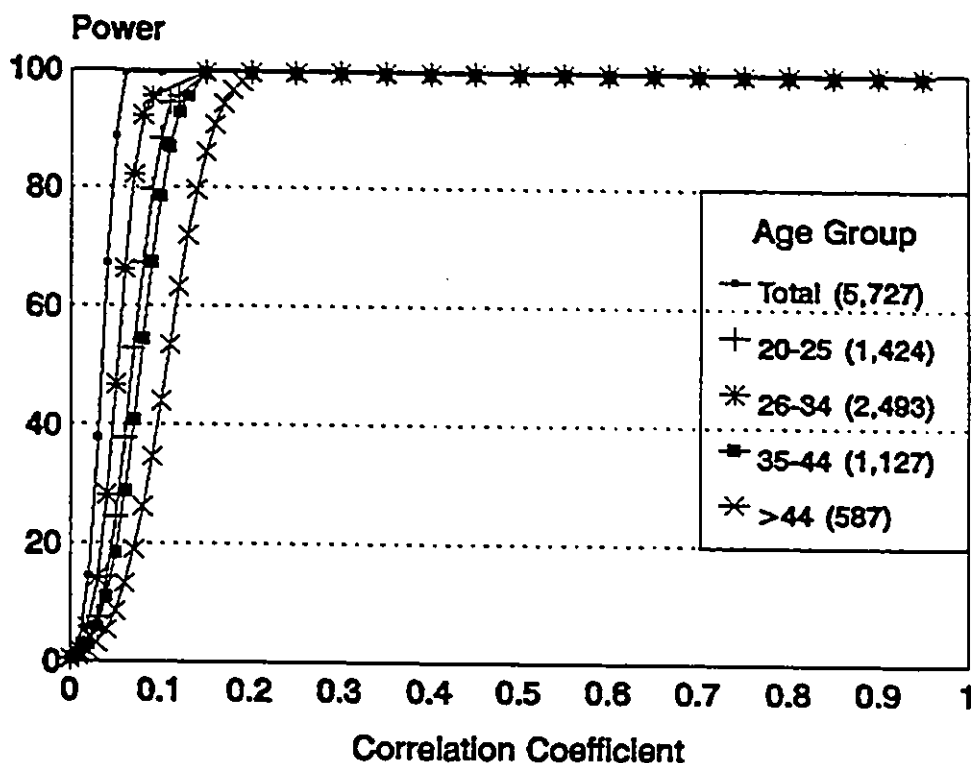
Power curves were calculated for correlation coefficient values from 0 to 0.95 for sample sizes of the crude and age-stratified populations. Two-tailed tests were used with a type I error of 0.01. The power (1- β) was then calculated from the equation:

$$z_{1-\beta} = [z' * (n-3)^{1/2}] - z_{1-\alpha/2}$$

where:

n = sample size

z' is a Fisher transformation of r



Sample sizes are in parentheses

* Cohen J. Statistical power analysis for the behavioral sciences. New York: Academic Press, 1969; and Darlington RB, Carlson PM. Behavioral statistics: logic and methods. London: Collier MacMillan, 1987.

APPENDIX J - Pearson correlation matrices for risk-scored health behaviours for crude and rank-stratified populations.

<u>Crude</u>	Drink	Smoke	Brush	Floss	Eatbrf	Eatbtml	Exrate	Sleep	Testslf
Drink	1.000								
Smoke	0.180	1.000							
Brush	0.024	0.086	1.000						
Floss	0.055	0.061	0.270	1.000					
Eatbrf	0.096	0.228	0.143	0.124	1.000				
Eatbtml	0.001	-0.007	0.035	0.044	-0.016	1.000			
Exrate	0.015	0.125	0.136	0.114	0.098	0.044	1.000		
Sleep	0.112	0.165	0.040	0.029	0.170	0.023	0.026	1.000	
Testslf	-0.009	0.008	0.035	0.069	-0.002	-0.006	0.048	-0.018	1.000
<u>SnrOff</u>	Drink	Smoke	Brush	Floss	Eatbrf	Eatbtml	Exrate	Sleep	Testslf
Drink	1.000								
Smoke	0.138	1.000							
Brush	0.182	0.240	1.000						
Floss	0.103	0.072	0.290	1.000					
Eatbrf	0.124	0.353	0.258	0.235	1.000				
Eatbtml	0.047	-0.100	0.059	0.098	-0.032	1.000			
Exrate	0.041	0.217	0.067	0.102	0.100	0.060	1.000		
Sleep	0.003	0.219	0.134	0.001	0.161	0.035	0.120	1.000	
Testslf	0.141	-0.041	0.120	0.147	0.097	-0.114	-0.061	-0.033	1.000
<u>JnrOff</u>	Drink	Smoke	Brush	Floss	Eatbrf	Eatbtml	Exrate	Sleep	Testslf
Drink	1.000								
Smoke	0.118	1.000							
Brush	0.089	0.137	1.000						
Floss	0.126	0.148	0.227	1.000					
Eatbrf	0.078	0.199	0.157	0.193	1.000				
Eatbtml	-0.010	0.028	0.047	0.063	-0.056	1.000			
Exrate	0.087	0.221	0.136	0.202	0.114	0.092	1.000		
Sleep	0.100	0.131	0.032	0.050	0.078	0.062	0.070	1.000	
Testslf	-0.027	-0.004	0.053	0.018	0.018	0.007	0.030	-0.052	1.000
<u>SrNCM</u>	Drink	Smoke	Brush	Floss	Eatbrf	Eatbtml	Exrate	Sleep	Testslf
Drink	1.000								
Smoke	0.149	1.000							
Brush	0.024	0.045	1.000						
Floss	0.034	0.061	0.285	1.000					
Eatbrf	0.051	0.219	0.129	0.121	1.000				
Eatbtml	-0.017	-0.005	0.036	0.051	0.006	1.000			
Exrate	-0.012	0.150	0.087	0.090	0.107	0.024	1.000		
Sleep	0.057	0.115	0.011	0.025	0.187	0.021	0.055	1.000	
Testslf	-0.008	-0.039	0.050	0.084	0.000	0.021	0.048	-0.039	1.000
<u>JrNCM</u>	Drink	Smoke	Brush	Floss	Eatbrf	Eatbtml	Exrate	Sleep	Testslf
Drink	1.000								
Smoke	0.195	1.000							
Brush	0.015	0.077	1.000						
Floss	0.055	0.026	0.282	1.000					
Eatbrf	0.117	0.198	0.129	0.087	1.000				
Eatbtml	0.011	-0.029	0.027	0.004	-0.053	1.000			
Exrate	0.022	0.102	0.153	0.101	0.087	0.045	1.000		
Sleep	0.147	0.178	0.034	0.017	0.177	0.004	0.003	1.000	
Testslf	-0.012	0.029	0.026	0.071	-0.009	-0.024	0.050	-0.002	1.000