

# Health-related characteristics and dietary intakes of male veterans and non-veterans in the Multiethnic Cohort Study (United States)

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## Abstract

**Background:** Nationwide surveys in the United States found that certain health-related factors, in particular cigarette smoking and obesity, were more prevalent in veterans than in non-veterans.

**Purpose:** The objective of this paper was to compare health-related characteristics and dietary intakes between veterans and non-veterans in the Multiethnic Cohort.

**Materials and Methods:** The cohort participants (aged 45-75 years), residing in Hawaii and California at baseline, completed a mailed questionnaire on diet, medical history, and lifestyle in 1993-1996. The current analyses included 20,939 men (14,975 veterans and 5,964 non-veterans) who returned a survey questionnaire on military service in 2007.

**Results:** Compared to non-veterans, veterans were more likely to be overweight and obese (BMI $\geq$ 25, 61% vs. 55%), former smokers (54% vs. 47%), heavier consumers of red and processed meat, and lighter consumers of fruits and vegetables. Within the veteran group, enlisted men were more likely to be obese, to have a history of smoking, to consume more processed meat and to consume smaller amounts of dairy products and fruits than officers.

**Conclusion:** The findings imply that veterans as a group are at somewhat higher risk of developing lifestyle-related chronic diseases than are non-veterans. Comparisons of actual differences in disease incidence and mortality in the Multiethnic Cohort between veterans and non-veterans will require several more years of follow-up.

## Introduction

Military veterans constitute approximately 13% of the total population aged 18 or older in the United States<sup>1</sup>. Although military populations may differ from the general population in certain disease risks due to service-related exposure to health hazards and intense and stressful environments<sup>2</sup>, overall, active duty military populations are likely to be healthier than other populations because of physical screening prior to entry into military service and better access to health care<sup>3</sup>. This is reflected in data showing that mortality among military populations was 10% to 25% lower than in the general population. However, this “healthy soldier” effect may be attenuated as they age. Indeed, in a national survey in the U.S., older veterans had a slightly higher mortality rate than their non-veteran counterparts<sup>4</sup>.

Nationwide and statewide surveys in the U.S. found that certain health-related factors, in particular cigarette smoking and obesity, were more prevalent in veterans than in non-veterans<sup>5-8</sup>. However, information on the dietary intakes of veterans, another important determinant of health status, is very limited. With data from the Multiethnic Cohort Study, which was initiated to investigate diet and cancer in Hawaii and

California, we recently conducted a special survey to obtain information on the military backgrounds of male participants. The objective of this paper is to compare health-related characteristics and dietary intakes between veterans (both officers and enlisted men) in the cohort.

## Materials and methods

### Study Population

The Multiethnic Cohort is comprised of more than 215,000 men and women living in Hawaii and California who completed a mailed baseline questionnaire on diet, medical history and lifestyle in 1993-1996<sup>9</sup>. Sampling for the study was based primarily on the drivers' license files in both states and additionally on the voters' registration file in Hawaii and the Health Care Financing Administration files in California, and these yielded a highly representative group for the study<sup>9</sup>. The participants were mostly African Americans, native Hawaiians, Japanese Americans, Latinos and Whites, aged 45-75 years when they entered the cohort. Follow-up of the cohort includes active contact with the participants by annual newsletters and five-year follow-up questionnaires, as well as annual computer linkages of the cohort to population-based tumour registries

and death certificate files in Hawaii and California and to the U.S. National Death Index. Out-migration from the study areas is low (3.7% after 7 years of follow-up). The study was approved by the review boards of the University of Hawaii, the University of Southern California, and the Uniformed Services University of the Health Sciences.

In 2007, a one-page survey was mailed to living male participants (n=77,258) in the Multiethnic Cohort. The survey included questions on military background, such as ever serving in the U.S. Military, the service branch, length of active duty, and job category. A total of 21,472 men (28%) returned the questionnaire. Compared to non-respondents, respondents were more likely to be younger (58.1 vs. 59.1 years), to be from Hawaii rather than California (65% vs. 47%), and to be more educated (college graduate and higher, 44% vs. 26%). For the current analyses, we excluded participants who reported implausible dietary intakes on the baseline questionnaire (n=533). Therefore, 20,939 male participants were included in the analyses.

### Variables

Respondents were divided into veterans and non-veterans based on the answer (yes or no) to the question, "Have you ever served in the U.S. Military?" Veterans were also subdivided into enlisted men and officers according to their main or longest-held grade.

Socio-demographic characteristics, health-related characteristics and dietary intake at baseline were compared between veterans and non-veterans and between enlisted men and officers. Body mass index (BMI, kg/m<sup>2</sup>) was calculated from self-reported height and weight on the baseline questionnaire. Smoking status, vitamin and mineral supplement use, and physical activity were also obtained. Heavy drinkers were defined as those who had consumed two drinks or more per day, based on the criteria of the U.S. National Institute of Alcohol Abuse and Alcoholism<sup>10</sup>. The baseline questionnaire included an extensive quantitative food frequency questionnaire (QFFQ) with over 180 items. The QFFQ was validated by a calibration study which showed satisfactory correlations between energy-adjusted daily nutrient intakes from the QFFQ and three 24-hour recalls<sup>11</sup>. Energy, nutrient, and food group intakes were calculated from the QFFQ using the food composition table that has been developed and maintained at the Cancer Research Center of Hawaii for use in the Multiethnic Cohort Study.

### Data Analysis

Descriptive statistics were used to compare selected socio-demographic characteristics between veterans and non-veterans, and between enlisted men and officers. Because the age and race/ethnicity distribution differed between veterans and non-

	Non-veterans (n=5,964)	Veterans (n=14,975)	P <sup>†</sup>	Veterans		P <sup>†</sup>
				Enlisted <sup>‡</sup> (n=12,195)	Officers <sup>‡</sup> (n=2,452)	
Age (years, mean (SD))	56.1 (8.4)	58.9 (8.3)	< 0.0001	58.8 (8.3)	59.2 (8.2)	0.0095
Race/ethnicity (%)						
African American	5.1	8.7	< 0.0001	9.3	4.9	<0.0001
Native Hawaiian	6.0	6.6		7.2	4.0	
Japanese American	32.3	38.1		40.4	27.7	
Latino	19.4	12.8		14.2	4.7	
White	32.0	31.6		26.3	57.8	
Other	5.2	2.3		2.5	0.9	
Area of residence (%)						
Hawaii	60.7	67.1	< 0.0001	64.2	82.5	<0.0001
California	39.3	33.0		35.8	17.5	
Marital status (%)						
Married	78.6	80.9	< 0.0001	80.2	84.1	0.0001
Separated or divorced	10.8	10.2		10.5	8.9	
Widowed	1.8	2.7		2.8	2.3	
Never married	8.8	6.2		6.5	4.7	
Education (%)						
≤ 12th grade	28.4	23.0	< 0.0001	26.4	4.7	<0.0001
Vocational/some college	23.3	33.7		38.0	13.0	
≥ college graduate	48.3	43.4		35.7	82.3	
Number of children (%)						
None	18.3	16.4	< 0.0001	16.7	14.9	0.041
1-2	39.1	40.2		40.3	40.5	
3-4	31.1	34.0		33.5	35.9	
≥5	11.5	9.4		9.5	8.8	

<sup>‡</sup>Defined as a person who has ever served in the U.S. Military.

<sup>†</sup>Based on t-test (means) and chi-square test (proportions).

<sup>‡</sup>328 participants were missing information on military grade.

Table 1. Characteristics of veteran\* vs. non-veteran males in the Multiethnic Cohort, 1993-1996

	Non-veterans (n=5,964)	Veterans (n=14,975)	P <sup>†</sup>	Veterans		P <sup>†</sup>
				Enlisted (n=12,195)	Officers (n=2,452)	
BMI (kg/m <sup>2</sup> , %)						
<18.5 (underweight)	0.9	0.7	<0.0001	0.7	0.7	<0.0001
18.5-24.9 (normal)	43.7	38.7		38.6	40.1	
25-29.9 (overweight)	41.8	45.9		45.5	47.6	
≥30 (obese)	13.6	14.7		15.2	11.6	
Smoking status (%)						
Never	40.4	31.7	<0.0001	29.7	42.9	<0.0001
Former	46.6	53.5		55.4	47.8	
Current	13.0	14.8		14.9	9.3	
Pack years for ever smokers (mean (SD))	17.2 (17.1)	19.1 (20.8)	<0.0001	19.5 (22.4)	17.7 (17.9)	<0.0001
Heavy alcohol drinking (≥2 drinks/day, %)	15.8	17.6	0.0052	17.6	17.8	0.91
Vitamin and mineral supplement use (%)	56.0	55.8	0.84	55.9	58.0	0.025
Physically active (≥30 min/day, %) <sup>‡</sup>	32.1	31.4	0.41	30.9	31.8	0.38

\*Adjusted for age and race/ethnicity.

<sup>†</sup>Based on chi-square test (proportions) and t-test (means)

<sup>‡</sup>Strenuous sports or vigorous work

Table 2. Health-related characteristics of veteran vs. non-veteran males in the Multiethnic Cohort, 1993-1996\*

veterans, comparisons for health-related characteristics and dietary intake were conducted using the general linear model procedure and least square means to control for age and race/ethnicity. Food group and nutrient intakes were adjusted for energy intake in addition to age and race/ethnicity. Other potential confounding variables, including education as a measure of socioeconomic status, were also considered. However, none of these variables had a substantial effect on the results, and thus were not included in the final models. Significant differences in proportions and means between comparison groups were determined using the chi-square and t-tests, respectively. A conservative significance level of  $p < 0.0001$  was selected as an indicator of statistically significant differences to compensate for the large sample size. All analyses were performed using SAS software, version 9.1 (SAS Institute, Cary, N. Carolina).

## Results

Out of 20,939 respondents, 14,975 (72%) were veterans and 5,964 (28%) were non-veterans. We performed a telephone survey of non-respondents using an ethnic-stratified random sample of 125 men. Since only 57% of them identified themselves as veterans, our study sample in the analysis is likely to over-represent veterans in the cohort. Table 1 summarizes age, race/ethnicity, marital status and education of veterans and non-veterans in the cohort. Veterans were likely to be older (mean age = 58.9 years) than were non-veterans (56.1 years) at baseline. The veteran group had higher proportions of African Americans and Japanese Americans, and fewer Latinos compared to the non-veteran group. Among veterans, the officer group included higher proportions of Whites, Hawaii residents, and college graduates than did the enlisted group.

Several health-related characteristics of the participants are compared in Table 2. Compared to non-veterans,

more veterans tended to be overweight ( $25 \leq \text{BMI} < 30$  kg/m<sup>2</sup>, 46% vs. 42%) or to be obese ( $\text{BMI} \geq 30$  kg/m<sup>2</sup>, 15% vs. 14%) and to have smoked at some stage (68% vs. 60%). Furthermore, veterans who had a history of smoking had a greater lifetime exposure (19.1 pack years) than did non-veterans (17.2 pack years). Veterans were also more likely to be heavy alcohol drinkers (18% vs. 16%), although the difference was only suggestive. There was no statistically significant difference in vitamin and mineral supplement use and in vigorous physical activity between the two groups. Among veterans, enlisted men were more likely to be obese (15% vs. 12%) and to have smoked at some time (70% vs. 57%) than were officers.

Comparing food group intakes, veterans consumed more red meat and processed meat, but fewer fruits and vegetables than did non-veterans (Table 3). As expected from the food group patterns, veterans had lower intakes of vitamins and dietary fibre and a higher intake of total fat as a percentage of energy than did non-veterans. Within the veteran group, enlisted men consumed more processed meat and fewer quantities of dairy products and fruit juice; they also had lower intakes of calcium and vitamins than did the officers.

## Discussion

In general, in the Multiethnic Cohort, health indicators were poorer in veterans than non-veterans, and among veterans, were poorer for enlisted men than for officers. Specifically, veteran men were somewhat more likely to be overweight/obese, former smokers, heavier consumers of red and processed meat, and lighter consumers of fruits and vegetables on average compared to non-veterans. Among veterans, a higher proportion of men who were enlisted when they served in the military tended to be obese, to be smokers, and to consume more processed meat and fewer dairy products and fruits than those who were officers.

	Non-veterans (n=5,964)	Veterans (n=14,975)	P <sup>†</sup>	Veterans		P <sup>†</sup>
				Enlisted (n=12,195)	Officers (n=2,452)	
Food group (g)						
Red meat	45.5 (33.7)	48.4 (40.0)	<0.0001	47.5 (41.4)	46.3 (33.8)	0.063
Poultry	50.8 (41.2)	49.0 (48.9)	0.0014	47.2 (50.2)	49.3 (41.1)	0.0089
Processed meat	22.5 (21.2)	25.1 (25.1)	<0.0001	25.1 (26.5)	23.0 (21.7)	<0.0001
Fish and shellfish	27.9 (25.6)	27.1 (30.4)	0.039	26.6 (31.6)	27.7 (25.9)	0.033
Dairy products	207 (192)	203 (228)	0.14	200 (239)	217 (195)	<0.0001
Milk	143 (174)	143 (206)	0.80	142 (218)	154 (178)	0.0005
Vegetables	346 (190)	333 (226)	<0.0001	329 (236)	341 (193)	0.0014
Fruits	265 (235)	241 (279)	<0.0001	239 (288)	242 (235)	0.53
Fruit juice	93 (127)	89 (151)	0.021	87 (158)	100 (130)	<0.0001
Nutrient						
Energy (kcal)	2,430 (1,070)	2,388 (1,271)	0.0043	2,379 (1,323)	2,338 (1,083)	0.048
Protein (g)	85.3 (18.7)	85.0 (22.3)	0.35	83.7 (23.3)	84.9 (19.1)	0.0011
Fat (g)	77.7 (21.5)	79.4 (25.5)	<0.0001	78.5 (27.1)	77.5 (22.1)	0.019
Carbohydrate (g)	311 (62)	304 (74)	<0.0001	300 (78)	301 (64)	0.57
% Energy from protein	14.4 (2.9)	14.4 (3.5)	0.43	14.4 (3.7)	14.6 (3.0)	0.0048
% Energy from fat	29.3 (7.6)	30.0 (9.0)	<0.0001	30.1 (9.6)	29.6 (7.9)	0.0011
% Energy from carbohydrate	52.7 (9.6)	51.5 (11.3)	<0.0001	51.5 (12.1)	51.5 (9.9)	0.89
Calcium (mg)	787 (294)	772 (349)	0.0002	762 (364)	798 (298)	<0.0001
Iron (mg)	17.4 (7.5)	17.5 (8.9)	0.14	17.3 (9.4)	18.3 (7.7)	<0.0001
Vitamin A (µg RE)	1,492 (943)	1,448 (1,120)	0.0009	1,436 (1,175)	1,498 (961)	0.0010
Vitamin C (mg)	180 (117)	171 (139)	<0.0001	170 (147)	182 (120)	<0.0001
β-carotene (µg)	5,060 (4,081)	4,807 (4,845)	<0.0001	4,754 (5,037)	4,970 (4,119)	0.0072
Vitamin E (mg α-TE)	12.2 (6.3)	12.4 (7.5)	0.0020	12.3 (8.0)	12.8 (6.6)	<0.0001
Folate (µg)	385 (200)	380 (237)	0.058	375 (250)	402 (204)	<0.0001
Dietary fiber (g)	25.5 (11.1)	24.5 (13.1)	<0.0001	24.3 (13.6)	25.2 (11.1)	<0.0001

RE, retinol equivalents; α-TE, α-tocopherol equivalents.

\*Adjusted for age, race/ethnicity, and energy intake. Mean (SD)

<sup>†</sup>Based on t-test.

Table 3. Daily food group and nutrient intakes of veteran vs. non-veteran males in the Multiethnic Cohort, 1993-1996\*

Several reports from the Behavioral Risk Factor Surveillance System (BRFSS), a cross-sectional telephone survey of the civilian, noninstitutionalized adult population over the age of 18 years, has examined the prevalence of those considered overweight or obese among U.S. veterans compared with the general U.S. population. In a report based on the year 2000 BRFSS survey, the authors found that veterans tended to be overweight<sup>8</sup> and male veterans particularly were somewhat more likely to be obese<sup>12</sup>, which is consistent with the present study results. Similarly, based on the 2003 BRFSS, veterans who received care at the U.S. Department of Veterans Affairs (VA) facilities had higher rates of being overweight or obese than the general population<sup>5</sup>. In contrast, a report based on the 2004 BRFSS found a similar prevalence of these conditions among U.S. veterans and the general U.S. population<sup>13</sup>. An analysis combining the 2003 and 2004 BRFSS showed that being overweight was more frequent in veterans than in non-veterans but obesity prevalence was similar between the two groups<sup>14</sup>. Since our data were collected in the mid 1990's, they may be more comparable to the earlier BRFSS surveys. The more recent increase in the prevalence of being overweight and of obesity in the U.S. population generally and/or the VA weight control campaign<sup>15</sup> may have obliterated differences between veterans and non-veterans. In the current study, only weight and height information was

available, and thus, body fat distribution and muscle content could not be compared between veterans and non-veterans. However, the Multiethnic Cohort Study recently collected waist and hip circumferences in a follow-up survey, which should enable us to examine central adiposity as a risk factor for disease in the future. One limitation of the BMI as a measure of adiposity is its lack of specificity, since greater muscle mass will also result in a higher BMI.

Several studies in the U.S. have reported that the prevalence of smoking is higher in veterans than in non-veterans<sup>5,6,12,13,16,17</sup>, as shown also in our study. Koepsell et al.<sup>7</sup> speculated that young men who are already smokers may be more likely to enter the military services, or that military life may initiate tobacco use. However, we did not have information on the starting age of smoking, and thus cannot address this issue. The U.S. Department of Defense reported that the prevalence of cigarette smoking was higher in enlisted men than in officers in the Survey of Health Related Behaviors Among Active Duty Military Personnel<sup>18</sup> as well as in the more recent Millennium Cohort Study<sup>19</sup>, which is consistent with our finding that the proportion of smokers (at any time) was higher in enlisted men than in officers. Several factors may affect the smoking prevalence in the U.S. military, such as the lower cost of cigarettes and the stresses associated with military life



that may increase smoking prevalence, and the anti-smoking policy of the U.S. Department of Defense for health promotion in the military may decrease smoking prevalence. The suggestions of a higher proportion of heavy drinkers among veterans in this study, though not statistically significant, is also consistent with findings from a survey using nationally representative samples that reported more frequent daily or almost daily alcohol use in veterans than in non-veterans<sup>20</sup>.

With regard to diet, we found that veterans consumed fewer fruits and vegetables than non-veterans. The 2003 BRFSS<sup>5</sup> also reported that veterans were less likely to eat the recommended daily number of fruits and vegetables ( $\geq 5$  servings/day). In the current study, total fat intake in both veterans (30%) and non-veterans (29%) groups was within the recommended range, 20 to 35% of total energy intake<sup>21</sup>. The daily calcium intake of both groups was lower than the recommended intake for U.S. adult men (1,000 mg/day for 31-70 years)<sup>22</sup> probably because of their low consumption of milk and dairy products. Overall, our study showed fairly consistent results with previous studies on health-related behaviors of veterans and non-veterans, and provides additional information on their usual dietary intake. To our knowledge, this is the first study to compare usual nutrient intake between veterans and non-veterans, using a comprehensive validated food frequency questionnaire.

This study also had several limitations. The survey to identify military veterans in the Multiethnic Cohort was conducted in 2007, more than 10 years after cohort entry, which necessarily restricted participation to those who were alive at that time. Therefore, the population for this analysis may have been healthier than the full cohort at baseline, which was when the exposure variables were collected. Unfortunately, the overall response rate to the survey was not high (28%). When we contacted a random sample of non-respondents to the veterans' survey, we found that 57% of the sample were veterans, whereas 72% of our respondents identified themselves as veterans. This indicates some selection bias in the survey, with over-representation of veterans. Although the study population was limited to residents living in Hawaii and California, the participants comprised a reasonably representative sample of the general population as evidenced by comparisons with U.S. census data<sup>9</sup>. Nevertheless, the findings may not apply to the entire U.S. veteran population. In addition, all information, including weight and height, was based on self-report and was obtained only at one time, at cohort entry, and, though it seems unlikely, we cannot confirm the reliability of the data being similar for veterans and non-veterans. Although time since the end of military service might affect health-related characteristics of veterans, no information on this was available. Because veterans in this study were defined

as persons who had ever served in the U.S. military, they might be a rather heterogeneous group in terms of length of service, service branch, active duty/reserves, and so on, compared to a veterans group more strictly defined. The multiple comparisons in our analysis would have increased the probability of a type I error, though we used a conservative significance level of  $p < 0.0001$ . Finally, because this special survey was only completed recently, comparisons of actual disease incidence and mortality between veterans and non-veterans will require several more years of follow-up. Indeed, Zhu et al.<sup>23</sup> reported that cancer incidence patterns were different between the U.S. military and the general population, with incidence rates of some sites being higher and that of other sites lower in the restricted population<sup>23</sup>. The authors speculated that these differences may be related to access to medical care and cancer screening services, in addition to lifestyle factors.

In summary, veteran men in the Multiethnic Cohort were more likely to be overweight or obese, to have smoked at some stage, they were heavier consumers of red and processed meat and lighter consumers of fruits and vegetables on average compared to non-veterans, and that these differences were more extreme for enlisted men than for officers. Veterans' health-related characteristics and dietary intakes indicate that as a group, they had a somewhat less healthy lifestyle than did non-veterans, especially among the enlisted men, and thus presumably are at higher risk of subsequently developing chronic diseases such as diabetes, hypertension, cardiovascular diseases and certain types of cancers. Further study is warranted to investigate how the less healthy lifestyle of veterans affects their disease incidence in later life.

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