

Overweight and Obesity in Military Personnel: Sociodemographic Predictors

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In the United States, nationally representative civilian studies have shown that BMI is associated with select sociodemographic characteristics. Active-duty military personnel are not included in these surveys and the persistence of these associations in military personnel is unknown. Data from the worldwide, representative 2002 and 2005 Department of Defense (DoD) Surveys of Health-Related Behaviors Among Active Duty Military Personnel were used to assess the prevalence of overweight and obesity and, the association of BMI with sociodemographic characteristics. The final response bases included 12,756 (2002) and 16,146 (2005) personnel. Results indicated that the combined prevalence of overweight and obesity in military personnel increased to an all-time high in 2005 (60.5%) with higher prevalence of obesity in 2005 compared to 2002 (12.9% vs. 8.7, respectively, $P \leq 0.01$). Holding other variables constant, regression analysis indicated that women were significantly less likely than men to be overweight or obese in both survey years ($P \leq 0.0001$), which is contrary to civilian data. Similar to civilian data, the prevalence of obesity was significantly associated with increased age, black or Hispanic/Latino race/ethnicity, and being married ($P \leq 0.01$). US military personnel are not immune to the US obesity epidemic. Demographic characteristics associated with being overweight should be considered when developing military-sponsored weight management programs.

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Healthy People (HP) 2010 objectives were released in 2000 to improve the health of individuals, communities, and the nation (1). One HP2010 objective was to increase the proportion of adults with a healthy weight (BMI ≥ 18.5 and < 25) to at least 60%. The Department of Defense (DoD) designated this objective to be among the most important for their personnel (2,3). While active duty US military personnel are not included in nationally representative health surveys, the DoD monitors Healthy People objectives through the DoD Survey of Health-Related Behaviors Among Military Personnel (HRBS) (2,3).

Regular exercise among military personnel, with expectations to remain physically fit, might be assumed to prevent or reduce overweight and obesity and the prevalence of chronic conditions typically associated with obesity (4,5). Military personnel have a lower prevalence of high blood pressure than the US civilian population (3). However, the combined prevalence of overweight and obesity among active duty military personnel was ~9% higher in 1998 (59%) than in 1995 (54%), and the prevalence of obesity was ~20% higher (6% vs. 5%, respectively) which still met the *HP2000* objectives for overweight while rates for the US civilian population did not (6–9). In the US civilian population, the prevalence of obesity differs among

certain racial and ethnic populations disproportionately (8), and is positively associated with age and being married (9). HRBS data from 1995, 1998, and 2002 indicated that overweight military personnel were more likely to be male, older, African American or Hispanic, and married (6,7).

The purpose of this study was to assess changes in the prevalence of overweight and obesity (as indicated by BMI) from 2002 to 2005 among a representative sample of US military personnel, and to identify the association of select sociodemographic factors with overweight and obesity.

METHODS AND PROCEDURES

Data were from the 2002 and 2005 HRBS conducted by Research Triangle Institute International (2,3). A deidentified public use file was provided by the surveys' sponsor, TriCare Management Activity. The original HRBSs were approved by the Surgeon General of the US Army Human Subjects in Research Protection Office (Fort Detrick), and the Research Triangle Institute Institutional Review Board. This secondary analysis was approved by Institutional Review Boards at the US Army Research Institute of Environmental Medicine, TriCare Management Activity, and Abt Associates Inc.

The target populations for the anonymous, voluntary, 50-min survey included all active duty personnel at the time of the survey. Recruits, Service academy students, individuals absent without official leave, incarcerated individuals, and persons whose duty station

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had been changed, were excluded. After the survey, updated counts of military personnel were obtained and observed eligibility rates were applied to these new personnel counts for the sampling strata defined by the intersection of Service, region, gender, and pay grade groups. Adjustment factors were applied to the weights to correct for differences in the proportion responding in the sample relative to the proportion in the population. In this analysis, we used the adjusted sampling weights. Further design and analysis details can be found in the HRBS reports (2,3).

BMI (body mass in kilograms divided by squared height in meters, rounded to the nearest tenth) was calculated using respondents' self-reported height (in feet and inches) and weight (in pounds). Standard BMI definitions were used to classify respondents as underweight (<18.5), healthy weight (18.5–24.9), overweight (≥ 25 <30), or obese (≥ 30) (2,3,10). Gender, age, race/ethnicity, educational attainment, and marital status were included in the analysis. The participants were grouped after the study into "white/non-Hispanic," "black or African American/non-Hispanic," "Hispanic or Latino," and "other" based on their combined responses to two race/ethnicity questions. Military personnel of Hawaiian, Native American, or Asian descent were included in the "other" category for race/ethnicity due to the small sample size within these categories.

The data were analyzed using SAS (v 9.1; SAS Institute, Cary, NC). Odds ratios and 95% confidence intervals were computed using multivariate logistic regression for binary outcome measures to determine the degree of association between each sociodemographic characteristic and BMI. *t*-test and χ^2 -tests were used with a minimal acceptable level of $P \leq 0.05$.

RESULTS

In 2002 and 2005, the final sample sizes were 12,756 and 16,146, respectively (weighted sample: 1,125,083 and 1,011,852). The total DoD weighted prevalence of BMI, sociodemographic characteristics, and regression analyses are shown in **Table 1**.

The combined prevalence of overweight and obese individuals was 57.2% in 2002 and 60.5% in 2005. In 2005 the prevalence of individuals in the 18.5–24.9 BMI category was significantly lower ($38.6 \pm 0.87\%$) than 2002 ($42.2 \pm 0.80\%$), while the proportion of persons who were obese was significantly higher ($12.9 \pm 0.35\%$ vs. $8.7 \pm 0.40\%$, respectively).

In both survey years, women were significantly less likely to be overweight or obese compared to men ($P \leq 0.0001$) and there was a significant positive relationship between age and being overweight or obese ($P \leq 0.01$). In 2005, those aged 31–39 and 40+ were two to three times more likely to be obese as those aged 17–20.

In 2002 and 2005, blacks and Hispanics were more likely to be obese relative to whites ($P \leq 0.01$) and, married personnel were more likely to be overweight or obese than nonmarried personnel ($P \leq 0.01$).

DISCUSSION

Significantly fewer active duty military personnel were classified as healthy weight in 2005 than in 2002, and significantly more personnel were obese in 2005 compared to 2002 (2,3). The prevalence of overweight in 2005 was significantly associated with being male, older, or married, which is similar to earlier military studies (6,7). In this study, being African American or Hispanic/Latino was associated with obesity, but not consistently with overweight (10). Consistent with our findings in military personnel, age, race/ethnicity, and marital

status are associated with overweight and obesity in the US civilian population (4).

Age was associated with obesity among military personnel, most likely as a result of gaining small amounts of weight over many years (11,12). This trend thus should be considered more prominently when developing weight management interventions for military personnel and civilians alike. For example, Robbins *et al.* found that a low-intensity intervention consisting of weekly emails about diet and physical activity was effective in preventing annual weight gain (13).

Marital status should also be considered when developing weight management programs, since being married is a risk factor for overweight and obesity in military personnel and civilians (4). It may be advisable to investigate the addition of a family based or couples-based component to existing military and civilian weight management programs. Data from a meta-analysis on couples weight loss programs indicated that spouses undergoing weight loss treatment together were more successful in reaching their goals than persons who participated in treatment alone (14).

In contrast to recent civilian data where prevalence of obesity has been higher among women (35.5%) than among men (32.2%) (9), our study found that military males were more likely to be overweight or obese than females. Military personnel are highly active (2,3), which likely results in higher lean mass especially in males (15). The use of BMI as an estimate of body fat may misclassify some male respondents, in particular, as overweight due to excess lean mass (10,15). However, it is not clear why this gender association persists among obese military personnel and most likely cannot account for the entire reverse gender association between military and US civilians. Nevertheless, this finding indicates that existing weight management programs should be better targeted to military males in an effort to reduce obesity.

Even if the prevalence of overweight personnel in the present study may be somewhat overstated due to incorrect BMI classification of some military personnel with large lean body mass (10,15), only ~40% of military personnel met the HP2010 healthy weight objective in both survey years which is substantially below the 60% Healthy People 2010 target (1). According to these results, however, the military appeared to be more successful in meeting the healthy weight objective compared to the US civilian population (40% vs. 33%, respectively) (1).

A potential limitation of this study is that the height and weight data for the Military cohorts are self-reported. A validity study using National Health and Nutrition Examination Survey III data concluded that self-reported height and weight data did not differ significantly from measured data for younger adults (16). Also, military personnel monitor their body weight more closely than the US civilian populace (17); therefore, we believe that potential self-reported weight bias is minimized in the current study. In addition, we cannot determine the accuracy of the BMI categorizations in relation to lean body mass, since the DoD survey is based on self-reported heights and weights and does not take into account body fat.

Table 1 Weighted prevalence (%±SE) of selected sociodemographic characteristics and BMI, and association of BMI and sociodemographic characteristics, 2002 and 2005 Department of Defense Survey of Health-Related Behaviors Among Active Duty Military Personnel^a.

Characteristics	2002					2005				
	DoD 2002 (% ± SE)	BMI <18.5	BMI 18.5–24.9	BMI 25–29.9	BMI ≥30	DoD 2005 (% ± SE)	BMI <18.5	BMI 18.5–24.9	BMI 25–29.9	BMI ≥30
		Odds ratios	(95% Confidence levels)				Odds ratios	(95% Confidence levels)		
Total DoD (% ± SE)		0.7 ± 0.10 ^b	42.2 ± 0.80 ^b	48.5 ± 0.63 ^b	8.7 ± 0.40 ^b		0.9 ± 0.09 ^b	38.6 ± 0.87 ^b	47.6 ± 0.78 ^b	12.9 ± 0.35 ^b
Gender										
Men	83.1 ± 0.79 ^b	1	1	1	1	85.2 ± 0.94 ^b	1	1	1	1
Women	16.9 ± 0.79 ^b	3.97***	3.12***	0.37***	0.38***	14.8 ± 0.94 ^b	2.65***	2.42***	0.49***	0.55***
		(3.02–5.22)	(2.73–3.57)	(0.32, 0.42)	(0.31, 0.48)		(1.70, 4.11)	(2.02–2.898)	(0.40, 0.62)	(0.50, 0.60)
Age										
17–20	13.8 ± 0.98	1	1	1	1	14.1 ± 0.64	1	1	1	1
21–30	50.1 ± 1.34	0.94	0.62***	1.49***	1.68*	51.2 ± 1.86	0.82	0.69***	1.20**	1.81***
		(0.54–1.65)	(0.58–0.66)	(1.36, 1.63)	(1.02, 2.75)		(0.39, 1.73)	(0.65–0.74)	(1.07, 1.35)	(1.47, 2.24)
31–39	25.4 ± 1.12	0.46	0.34***	2.12***	2.85**	23.9 ± 1.14	0.035*	0.38***	1.66***	2.88***
		(0.21, 1.03)	(0.29–0.41)	(1.86, 2342)	(1.66, 4.90)		(0.13, 0.92)	(0.37–0.39)	(1.62, 1.70)	(2.46, 3.37)
40 or over	10.6 ± 1.01	0.23*	0.29***	2.62***	2.44**	10.8 ± 1.26	0.42*	0.34***	1.79***	3.01***
		(0.07, 0.72)	(0.25–0.34)	(2.31, 2.98)	(1.34, 4.44)		(0.20, 0.89)	(0.32–0.36)	(1.57, 2.04)	(2.42, 3.74)
Educational attainment										
High school or less	36.0 ± 1.69	1	1	1	1	33.9 ± 1.12	1	1	1	1
Some college	44.3 ± 1.19	0.88	0.87**	1.12*	1.07	44.1 ± 1.05	1.72	0.82***	1.26***	0.83**
		(0.46, 1.67)	(0.79–0.96)	(1.02, 1.22)	(0.92, 1.24)		(0.76, 3.91)	(0.75–0.91)	(1.16, 1.36)	(0.73, 0.94)
College graduate	19.7 ± 1.61 ^b	0.7	0.99	1.23*	0.61***	22.0 ± 1.96 ^b	1.07	1.07	1.33***	0.46***
		(0.22, 2.25)	(0.88–1.11)	(1.06, 1.42)	(0.51, 0.73)		(0.33, 3.49)	(0.86–1.34)	(1.19, 11.48)	(0.37, 0.58)
Race/ethnicity										
White/non-Hispanic	67.3 ± 1.27 ^b	1	1	1	1	64.4 ± 0.42 ^b	1	1	1	1
Black or African American/non-Hispanic	20.7 ± 1.40 ^b	0.77	0.76***	1.09	1.67***	17.6 ± 0.57 ^b	1.39***	0.66***	0.99	2.02***
		(0.34, 1.77)	(0.66–0.87)	(0.96, 1.24)	(1.40, 1.99)		(1.23, 1.57)	(0.56–0.77)	(0.76, 1.28)	(1.70, 2.40)
Hispanic or Latino	7.1 ± 0.41 ^b	0.78	0.82*	1.04	1.59**	8.8 ± 0.35 ^b	0.76*	0.76***	1.18***	1.26*
		(0.29, 2.09)	(0.68–0.97)	(0.88, 1.22)	(1.21, 2.09)		(0.59, 0.97)	(0.74–0.79)	(1.11, 1.25)	(1.05, 1.52)

Table 1 Continued on next page

Table 1 Continued

Characteristics	2002					2005				
	DoD 2002 (% ± SE)	BMI <18.5	BMI 18.5–24.9	BMI 25–29.9	BMI ≥30	DoD 2005 (% ± SE)	BMI <18.5	BMI 18.5–24.9	BMI 25–29.9	BMI ≥30
		Odds ratios	(95% Confidence levels)	Odds ratios	(95% Confidence levels)		Odds ratios	(95% Confidence levels)	Odds ratios	(95% Confidence levels)
Total DoD (% ± SE)		0.7 ± 0.10 ^b	42.2 ± 0.80 ^b	48.5 ± 0.63 ^b	8.7 ± 0.40 ^b		0.9 ± 0.09 ^b	38.6 ± 0.87 ^b	47.6 ± 0.78 ^b	12.9 ± 0.35 ^b
Other race	5.0 ± 0.54 ^b	0.99 (0.36, 2.70)	1.33* (1.03–1.72)	0.81 (0.65, 1.02)	0.77 (0.46, 1.26)	9.2 ± 0.16 ^b	1.45 (0.94, 2.24)	1.15** (1.05–1.27)	0.90* (0.83, 0.98)	0.89* (0.82, 0.98)
<i>Marital status</i>										
Single not living as married or with partner	55.7 ± 1.18	1	1	1	1	54.5 ± 0.96	1	1	1	1
Married or living as married/partners	44.3 ± 1.18	1.04 (0.72, 1.49)	0.76*** (0.69–0.84)	1.10* (1.01, 1.20)	1.67*** (1.40, 1.99)	45.5 ± 0.96	0.89 (0.40, 1.99)	0.79*** (0.71–0.89)	1.07** (1.02, 1.11)	1.43*** (1.27, 1.61)
<i>Branch of service</i>										
Army	3,269 (379,831)	1	1	1	1	3,639 (321, 576)	1	1	1	1
Navy	3,625 –285,475	1.91* (1.07, 3.42)	0.80** (0.69–0.94)	1.06 (0.95–1.18)	1.42** (1.12, 1.79)	4,627 (270,908)	0.55 (0.27, 1.14)	0.83 (0.64–1.08)	0.88 (0.77, 1.01)	1.99*** (1.54, 2.56)
Marines	3,008 –151,344	1.34 (0.65, 2.74)	1.17* (1.04–1.32)	1.02 (0.92, 1.14)	0.43*** (0.34, 0.55)	3,356 (128,589)	0.64 (0.29, 1.42)	1.16 (0.81–1.64)	0.99 (0.76, 1.29)	0.71 (0.49, 1.01)
Air force	2,854 –308,433	3.10** (1.59, 6.05)	0.95 (0.81–1.12)	1.02 (0.90, 1.16)	0.95 (0.79, 1.14)	4,524 –290,779	0.84 (0.53, 1.35)	1.02 (0.76–1.37)	0.86 (0.69, 1.07)	1.45** (1.19, 1.78)

Prevalence values (italicized throughout table) adapted with permission from Bray et al. (2,3); selected italicized values are reprinted with permission from *Preventive Medicine and Military Medicine: International Journal of AMSUS* (see ref. 21).

DoD, Department of Defense.

^aThe data for the DoD 2002 Health-Related Behaviors Survey Among Active Duty Military Personnel was collected from September 2002 through mid-February 2003; data for the DoD 2005 Health Behaviors Survey Among Active Duty Military Personnel was collected from April through August, 2005. ^bValues between the total DoD in 2002 in comparison with the total DoD in 2005 differed significantly, $P < 0.001$.

Statistical significance for odds ratios is represented as * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

In conclusion, similar to the US civilian population, active duty military are faced with a continuing problem of overweight and obesity. Weight status is a DoD concern since it increases the risk of chronic disease (18) and injuries (19). Additionally, overweight and obesity burdens the military healthcare system (20). While the US military services each have carefully developed weight management programs, the percent of obesity was higher in 2005 compared to 2002 and was positively associated with age and being male in both survey years. These data serve to underscore earlier reports (6,7) that active duty US military personnel are not immune to the obesity epidemic in the United States, and that this population requires a more proactive approach to target at-risk personnel in an effort to prevent the potentially deleterious health outcomes associated with excess weight gain.

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DISCLOSURE

All authors declare that they have no conflict of interest. The opinions or assertions contained herein are the private views of the author(s) and are not to be construed as official or reflecting the views of the Army, Department of Defense or TMA. Any citations of commercial organizations and trade names in this report do not constitute an official Department of the Army endorsement of approval of the products or services of these organizations.

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