

# Obesity in US Workers: The National Health Interview Survey, 1986 to 2002

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In the United States, obesity has risen at an unprecedented rate during the past 20 years,<sup>1</sup> and current research indicates that the situation is worsening rather than improving. From 1960 to 1980, the prevalence of obesity among adults in the United States was relatively stable; however, recent findings from the National Health and Nutrition Examination Survey (NHANES) showed that 3 out of every 10 US adults are obese.<sup>2</sup> In addition to increasing mortality from all causes, obesity is linked to an increased risk of developing hypertension, type 2 diabetes mellitus, dyslipidemia, gallbladder disease, osteoarthritis, coronary heart disease, stroke, asthma, and sleep apnea.<sup>3-7</sup> Additionally, new evidence suggests that obesity is a risk factor for endometrial, breast, prostate, and colon cancers.<sup>8-10</sup>

The relationship between obesity and occupation has not been fully investigated. Work-related factors, such as job and position, job stress, and extended work (including overtime night work and sedentary work) may promote weight gain and abdominal fat accumulation.<sup>11-14</sup> One of the national Healthy People 2010 Objectives is to reduce the prevalence rate of obesity among adults to less than 15%,<sup>15</sup> therefore, because treatment often fails, research efforts focused on prevention are required. Weight loss intervention and education programs targeting workers employed in various occupational groups are urgently needed, but, unfortunately, nationally representative data identifying occupational groups with the highest obesity rates are not presently available.<sup>16,17</sup> It is also not known which occupational groups are experiencing large increases in obesity rates. Our research objective was to evaluate overall, gender- and race-specific obesity rates and their 17-year trends, including the past decade, within 41 occupational groups using nationally representative samples of the US worker population.

**Objectives.** Obesity has emerged as one of the most important public health issues in the United States. The present study assesses obesity prevalence rates and their trends among major US occupational groups.

**Methods.** Self-reported weight and height were collected annually on US workers, aged 18 years or older, from the 1986 to 1995 and the 1997 to 2002 National Health Interview Surveys. Overall, occupation-, race-, and gender-specific rates of obesity (defined as a body mass index >30.0 kg/m<sup>2</sup>) were calculated with data pooled from both study periods (n > 600 000). Annual occupation-specific prevalence rates were also calculated, and their time trends assessed.

**Results.** Obesity rates increased significantly over time among employed workers, irrespective of race and gender. The average yearly change increased from 0.61% (±.04) during the period from 1986 to 1995, to 0.95% (±.11) during the period from 1997 to 2002. Average obesity prevalence rates and corresponding trends varied considerably across occupational groups; pooled obesity prevalence rates were highest in motor vehicle operators (31.7% in men; 31.0% in women).

**Conclusions.** Weight loss intervention programs targeted to workers employed in occupational groups with high or increasing rates of obesity are urgently needed. (*Am J Public Health*. 2005;95:XXX-XXX. doi:10.2105/AJPH.2004.050112)

## METHODS

The National Health Interview Survey (NHIS) is a continuous multipurpose and multistage probability area survey of the US civilian noninstitutionalized population living at addressed dwellings.<sup>18</sup> Each week, a probability sample of households is interviewed by trained personnel to obtain information about the characteristics of each member of the household.<sup>19</sup> In the majority of cases (63%) in the 1986 to 1996 NHIS surveys, the participants themselves answered all the questions; for the remaining participants, the responses were obtained from their relatives or other proxies. However, beginning with the 1997 NHIS survey, all survey responses were self-reported. For simplicity, in the present study, both self-reported or proxy-reported data are referred to as “reported.” In the period from 1986 to 1996, annual NHIS survey response rates ranged from 95% to 98%<sup>20</sup>; in the period from 1997 to 2002, these rates fell to 70%–80%, reflecting the trend of lower response rates in all national surveys.<sup>21,22</sup>

Body mass index (BMI) is commonly used to define obesity and has been found to closely correlate with the level of body fat.<sup>23</sup> BMI was calculated by dividing weight in kilograms by height in meters squared. Respondents were classified as obese if their BMI was greater than 30.0 kg/m<sup>2</sup>.<sup>24</sup> From 1986 to 1995, the NHIS reported weight and height values for all participants. Data from the 1996 survey year are not presented because, for that year, the National Center for Health Statistics (NCHS) reported data only for participants with a weight between 98 and 289 pounds and a height between 59 and 76 inches; BMI for the 1996 participants outside of these weight and height ranges were not made available by NCHS. Starting in 1997, the NHIS was redesigned and the NCHS made available the BMI values for all participants, even those with weight and height outside the above ranges.<sup>25</sup> Because of these differences in the reporting, and because of the major redesign of the sampling and interview format, we analyzed data separately for NHIS survey periods 1986 to 1995 and 1997 to 2002.

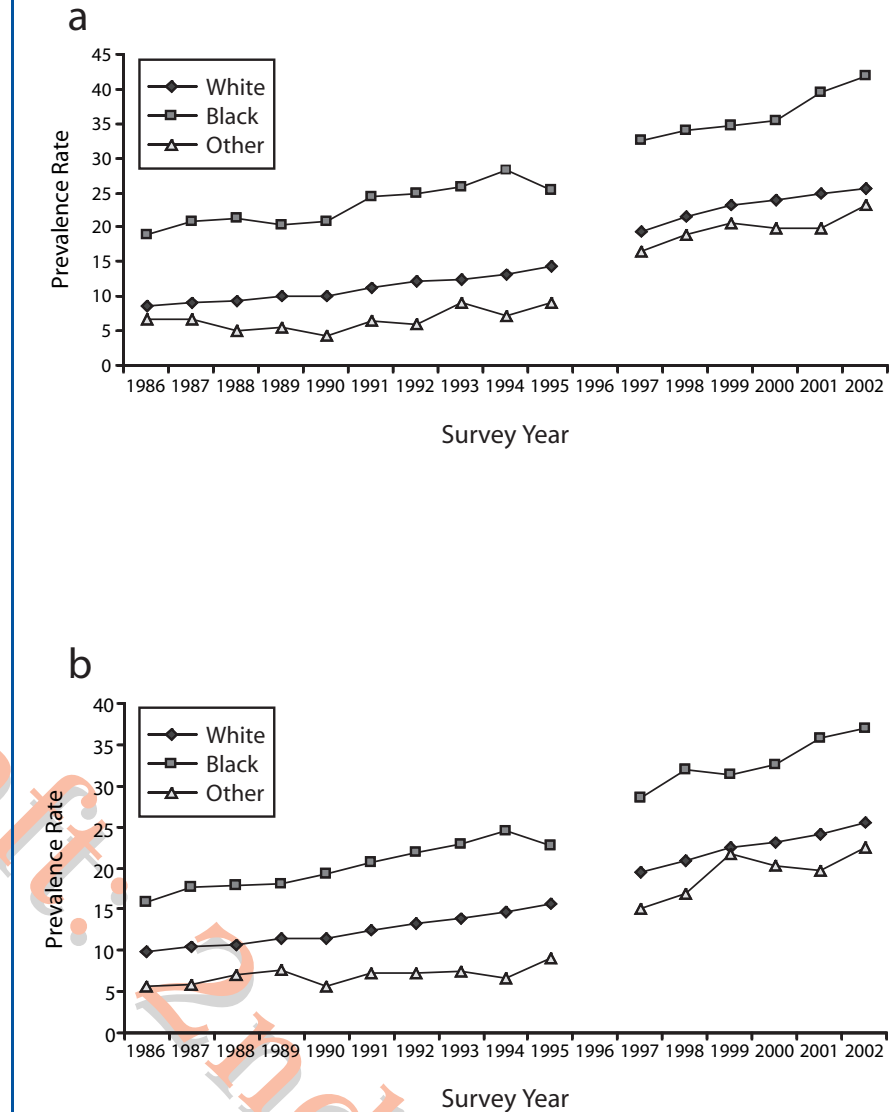
In the 1986 to 1995 NHIS, employment information was collected on all subjects aged 18 years or older who reported working during the 2 weeks prior to the survey<sup>26,27</sup>; starting in 1997, NCHS collected employment information from adults who stated that they were working during the week before the NHIS survey. Both of these definitions included paid and unpaid work. Forty-one standardized occupational codes derived from more detailed US Census occupational codes were provided in the NHIS database from 1986 to 1995 and from 1997 to 2002.<sup>28,29</sup> We grouped survey participants in the trend data analysis into White, Black, or “other race” category. “Other race” included other, Aleutian Eskimo/American Indian, Asian/Pacific Islander, and unknown/multiple races.

Because of the complex sample survey design, analyses were completed with the SUDAAN package to take into account sample weights and design effects.<sup>30</sup> For pooled prevalence estimates, sample weights were adjusted to account for the aggregation of data over multiple survey years by dividing the original weight by 10 (the number of years combined in survey years 1986 through 1995) and by 6 (the number of years combined in survey years 1997 through 2002).<sup>18</sup> To assess obesity trends within each survey period, a weighted linear regression model was fitted to the annual design-adjusted rates within occupational groups. The weight used for each annual rate was the inverse of its variance.

## RESULTS

A total of 603 139 persons aged 18 years and older reported working within the 2 weeks prior to their participation in the 1986 to 1995 NHIS surveys, and in the 1 week prior to their participation in the 1997 to 2002 NHIS surveys. Among the 488 612 workers in the 1986 to 1995 survey period, the mean age ( $\pm$ SD) was 38.9  $\pm$ 12.8, with a total of 226 128 women (46.3%); the mean age of the 114 527 workers from the 1997 to 2002 period was 40.3  $\pm$ 12.7, including 57 198 women (49.9%).

The average yearly change ( $\pm$ SE) in obesity rates increased from 0.61% ( $\pm$ .04) in the 1986 to 1995 period to 0.95% ( $\pm$ .11)



**FIGURE 1—Trends in gender- and race-specific prevalence rates of obesity among working adults, (a) men and (b) women: the National Health Interview Survey, 1986 to 2002.**

in the 1996 to 2002 period. Annual obesity rates increased significantly among all gender-race groups in the survey periods 1986 to 1995 and 1997 to 2002 (Figure 1). In all survey years, annual obesity rates were highest in Black workers (particularly women) and lowest among those in the “other race” category.

For each gender and each 1 of the 41 occupational groups, Tables 1 and 2 show: the sample size; the percentage of Black workers for each occupational group (given that Black workers had the highest rates of

obesity); the pooled and annual prevalence rates of obesity; and the slope (i.e., yearly change in obesity rate) of the weighted linear regression of rate of obesity over time, its standard error, and the corresponding *P* value. Slopes were not calculated for a particular occupational group when the sample size for any given survey year was below 46. Pooled and annual obesity rates preceded by an asterisk have a relative standard error [defined as 100  $\times$  SE (rate)/rate] of greater than 30% and, following the

**TABLE 1—Pooled and Annual Prevalence Rates of Obesity in 41 Occupational Categories: the National Health Interview Survey, 1986–1995**

Occupation	No.	Estimated US Population	Percentage Black	Overall Prevalence	Annual Prevalence Rate of Obesity										Slope ±SE	P
					1986	1987	1988	1989	1990	1991	1992	1993	1994	1995		
<b>Men</b>																
Officials and administrators (public administration)	1341	320 864	7.2	14.95	10.3	13.2	12.4	16.0	16.3	13.3	13.4	14.4	19.3	19.2	0.631±0.245	.03
Managers and administrators (except public administration)	30 273	7 217 767	4.9	13.11	11.4	10.6	11.5	12.7	12.6	12.8	13.2	15.0	15.5	15.6	0.578 ±0.064	.00
Management-related occupations	7822	1 882 304	6.0	11.97	12.2	10.3	10.0	9.9	10.6	10.3	12.6	14.2	14.6	15.3	0.545±0.170	.01
Engineers	7578	1 821 250	3.8	10.37	9.2	8.8	10.9	8.3	8.6	10.5	10.8	9.6	12.2	15.2	0.389 ±0.179	.06
Architects and surveyors	729	174 141	3.5	8.34	8.3 <sup>a</sup>	14.5 <sup>a</sup>	4.8 <sup>a</sup>	8.7 <sup>a</sup>	4.7 <sup>a</sup>	12.6	8.1 <sup>a</sup>	10.7 <sup>a</sup>	6.0 <sup>a</sup>	9.7 <sup>a</sup>	<sup>b</sup>	<sup>b</sup>
Natural, mathematical/computer scientists	3835	939 904	5.3	10.43	5.8	9.7	9.8	10.0	7.8	9.2	10.1	11.1	15.1	12.3	0.641 ±0.192	.01
Health-diagnosing occupations	2813	664 264	3.4	6.15	2.8	4.1	10.2	4.8	5.9	5.0	4.8	10.1	6.5	7.0	0.335 ±0.224	.17
Health assessment/treating occupations	1349	323 775	8.0	11.03	6.9	4.7	7.8	14.5	10.7	15.9	9.9	16.7	13.1	9.5	0.791 ±0.344	.05
Teachers, librarians, counselors	6904	1 643 367	7.4	12.66	7.9	10.5	12.1	12.1	13.5	12.2	12.9	14.5	12.3	17.8	0.613 ±0.171	.01
Writers, artists, entertainers, athletes	4206	1 032 077	6.5	9.68	8.3	5.7	7.5	10.6	9.0	7.4	12.0	12.2	15.1	8.4	0.593 ±0.265	.06
Other professional specialty occupations	5612	1 332 807	7.9	11.86	8.8	9.9	9.6	10.6	10.4	12.8	12.9	13.9	15.4	13.7	0.719 ±0.094	.00
Health technologists/technicians	1046	257 832	12.6	12.37	9.3 <sup>a</sup>	5.3 <sup>a</sup>	11.7	9.1	6.3 <sup>a</sup>	7.3	17.8	11.7	18.4	16.2	<sup>b</sup>	<sup>b</sup>
Technologists, technicians (except health)	7621	1 854 827	6.7	11.72	10.1	9.5	9.4	9.9	11.8	11.0	12.1	13.9	13.0	15.3	0.586 ±0.088	.00
Supervisors and proprietors	9661	2 325 275	3.8	13.02	9.9	10.9	10.2	11.5	11.2	15.7	14.5	14.4	14.7	15.8	0.710 ±0.127	.00
Sales representatives, commodities and finance	9883	2 380 853	3.6	12.13	9.9	10.4	11.3	12.3	10.6	9.9	12.9	12.9	15.0	15.9	0.568 ±0.145	.00
Other sales personnel	8391	2 018 715	7.9	12.07	7.1	10.1	9.9	11.6	10.8	12.3	13.5	14.7	13.0	16.3	0.762 ±0.114	.00
Computer equipment operators	920	222 071	12.8	12.53	10.1	9.1	9.8	10.5	13.2	12.3	15.1	16.3	21.0	13.9 <sup>a</sup>	<sup>b</sup>	<sup>b</sup>
Secretaries, stenographers, and typists	340	79 564	16.6	11.01	0.0	8.4 <sup>a</sup>	12.1 <sup>a</sup>	17.3 <sup>a</sup>	7.0 <sup>a</sup>	12.7 <sup>a</sup>	15.7 <sup>a</sup>	4.9 <sup>a</sup>	10.0 <sup>a</sup>	22.0 <sup>a</sup>	<sup>b</sup>	<sup>b</sup>
Financial records processing occupations	889	215 674	8.4	9.81	4.4	7.4	8.8	9.5	10.1	9.4	12.7	11.9	12.7	14.8	0.984 ±0.129	.00
Mail and message distribution personnel	2482	570 995	17.4	11.88	6.6	7.2	12.1	12.4	13.2	12.5	15.0	10.5	13.4	18.2	0.918 ±0.243	.01
Other administrative support personnel	10 893	2 629 800	12.5	13.56	10.4	12.5	9.4	9.4	11.3	13.0	16.2	16.4	16.7	17.5	0.940 ±0.202	.00
Private household occupations	153	34 702	18.6	15.80	24.9 <sup>a</sup>	26.7 <sup>a</sup>	17.0 <sup>a</sup>	1.2 <sup>a</sup>	18.1 <sup>a</sup>	10.2 <sup>a</sup>	17.8 <sup>a</sup>	26.4 <sup>a</sup>	7.3 <sup>a</sup>	16.3 <sup>a</sup>	<sup>b</sup>	<sup>b</sup>
Police and firefighters	4258	1 023 980	12.5	17.70	15.2	13.8	15.6	18.0	13.9	19.3	18.2	18.6	18.7	24.2	0.871 ±0.229	.01
Other protective service occupations	2718	636 439	21.2	19.16	13.7	13.2	19.6	19.6	16.9	21.0	20.8	21.0	23.8	21.7	1.066 ±0.231	.00
Food service personnel	7182	1 719 150	16.1	9.94	7.1	9.1	9.1	9.2	9.4	10.1	10.1	12.4	10.1	12.0	0.384 ±0.093	.00
Health service personnel	896	207 000	30.4	16.58	14.3 <sup>a</sup>	18.0	10.3 <sup>a</sup>	17.0 <sup>a</sup>	17.1	16.6	15.8	17.1	20.9	16.8	<sup>b</sup>	<sup>b</sup>
Cleaning and building service personnel	7421	1 666 428	21.3	14.52	11.9	14.2	11.6	15.0	14.4	14.0	16.1	17.2	14.2	16.3	0.414 ±0.152	.03
Personal service workers	1808	429 701	15.2	9.71	3.3 <sup>a</sup>	9.6	6.3 <sup>a</sup>	8.6	6.2 <sup>a</sup>	5.8 <sup>a</sup>	14.9	10.4	11.5	17.7	0.973 ±0.340	.02
Farm operators and managers	5041	1 110 014	2.0	15.37	11.9	14.2	14.1	14.5	16.1	14.6	15.3	20.9	14.8	20.6	0.620 ±0.214	.02
Farm workers and other agricultural workers	5714	1 288 324	10.5	12.36	10.4	9.0	12.1	11.2	13.8	13.3	12.2	10.4	15.9	14.4	0.490 ±0.192	.03
Forestry and fishing occupations	742	186 114	10.4	15.10	10.7 <sup>a</sup>	12.3 <sup>a</sup>	9.8 <sup>a</sup>	12.0 <sup>a</sup>	12.7 <sup>a</sup>	24.0	16.9	17.6	24.2	13.2 <sup>a</sup>	0.966 ±0.430	.06
Mechanics and repairers	16 727	3 953 408	7.5	14.51	12.8	12.6	11.4	14.6	14.2	14.5	14.9	16.6	15.9	18.0	0.601 ±0.108	.00
Construction and extractive trades	20 296	4 815 157	6.9	12.19	10.8	11.5	9.8	10.5	11.3	11.7	14.1	15.8	13.4	13.4	0.517 ±0.142	.01
Precision production occupations	12 183	2 845 536	7.2	14.62	11.7	13.0	12.4	15.0	14.5	14.4	15.1	18.0	16.6	16.2	0.576 ±0.102	.00
Machine operators/tenders (except precision)	13 316	3 094 652	13.2	14.50	10.5	12.4	13.0	13.8	14.8	15.0	15.3	15.7	18.2	16.4	0.671 ±0.085	.00
Fabricators, assemblers, inspectors, samplers	6 702	1 557 173	11.6	14.41	11.6	13.7	12.2	13.3	13.2	15.3	15.6	15.5	15.6	18.1	0.568 ±0.103	.00
Motor vehicle operators	13 567	3 136 798	15.3	19.83	17.7	16.2	18.4	18.0	19.6	20.7	19.7	19.5	23.7	24.1	0.713 ±0.140	.00

Continued

TABLE 1—Continued

Other transportation (except motor vehicles)	698	168 742	7.5	18.20	10.8 <sup>a</sup>	11.9 <sup>a</sup>	20.4	18.6	16.0	17.6 <sup>a</sup>	29.3	10.9 <sup>a</sup>	24.7	18.6	b	b
Material-moving equipment operators	4396	1 018 823	13.4	19.18	16.8	16.9	16.9	15.6	20.8	18.7	26.1	19.2	21.1	20.7	0.670 ±0.267	.04
Construction laborers	2890	676 292	13.5	11.98	9.5	11.6	12.2	11.9	9.3	11.3	13.5	12.3	12.0	15.3	0.378 ±0.162	.05
Freight, stock, material handlers	11 188	2 618 398	16.5	12.46	8.9	10.3	10.5	12.9	12.4	12.5	12.2	13.4	15.4	15.6	0.645 ±0.095	.00
<b>Women</b>																
Officials and administrators (public administration)	1040	230 806	12.0	11.54	11.7 <sup>a</sup>	9.3 <sup>a</sup>	13.3	9.2 <sup>a</sup>	5.5 <sup>a</sup>	12.4	11.5	11.3	18.0	10.7	b	b
Managers administrators (except public administration)	17 747	4 057 038	6.9	10.26	8.0	9.4	8.0	8.6	10.4	9.7	11.3	11.7	10.2	13.7	0.501 ±0.119	.00
Management-related occupations	9035	2 066 419	9.3	9.24	6.6	7.3	7.1	6.8	8.3	9.0	8.3	12.2	10.9	13.4	0.709 ±0.129	.00
Engineers	694	159 477	7.5	5.75	0.0	2.1 <sup>a</sup>	6.2 <sup>a</sup>	3.1 <sup>a</sup>	8.4 <sup>a</sup>	4.3 <sup>a</sup>	4.0 <sup>a</sup>	9.2 <sup>a</sup>	9.8 <sup>a</sup>	9.9 <sup>a</sup>	b	b
Architects and surveyors	109	24 678	3.3	1.67 <sup>a</sup>	0.0	6.3 <sup>a</sup>	5.4 <sup>a</sup>	0.0	0.0	0.0	0.0	0.0	0.0	2.6 <sup>a</sup>	b	b
Natural, mathematical/computer scientists	1830	423 638	8.7	7.85	1.4 <sup>a</sup>	5.5 <sup>a</sup>	11.4	7.2	8.4	6.7	11.3	8.1	6.4	8.8	0.580 ±0.290	.08
Health-diagnosing occupations	735	167 635	6.6	4.27	3.0 <sup>a</sup>	5.4 <sup>a</sup>	4.2 <sup>a</sup>	6.6 <sup>a</sup>	2.8 <sup>a</sup>	4.1 <sup>a</sup>	4.6 <sup>a</sup>	3.7 <sup>a</sup>	4.7 <sup>a</sup>	3.6 <sup>a</sup>	b	b
Health assessment/treating occupations	9457	2 15 290	9.4	11.57	9.0	8.9	10.4	9.9	9.3	13.0	12.7	13.5	14.9	12.8	0.624 ±0.127	.00
Teachers, librarians, counselors	15 718	3 551 611	9.3	10.33	8.6	7.9	9.6	8.6	8.8	10.4	11.3	12.2	11.4	13.4	0.563 ±0.095	.00
Writers, artists, entertainers, athletes	3999	936 020	4.4	6.59	5.1	4.1	6.5	7.1	6.7	7.5	7.3	5.6	7.0	8.2	0.317 ±0.110	.02
Other professional specialty occupations	3956	882 293	13.6	11.22	9.9	7.8	7.4	10.4	11.0	12.4	11.4	13.5	14.2	11.7	0.674 ±0.159	.00
Health technologists/technicians	5033	1 109 678	14.9	15.10	14.7	13.4	14.5	14.6	12.7	15.7	14.4	14.2	17.3	18.5	0.395 ±0.158	.04
Technologists, technicians (except health)	3559	826 693	8.4	8.71	6.0	6.9	5.4	7.4	7.5	9.3	9.9	10.2	12.4	11.6	0.738 ±0.099	.00
Supervisors and proprietors	5598	1 278 544	6.2	11.78	10.6	8.6	9.9	11.5	12.5	11.5	12.6	12.0	13.3	14.0	0.497 ±0.093	.00
Sales representatives, commodities and finance	5167	1 193 821	4.7	6.58	4.5 <sup>a</sup>	3.8	5.9	4.8	5.7	6.5	8.3	8.2	8.6	9.2	0.635 ±0.085	.00
Other sales personnel	16 605	3 796 117	11.0	10.83	8.2	9.6	8.2	9.9	10.0	11.8	11.9	13.1	12.7	13.2	0.594 ±0.084	.00
Computer equipment operators	1810	400 929	14.5	9.99	7.1 <sup>a</sup>	6.5	9.0	9.8	11.3	14.2	10.4	15.4	13.6	4.8 <sup>a</sup>	0.329 ±0.364	.39
Secretaries, stenographers and typists	18 167	4 131 183	8.6	9.58	6.8	6.6	7.7	7.7	9.0	10.7	10.0	12.2	13.8	14.4	0.889 ±0.084	.00
Financial records processing occupations	8563	1 955 437	6.0	11.00	8.2	9.2	9.1	9.0	9.6	11.4	11.7	13.3	14.0	16.7	0.810 ±0.111	.00
Mail and message distribution personnel	1538	328 665	22.5	13.60	7.2 <sup>a</sup>	8.7	15.1	8.7	13.0	16.0	15.1	15.1	23.1	15.9	1.155 ±0.341	.01
Other administrative support	29 669	6 687 733	12.8	11.94	7.5	10.6	9.3	11.6	10.2	11.5	13.0	13.5	15.1	15.1	0.767 ±0.107	.00
Private household occupations	3369	697 123	27.7	18.85	22.0	18.4	17.9	20.4	17.4	18.7	17.1	19.3	20.9	16.0	-0.232 ±0.194	.27
Police and firefighters	628	138 860	26.6	11.41	1.6 <sup>a</sup>	13.3 <sup>a</sup>	10.7 <sup>a</sup>	2.2 <sup>a</sup>	16.6	7.2 <sup>a</sup>	14.2 <sup>a</sup>	14.9 <sup>a</sup>	10.0	16.6	b	b
Other protective service occupations	721	159 289	22.3	15.42	6.2 <sup>a</sup>	9.4 <sup>a</sup>	18.4	17.1 <sup>a</sup>	14.1	19.0	16.7	17.6	16.3	16.7	b	b
Food service personnel	12 391	2 785 582	11.2	12.85	8.5	11.6	12.4	12.4	11.2	13.0	14.1	14.5	14.8	15.3	0.586 ±0.107	.00
Health service personnel	8292	1 756 092	26.5	20.95	19.7	20.6	17.8	18.8	18.1	21.6	23.4	19.3	25.3	24.4	0.613 ±0.244	.04
Cleaning and building service personnel	5523	1 149 738	26.4	19.70	17.6	18.9	17.8	21.6	15.7	22.3	22.3	18.2	19.8	22.4	0.374 ±0.290	.23
Personal service workers	8514	1 908 222	11.3	13.73	13.3	14.1	11.8	12.3	10.0	14.4	14.1	14.7	16.4	15.3	0.438 ±0.200	.06
Farm operators and managers	1033	221 061	0.9	11.69	5.4 <sup>a</sup>	8.9	9.2	11.9	12.1	16.2	16.8	10.0 <sup>a</sup>	14.5	14.3	0.965 ±0.271	.01
Farm workers and other agricultural workers	1275	283 096	4.7	12.79	8.2 <sup>a</sup>	10.1	8.6	13.0	14.0	8.8	17.8	12.1	20.6	14.4	0.836 ±0.326	.03
Forestry and fishing occupations	31	7307	14.2	15.30 <sup>b</sup>	100.0	0.0	0.0	17.3 <sup>a</sup>	0.0	0.0	23.1 <sup>a</sup>	0.0	48.1 <sup>a</sup>	0.0	b	b
Mechanics and repairers	715	159 931	14.1	12.44	8.1 <sup>a</sup>	12.6 <sup>a</sup>	9.4 <sup>a</sup>	13.7 <sup>a</sup>	2.1 <sup>a</sup>	12.8	17.4	17.8	12.6	20.6	1.092 ±0.924	.27
Construction and extractive trades	473	104 398	8.3	10.62	6.4 <sup>a</sup>	6.1 <sup>a</sup>	11.4 <sup>a</sup>	5.4 <sup>a</sup>	10.8 <sup>a</sup>	8.5 <sup>a</sup>	8.1 <sup>a</sup>	28.9 <sup>a</sup>	15.1 <sup>a</sup>	13.2	b	b
Precision production occupations	3844	847 349	11.6	14.35	13.7	13.2	11.6	13.5	12.8	13.4	14.6	16.7	17.1	17.4	0.585 ±0.139	.00

Continued

TABLE 1—Continued

Machine operators/tenders (except precision)	9280	2 008 473	17.9	16.39	14.0	14.7	15.2	14.8	15.4	18.0	18.2	18.2	19.7	17.4	0.553 ±0.108	.00
Fabricators, assemblers, inspectors, samplers	4409	964 580	16.0	15.79	11.3	13.0	14.2	15.3	16.2	15.3	16.3	21.4	17.5	18.1	0.784 ±0.163	.00
Motor vehicle operators	1728	376 126	15.4	22.61	21.4	18.3	14.8	20.7	22.1	25.5	24.9	25.2	26.2	25.9	1.196 ±0.287	.00
Other transportation, except motor vehicles	23	5277	17.5	19.91 <sup>a</sup>	0.0	0.0	31.6 <sup>a</sup>	0.0	0.0	0.0	100.0	0.0	0.0	40.7 <sup>a</sup>	<sup>b</sup>	<sup>b</sup>
Material moving equipment operators	255	55 875	18.5	16.54	6.4 <sup>b</sup>	16.3 <sup>a</sup>	13.0 <sup>a</sup>	32.4 <sup>a</sup>	10.8	6.6 <sup>a</sup>	36.5 <sup>a</sup>	13.3 <sup>a</sup>	21.4 <sup>a</sup>	4.1 <sup>a</sup>	<sup>b</sup>	<sup>b</sup>
Construction laborers	88	21 029	18.3	12.81 <sup>a</sup>	11.8 <sup>a</sup>	0.0	32.4 <sup>a</sup>	7.8 <sup>a</sup>	0.0	7.6 <sup>a</sup>	13.0 <sup>a</sup>	0.0	21.3 <sup>a</sup>	31.7 <sup>a</sup>	<sup>b</sup>	<sup>b</sup>
Freight, stock, material handlers	3507	765 254	15.2	14.20	12.8	10.9	15.6	15.1	13.3	14.2	16.0	15.3	14.8	13.9	0.311 ±0.179	.12

<sup>a</sup>Estimates have a relative standard error > 30% and should be used with caution, as they do not meet NCHS standards of reliability or precision.<sup>31</sup>

<sup>b</sup>Trends were not calculated when the sample size for any individual survey year fell below 45.

practice of the NCHS, should be considered imprecise estimates.<sup>31</sup>

During the period from 1986 to 1995, the highest pooled obesity rates were observed for male workers employed as motor vehicle operators (19.8%), material-moving equipment operators (19.2%), and other protective services employees (19.2%); for female workers, the highest pooled obesity rates were among motor vehicle operators (22.6%), health services workers (21.0%), and cleaning and building services workers (20.0%). Among men, the only occupational group with a pooled obesity prevalence rate below 7% was that of individuals employed in the health-diagnosing occupations (6.2%); female occupations with obesity prevalence rates below 7% included architects and surveyors (1.7%); health-diagnosing occupation employees (4.3%); engineers (5.8%); sales representatives and commodities and finance workers (6.6%); and writers, artists, entertainers, and athletes (6.6%). Irrespective of gender, there were no employed groups that experienced a reduction in obesity rates during this time period. Occupational groups with a significant increase of 1% or greater per year included male workers employed in the other protective service occupations (1.07 ±.23,  $P < .001$ ), female motor vehicle operators (1.20 ±.29,  $P < .001$ ), and female mail and message distributors (1.16 ±.34,  $P < .01$ ).

In the period from 1997 to 2002, the highest pooled obesity rates were observed for male workers employed as motor vehicle operators (31.7%), police and firefighters

(29.8%), other transportation except motor vehicle moving operators (28.7%), and material-moving equipment operators (28.2%); and, for female workers, those employed as motor vehicle operators (31.0%), other protective service workers (30.5%), material-moving equipment operators (29.5%), and cleaning and building service workers (25.3%). In contrast to the earlier survey period, there were no occupational groups among the men with an obesity rate below 11%. Among women, only those employed in the health-diagnosing occupations (10.3%), as architects and surveyors (7.3%), and in the construction and extractive trades (6.9%) had obesity rates below 11%. There were no significant downward trends in obesity rates for any occupational group during the survey period from 1997 to 2002. Obesity rates among male workers employed as police or firefighters had an annual increase of 2.1% (±.8); female workers with annual increases above 2% included motor vehicle operators (5.7 ±1.1); health service workers (2.4 ±.5); other professional specialty occupation employees (2.1 ±.7); and fabricators, assemblers, inspectors, and samplers (2.1 ±.9).

## DISCUSSION

Using data from a large, nationally representative sample of US workers, we found that obesity rates were higher for female workers than for male workers within most of the 41 occupational groups. Black female workers were found to have the highest

prevalence of obesity relative to “other race” and White workers of both genders. However, it is important to note that over the past decade, obesity rates were rising in all worker groups, irrespective of race and gender. Among the various US working groups, the prevalence of obesity increased almost 10% between the survey years 1986 and 2002. This increasing obesity epidemic poses substantial challenges to the US workforce.

Obesity and its related health conditions directly damage the health and well-being of the current workforce and significantly contribute to long-term chronic disability.<sup>32–36</sup> Additionally, the significant increase in the prevalence of obesity among children and adolescents indicates an even greater problem that employers will likely confront within the future workforce.<sup>37</sup> Short-term disability claims attributed to obesity have increased 10-fold over the past decade, according to an UnumProvident study that analyzed its extensive disability database.<sup>38</sup> Obesity-related disabilities cost employers an average of \$8720 per employee every year.<sup>38</sup> Designing and implementing worksite weight-loss programs that educate and help employees to achieve and maintain weight loss could substantially reduce the costly health burden on both employers and workers. This effort will not only prevent work-related illness, injury, and disability but will promote healthy lifestyles, which, in turn, will prevent and reduce chronic disease in working-age Americans, many of whom spend 8 to 12 hours per day at work.

**TABLE 2—Pooled and Annual Prevalence Rates of Obesity in 41 Occupational Categories: the National Health Interview Survey, 1997–2002**

Occupation	No.	Estimated US Population	Percentage Black	Overall Prevalence	Annual Prevalence Rate of Obesity						Slope ±SE	P
					1997	1998	1999	2000	2001	2002		
<b>Men</b>												
Officials and administrators (public administration)	335	401 695	12.70	27.79	26.5	25.3	21.1 <sup>a</sup>	18.4 <sup>a</sup>	32.8	38.0	b	b
Managers administrators (except public administration)	6005	7 316 851	5.40	22.34	17.4	22.4	25.0	20.3	24.1	24.6	1.152 ±0.556	.11
Management-related occupations	1767	2 114 629	7.20	19.12	16.3	20.3	14.5	22.8	20.9	20.1	0.820 ±0.718	.32
Engineers	1471	1 831 119	4.10	18.18	14.9	15.4	16.2	22.6	16.9	23.4	1.317 ±0.628	.10
Architects and surveyors	158	185 661	4.50	14.54	9.4 <sup>a</sup>	21.1 <sup>a</sup>	11.1 <sup>a</sup>	12.6 <sup>a</sup>	13.6 <sup>a</sup>	14.1 <sup>a</sup>	b	b
Natural, mathematical/computer scientists	1543	1 794 908	4.90	18.85	18.5	19.1	15.1	15.5	25.1	18.6	0.439 ±0.885	.65
Health-diagnosing occupations	579	745 432	2.20	11.19	7.2 <sup>a</sup>	8.0 <sup>a</sup>	17.1	17.1	8.6 <sup>a</sup>	10.8 <sup>a</sup>	0.642 ±0.851	.49
Health assessment/treating occupations	357	412 753	9.00	22.20	22.3	12.0 <sup>a</sup>	25.6 <sup>a</sup>	23.1	17.4 <sup>a</sup>	31.2	1.360 ±1.668	.46
Teachers, librarians, counselors	1798	2 073 333	8.00	20.37	17.8	20.2	21.6	19.7	21.1	21.4	0.574 ±0.249	.08
Writers, artists, entertainers, athletes	1104	1 202 685	8.00	16.88	12.4	17.5	14.1	18.4	18.1	20.8	1.360 ±0.473	.05
Other professional specialty occupations	1231	1 426 256	9.00	20.72	16.8	23.1	13.5	27.3	18.5	25.8	1.141 ±1.278	.42
Health technologists/technicians	302	358 786	10.90	13.67	15.5 <sup>a</sup>	9.2 <sup>a</sup>	7.6 <sup>a</sup>	23.0 <sup>a</sup>	12.3 <sup>a</sup>	13.0 <sup>a</sup>	b	b
Technologists, technicians (except health)	1615	1 901 481	7.20	23.29	19.1	21.4	26.4	24.9	19.9	27.8	1.042 ±0.777	.25
Supervisors and proprietors	1871	2 274 531	5.30	21.79	22.2	15.8	24.6	17.5	26.5	23.9	0.912 ±1.039	.43
Sales representatives, commodities and finance	2097	2 570 730	4.50	19.02	18.9	16.7	20.5	22.3	17.7	18.3	0.049 ±0.514	.93
Other sales personnel	1891	2 320 817	9.50	18.67	14.9	18.3	20.6	18.8	17.5	22.1	0.892 ±0.487	.14
Computer equipment operators	155	180 586	13.10	24.94	20.0 <sup>a</sup>	18.5 <sup>a</sup>	28.9 <sup>a</sup>	25.3 <sup>a</sup>	29.9 <sup>a</sup>	33.1 <sup>a</sup>	b	b
Secretaries, stenographers, and typists	59	59 810	9.70	17.65 <sup>a</sup>	5.6 <sup>a</sup>	7.3 <sup>a</sup>	43.7 <sup>a</sup>	0.0	27.5 <sup>a</sup>	0.0	b	b
Financial records processing occupations	200	222 444	18.60	23.10	12.8 <sup>a</sup>	33.1 <sup>a</sup>	23.3 <sup>a</sup>	27.0 <sup>a</sup>	16.5 <sup>a</sup>	24.3 <sup>a</sup>	b	b
Mail and message distribution personnel	441	505 995	24.10	20.45	20.0	15.8	31.8	9.8	17.6	25.6	0.131 ±2.135	.95
Other administrative support personnel	2593	2 949 184	14.80	22.88	18.9	18.3	25.0	22.2	25.0	27.0	1.677 ±0.463	.02
Private household occupations	26	29 512	34.60	31.32 <sup>a</sup>	0.0	42.8 <sup>a</sup>	0.0	19.5 <sup>a</sup>	47.1 <sup>a</sup>	37.7 <sup>a</sup>	b	b
Police and firefighters	987	1 186 698	12.80	29.79	22.5	25.7	33.5	31.1	35.4	30.7	2.053 ±0.796	.06
Other protective service occupations	646	696 744	22.50	27.58	21.2	31.0	19.2	27.1	38.5	28.3	1.681 ±1.456	.31
Food service personnel	1825	2 080 815	14.60	18.49	16.2	13.1	23.5	18.4	17.3	22.4	1.205 ±0.843	.23
Health service personnel	247	254 544	33.30	24.61	30.0	23.4 <sup>a</sup>	33.5 <sup>a</sup>	19.7 <sup>a</sup>	24.8	16.7 <sup>a</sup>	b	b
Cleaning and building service personnel	1507	1 612 197	19.60	22.99	18.0	21.4	22.2	22.6	25.6	27.8	1.751 ±0.218	.00
Personal service workers	418	436 927	17.30	17.14	17.5 <sup>a</sup>	23.8	17.5	15.6 <sup>a</sup>	11.8 <sup>a</sup>	15.5 <sup>a</sup>	-1.362 ±0.775	.15
Farm operators and managers	627	764 784	1.00	21.62	14.9	19.9	23.8	26.9	23.1	22.6	1.692 ±0.741	.08
Farm workers and other agricultural workers	1556	1 535 568	6.70	18.72	19.5	17.3	23.6	17.0	19.2	15.2	-0.600 ±0.658	.41
Forestry and fishing occupations	117	134 640	6.00	19.81	16.0 <sup>a</sup>	25.8 <sup>a</sup>	0.0	17.4 <sup>a</sup>	39.8 <sup>a</sup>	20.5 <sup>a</sup>	b	b
Mechanics and repairers	3626	4 333 134	7.90	22.94	21.1	23.2	21.8	21.5	24.3	25.5	0.701 ±0.275	.06
Construction and extractive trades	4686	5 398 196	7.40	18.45	16.5	16.6	17.9	15.2	21.9	21.9	1.071 ±0.553	.13
Precision production occupations	2223	2 641 979	7.20	25.00	18.7	23.4	25.6	31.0	26.3	25.2	1.628 ±0.773	.10
Machine operators/tenders (except precision)	2605	2 947 586	11.80	23.37	24.2	20.0	25.5	24.9	20.6	25.2	0.024 ±0.662	.97
Fabricators, assemblers, inspectors, samplers	1414	1 690 948	10.90	22.00	21.8	19.5	17.7	24.9	22.4	26.4	0.973 ±0.662	.22
Motor vehicle operators	2989	3 426 058	14.40	31.66	27.9	31.5	29.5	30.9	34.2	35.9	1.391 ±0.347	.02
Other transportation (except motor vehicles)	140	185 361	10.40	28.72	12.2 <sup>a</sup>	30.6 <sup>a</sup>	49.0 <sup>a</sup>	27.0	21.9 <sup>a</sup>	32.3 <sup>a</sup>	b	b
Material-moving equipment operators	927	1 094 993	12.90	28.24	23.1	27.4	30.4	25.6	32.8	30.1	1.410 ±0.652	.10
Construction laborers	836	897 497	10.80	22.32	22.2	14.5	15.2	25.8	29.2	24.8	1.782 ±1.269	.23
Freight, stock, material handlers	2355	2 815 269	18.00	22.09	19.4	21.6	23.1	15.1	27.0	26.4	1.050 ±1.207	.43
<b>Women</b>												
Officials and administrators (public administration)	376	346 463	19.70	21.12	18.0	22.2	21.7	20.1 <sup>a</sup>	25.2	19.5	0.621 ±0.601	.36
Managers administrators (except public administration)	4934	4 797 582	8.50	18.11	17.0	14.9	20.3	17.9	18.4	19.9	0.660 ±0.437	.21
Management-related occupations	2936	2 897 763	11.70	17.78	12.6	15.4	21.7	14.7	18.1	24.1	1.671 ±0.746	.09
Engineers	210	207 259	5.60	12.84	8.5 <sup>a</sup>	12.1 <sup>a</sup>	10.8 <sup>a</sup>	15.6 <sup>a</sup>	17.4 <sup>a</sup>	11.7 <sup>a</sup>	b	b

Continued

TABLE 2—Continued

Architects and surveyors	39	40 444	2.60	7.29 <sup>a</sup>	0.0	4.0 <sup>a</sup>	0.0	15.6 <sup>a</sup>	27.7 <sup>a</sup>	0.0	b	b
Natural, mathematical/computer scientists	799	768 699	9.50	13.30	12.6	10.3	16.5	14.5	12.3	13.8	0.374 ±0.515	.51
Health-diagnosing occupations	283	288 217	6.60	10.25	0.0	10.5 <sup>a</sup>	16.9 <sup>a</sup>	8.2 <sup>a</sup>	10.2 <sup>a</sup>	14.7 <sup>a</sup>	b	b
Health assessment/treating occupations	2610	2 758 450	9.20	19.83	18.6	20.5	18.8	20.8	21.7	18.6	0.243 ±0.345	.52
Teachers, librarians, counselors	4400	4 477 066	9.40	16.84	15.7	14.4	16.6	16.6	18.9	18.6	0.818 ±0.234	.03
Writers, artists, entertainers, athletes	1117	1 092 478	5.30	13.48	13.2	10.4	17.8	11.2	12.0	16.8	0.451 ±0.683	.55
Other professional specialty occupations	1463	1 362 526	15.60	19.14	15.2	14.1	19.1	16.2	24.9	25.1	2.104 ±0.694	.04
Health technologists/technicians	1391	1 416 593	13.70	23.48	21.4	21.9	23.5	23.3	27.3	22.9	0.638 ±0.427	.21
Technologists, technicians (except health)	838	810 554	9.70	18.04	17.2	20.9	8.7	20.8	19.7	20.8	1.147 ±1.686	.53
Supervisors and proprietors	1421	1 449 510	7.50	19.96	16.4	20.5	17.0	18.2	21.4	25.1	1.390 ±0.546	.06
Sales representatives, commodities and finance	1503	1 483 280	6.00	13.68	9.0	15.9	13.3	15.0	12.8	16.6	1.159 ±0.534	.10
Other sales personnel	3585	3 684 792	12.60	18.24	14.7	19.2	21.0	18.5	19.1	16.7	0.370 ±0.583	.56
Computer equipment operators	236	224 232	15.40	23.76	20.3	19.2 <sup>a</sup>	27.7	49.3	17.3	32.1 <sup>a</sup>	b	b
Secretaries, stenographers, and typists	2532	2 572 819	8.70	19.63	21.2	17.1	21.6	19.1	17.9	21.3	-0.047 ±0.534	.93
Financial records processing occupations	1768	1 786 692	7.90	20.42	15.0	25.4	18.5	19.8	19.4	24.1	0.963 ±0.857	.32
Mail and message distribution personnel	379	361 468	20.90	17.39	26.3	11.1 <sup>a</sup>	13.9 <sup>a</sup>	17.7	15.4 <sup>a</sup>	20.4	0.480 ±1.407	.75
Other administrative support personnel	7941	7 864 575	14.40	22.46	18.7	23.6	19.8	23.2	23.9	24.9	0.970 ±0.449	.10
Private household occupations	701	578 535	13.20	18.76	0.0	15.6	18.8	23.0	16.9	20.2	b	b
Police and firefighters	232	189 198	29.00	15.89	26.0 <sup>b</sup>	4.2 <sup>a</sup>	13.3 <sup>a</sup>	10.1 <sup>a</sup>	26.1 <sup>a</sup>	18.9 <sup>a</sup>	b	b
Other protective service occupations	256	232 682	27.20	30.45	22.4 <sup>a</sup>	27.3	24.0	33.8	27.1 <sup>a</sup>	47.2	b	b
Food service personnel	3030	3 032 388	11.10	20.10	18.5	19.3	22.0	17.8	22.2	20.5	0.437 ±0.407	.34
Health service personnel	2423	2 156 950	27.90	32.43	26.9	26.9	30.4	36.7	35.4	36.6	2.354 ±0.486	.01
Cleaning and building service personnel	1545	1 325 389	21.50	25.25	23.2	26.3	23.2	24.9	26.5	27.6	0.668 ±0.345	.13
Personal service workers	2261	2 167 360	13.90	22.01	18.0	22.4	21.7	24.0	22.8	23.2	0.968 ±0.358	.05
Farm operators and managers	130	147 997	0.00	18.35	11.4 <sup>a</sup>	29.7 <sup>a</sup>	15.5 <sup>a</sup>	25.2 <sup>a</sup>	15.6 <sup>a</sup>	13.1 <sup>a</sup>	b	b
Farm workers and other agricultural workers	358	344 144	4.40	22.76	14.2 <sup>a</sup>	23.5	24.9 <sup>a</sup>	30.8	22.1	21.7	1.372 ±1.138	.29
Forestry and fishing occupations	7	5 587	43.50	9.32 <sup>a</sup>	0.0	0.0	0.0	32.2 <sup>a</sup>	0.0	0.0	b	b
Mechanics and repairers	218	203 532	11.80	20.65	8.9 <sup>a</sup>	6.6 <sup>a</sup>	21.5 <sup>a</sup>	26.4 <sup>a</sup>	25.3 <sup>a</sup>	26.9 <sup>a</sup>	b	b
Construction and extractive trades	144	152 008	4.50	6.93 <sup>a</sup>	2.1 <sup>a</sup>	3.6 <sup>a</sup>	0.9 <sup>a</sup>	10.7 <sup>a</sup>	10.1 <sup>a</sup>	16.4 <sup>a</sup>	b	b
Precision production occupations	848	802 569	12.40	23.20	28.2	21.6	22.9	24.5	18.4	24.0	-0.978 ±0.792	.28
Machine operators/tenders (except precision)	1678	1 498 063	17.60	25.14	24.8	23.5	24.2	24.7	25.4	29.1	0.669 ±0.335	.12
Fabricators, assemblers, inspectors, samplers	1045	970 146	16.80	25.30	23.1	21.6	21.0	23.2	32.5	30.7	2.075 ±0.854	.07
Motor vehicle operators	499	472 407	18.20	31.02	15.2	18.1	37.0	33.5	37.3	42.6	5.722 ±1.080	.01
Other transportation (except motor vehicles)	5	2608	76.80	64.08 <sup>b</sup>	0.0	0.0	0.0	100.0	100.0	0.0	b	b
Material-moving equipment operators	86	76 818	15.90	29.53	10.4 <sup>a</sup>	22.4 <sup>a</sup>	27.4 <sup>a</sup>	22.8 <sup>a</sup>	41.6 <sup>a</sup>	52.6 <sup>a</sup>	b	b
Construction laborers	23	19 105	9.10	21.09 <sup>a</sup>	15.1 <sup>a</sup>	14.8 <sup>a</sup>	47.5 <sup>a</sup>	0.0	0.0	20.0 <sup>a</sup>	b	b
Freight, stock, material handlers	948	905 494	14.10	19.12	15.4	19.5	15.3	22.1	21.7	19.9	1.061 ±0.595	.15

<sup>a</sup>Estimates have a relative standard error > 30% and should be used with caution, as they do not meet NCHS standards of reliability or precision.<sup>31</sup>

<sup>b</sup>Trends were not calculated when the sample size for any individual survey year fell below 45.

## Limitations

The NHIS data are cross-sectional data that permit only inferences of association of obesity in the 41 occupations analyzed. However, findings from this study are similar to those of others,<sup>33,34</sup> in which the prevalence of obesity has been found to vary according to occupation. Consistent with the present findings, previous research has shown that race/ethnicity, social class, age, and/or seden-

tary jobs can contribute to an increase in obesity.<sup>32,33,37</sup> Furthermore, it is possible that among obese people there exists bias by self-selection of occupation.

Although BMI has been shown, traditionally, to correlate with fat distribution, it must be noted that it does not take into account individuals who may have a large muscular habitus, nor does it directly measure percent body fat. However, most health organizations

and scientists support the use of BMI to define overweight and obesity, particularly when direct measures of fat distribution are not available.<sup>39–41</sup> Using a 2 or 1 week reference period prior to the NHIS interview to characterize occupational status might lead to misclassification of individuals with respect to their usual occupation. However, ongoing analyses of the NHIS data by the present team of investigators indicate a substantial

concordance between self-reported current occupation and longest-held job.<sup>42</sup>

The present analysis suffers from many of the limitations seen in large population-based studies. Weight and height were collected in a self-reported or proxy fashion, which could have led to less precision in the calculation of the BMI.<sup>43,44</sup> For example, previous research has suggested that people tend to underreport their weight and overreport their height, leading to the underestimation of BMI; additionally, the degree of under- and overreporting varies as a function of age, gender, race, ethnicity, and social class.<sup>45–47</sup>

The 1986 to 1995 NHIS employed proxy information when adults were not available for household interview. Proxy reports of weight and height may also be subject to bias. To reduce this potential bias, we reanalyzed our 1986 to 1995 data in the 61% of NHIS participants who directly reported weight and height during the interview. Results indicate that, for most occupations, the self-reported BMIs would be even higher than the combined proxy and self-reported BMIs. Examining the BMIs for all workers from 1986 to 1995, we found the average annual difference in the percentage of obesity between the nonproxy (self-reported) BMIs and the combined proxy and self-reported BMIs was 0.73%.

Finally, the change in the survey design methodology in 1996 prevented trend comparisons over the total 17-year time period. Moreover, small sample sizes could lead to less reliable estimates of obesity rates and trends in some worker subpopulations (e.g., private household occupations among men, and architects and surveyors among women).

### Strengths

Despite the limitations presented, the use of large sample sizes, the nationally representative nature of the sample, oversampling of select subgroups (e.g., Blacks), and the annual assessment useful for assessing trends in prevalence of obesity within occupations allows this study to be favorably compared to other evaluations of the US obesity epidemic.

Irrespective of gender, individuals employed as motor vehicle operators were found to have the highest prevalence of obesity in both time periods. Among men, these

pooled prevalence rates increased from 19.8% in the 1986 to 1995 survey period to 31.7% in the 1997 to 2002 survey period; corresponding rates for women were 22.6% and 31.0%, respectively. Developing weight-loss programs designed to take into account the job demands, physical demands, and even the socioeconomic and cultural backgrounds of motor vehicle operators could potentially help reduce this detrimental increase in obesity within this occupational group. Furthermore, examining occupations with a lower prevalence of obesity (such as female architects and surveyors or men employed in the health-diagnosing professions) could help researchers elucidate the relationship between occupation and optimal body weight.

### Conclusions

The behavioral effects of physical activity on health are well established.<sup>48–51</sup> Although the most promising weight-loss interventions focus on increasing physical activity in addition to implementing dietary changes, the increasing trend towards automation and other labor-saving strategies found at many work-sites will not foster physical activity conducive to weight loss. Primary and secondary prevention of obesity in occupational settings must therefore take into account the many societal and occupational factors that influence energy imbalance via multifaceted interventions (e.g., accountability of healthy food choices and food quantity, exercise programs). Such comprehensive, worksite-based interventions are urgently needed in order to slow the growing epidemic of obesity in the United States. ■

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### Contributors

A.J. Caban, L.E. Fleming, and D.J. Lee originated the study and led the writing of this article. W. LeBlanc and O. Gómez-Marín managed the data and performed statistical analyses. T. Pitman provided study support and data management. All authors helped conceptualize ideas, interpret findings, and provide critical review of the article.

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### Human Participant Protection

Because this study utilized anonymous data from a publicly available database, the protocol was reviewed and approved for exemption by the institutional review board of the University of Miami School of Medicine.

### References

1. Manson JE, Skerrett PJ, Greenland P, VanItallie TB. The escalating pandemics of obesity and sedentary lifestyle: a call to action for clinicians. *Arch Intern Med.* 2004;164:249–258.
2. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999–2000. *JAMA.* 2002;288:1723–1727.
3. Silva MM, Matsuoka VF, Silva AR, Reimo R, Faintuch J, Zilberstein B, Gama-Rodrigues J. Sleep abnormalities in morbid obesity. *Clin Nutr.* 2003;22: S21–S22.
4. Abbasi F, Brown BW Jr, Lamendola C, McLaughlin T, Reaven GM. Relationship between obesity, insulin resistance, and coronary heart disease risk. *J Am Coll Cardiol.* 2002;40:937–943.
5. Howard BV, Ruotolo G, Robbins DC. Obesity and dyslipidemia. *Endocrinol Metab Clin North Am.* 2003; 32:855–867.
6. Boland LL, Folsom AR, Rosamond WD, for the Atherosclerosis Risk in Communities (ARIC) Study Group. Hyperinsulinemia, dyslipidemia, and obesity as risk factors for hospitalized gallbladder disease. A prospective study. *Ann Epidemiol.* 2002;12:131–140.
7. Gelber AC. Obesity and hip osteoarthritis: the weight of the evidence is increasing. *Am J Med.* 2003; 114:158–159.



8. Carmichael AR, Bates T. Obesity and breast cancer: a review of the literature. *Breast*. 2004;13:85–92.
9. Mydlo JH, Gerstein MI, Harris CF, Braverman AS. Immune function, mitogenicity, and angiogenic growth factor concentrations in lean and obese rodent sera: implications in obesity-related prostate tumor biology. *Prostate Cancer Prostatic Dis*. 2003;6:286–289.
10. Ozcelik B, Basbug M, Ozsahin O, Yilmazsoy A, Erez R. Effects of hypertension and obesity on endometrial thickness. *Eur J Obstet Gynecol Reprod Biol*. 2003;109:72–75.
11. Kornitzer M, Kittel F. How does stress exert its effects: smoking, diet and obesity, physical activity? *Postgrad Med J*. 1986;62:695–696.
12. Langenberg C, Hardy R, Kuh D, Brunner E, Wadsworth M. Central and total obesity in middle aged men and women in relation to lifetime socioeconomic status: evidence from a national birth cohort. *J Epidemiol Community Health*. 2003;57:816–822.
13. Goodman E, Slap GB, Huang B. The public health impact of socioeconomic status on adolescent depression and obesity. *Am J Public Health*. 2003;93:1844–1850.
14. Wellman NS, Friedberg B. Causes and consequences of adult obesity: health, social and economic impacts in the United States. *Asia Pac J Clin Nutr*. 2002;11:S705–S709.
15. US Department of Health and Human Services. *Healthy People 2010: Understanding and Improving Health*. 2nd ed. Washington, DC: US Department of Health and Human Services; 2000.
16. Harrell JS, Johnston LF, Griggs TR, et al. An occupation based physical activity intervention program: improving fitness and decreasing obesity. *AAOHN J*. 1996;44:377–384.
17. Brill PA, Giles WH, Keenan NL, et al. Effect of body mass index on activity limitation and mortality among older women: the National Health Interview Survey, 1986–1990. *J Womens Health*. 1997;6:435–440.
18. Fowler FJ. The redesign of the National Health Interview Survey. *Public Health Rep*. 1996;111:508–511.
19. Liao Y, Cooper RS, Cao G, et al. Mortality patterns among adult Hispanics: findings from the NHIS, 1986–1990. *Am J Pub Health* 1998;88:227–232.
20. Wagener DK, Winn DW. Injuries in the workplace: black-white differences. *Am J Public Health*. 1991;81:1408–1414.
21. Atrostic BK, Bates N, Burt G, Silverstein A, Winters F. Nonresponse in federal household surveys: new measures and new insights. Paper presented at the International Conference on Survey Non-response; October, 1999; Portland, OR. Available at: [http://www.fcsn.gov/committees/ihsng/portland\\_3\\_\\_120299.pdf](http://www.fcsn.gov/committees/ihsng/portland_3__120299.pdf). Accessed July 8, 2004.
22. Gentlemen JF. Overview of the National Health Interview Survey. National Center for Health Statistics. Available at: [http://www.cdc.gov/nchs/ppt/bsc/OB193\\_BSC\\_JG.ppt](http://www.cdc.gov/nchs/ppt/bsc/OB193_BSC_JG.ppt). Accessed on: July 21, 2005.
23. Hill A, Roberts J. Body mass index: a comparison between self-reported and measured height and weight. *J Public Health Med*. 1998;21:116–117.
24. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. *World Health Organ Tech Rep Ser*. 1995;854:1–452.
25. *National Health Interview Survey, 2002*. Codebook: 2002. Hyattsville, MD: National Center for Health Statistics (US). Available at: [ftp://ftp.cdc.gov/pub/Health\\_Statistics/NCHS](ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS). Accessed July 8, 2004.
26. Zwerling C, Whitten PS, Davis CS, Sprince NL. Occupational injuries among older workers with visual, auditory, and other impairments: a validation study. *J Occ Environ Med*. 1998;40:720–723.
27. Brackbill R, Frazier T, Shilling S. Smoking characteristics of US workers, 1978–80. *Am J Ind Med*. 1998;13:5–41.
28. *National Health Interview Survey, 1986*. Codebook: 1986. Hyattsville, MD: National Center for Health Statistics (US). Available at: [ftp://ftp.cdc.gov/pub/Health\\_Statistics/NCHS](ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS). Accessed July 8, 2004.
29. *National Health Interview Survey, 2001*. Codebook: 2001. Hyattsville, MD: National Center for Health Statistics (US). Available at: [ftp://ftp.cdc.gov/pub/Health\\_Statistics/NCHS](ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS). Accessed July 8, 2004.
30. *Software for Survey Data Analysis (SUDAAN), Version 8.0.0*. Research Triangle Park, NC: Research Triangle Institute; 2001.
31. Lethbridge-Çejku M, Schiller JS, Bernadel L. Summary health statistics for US Adults: National Health Interview Survey, 2002. National Center for Health Statistics. *Vital Health Stat 10*. 2004;222:1–151.
32. Lahti-Koski M, Vartiainen E, Mannisto S, Pietinen P. Age, education and occupation as determinants of trends in body mass index in Finland from 1982 to 1997. *Int J Obes Relat Metab Disord*. 2000;24:1669–1676.
33. Sarlio-Lahteenkorva S, Silventoinen K, Lahelma E. Relative weight and income at different levels of socioeconomic status. *Am J Public Health* 2004;94:468–472.
34. Sturm R, Ringel JS, Andreyeva T. Increasing obesity rates and disability trends. *Health Affairs*. 2004;23:199–205.
35. Narbro K, Agren G, Jonsson E, et al. Sick leave and disability pension before and after treatment for obesity: a report from the Swedish Obese Subjects (SOS) study. *Int J Obes Relat Metab Disord*. 1999;23:619–624.
36. Regan J, Hamer G, Wright A. The epidemic of obesity: when a disease is not a disability. *Tenn Med*. 2003;96:564–565.
37. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999–2000. *JAMA*. 2002;288:1728–1732.
38. UnumProvident Obesity-Related Disability Claims Study. Available at: <http://www.unumprovident.com/newsroom/news/corporate/obesity.aspx>. Accessed July 8, 2004.
39. Lean MEJ, Han TS, Seidell JC. Impairment of health and quality of life using new federal guidelines for the identification of obesity. *Arch Intern Med*. 1999;159:837–843.
40. National Institutes of Health. *Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults*. Bethesda, Md: Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute; 1998.
41. Kuczmarski RJ, Flegal KM. Criteria for definition of overweight in transition: background and recommendations for the United States. *Am J Clin Nutr*. 2000;72:1074–1081.
42. Gómez-Marín O, Fleming LE, LeBlanc W, Lee DJ, Pitman T, Caban AJ. Longest-held job in US occupational groups: The National Health Interview Survey (NHIS). *J Occup Environ Med*. 2005;47:79–80.
43. Patrick DL, Bushnell DM, Rothman M. Performance of two self-report measures for evaluating obesity and weight loss. *Obes Res*. 2004;12:48–57.
44. Morgan PJ, Jeffrey DB. Restraint, weight suppression, and self-report reliability: how much do you really weigh? *Addict Behav*. 1999;24:679–682.
45. Kuczmarski MF, Kuczmarski RJ, Najjar M. Effects of age on validity of self-reported height, weight, and body mass index: findings from the Third National Health and Nutrition Examination Survey, 1988–1994. *J Am Diet Assoc*. 2001;101:28–34.
46. Engstrom JL, Paterson SA, Doherty A, Trabulsi M, Speer KL. Accuracy of self-reported height and weight in women: an integrative review of the literature. *J Midwifery Womens Health*. 2003;48:338–345.
47. Spencer EA, Appleby PN, Davey GK, Key TJ. Validity of self-reported height and weight in 4808 EPIC-Oxford participants. *Public Health Nutr*. 2002;5:561–565.
48. Zhang Q, Wang Y. Socioeconomic inequality of obesity in the United States: do gender, age, and ethnicity matter? *Soc Sci Med*. 2004;58:1171–1180.
49. Belza B, Warms C. Physical activity and exercise in women's health. *Nurs Clin North Am*. 2004;39:181–193.
50. Wang F, McDonald T, Champagne LJ, Edington DW. Relationship of body mass index and physical activity to health care costs among employees. *J Occup Environ Med*. 2004;246:428–436.
51. Brown DW, Brown DR, Heath GW, et al. Associations between physical activity dose and health-related quality of life. *Med Sci Sports Exerc*. 2004;36:890–896.