

# Quality of Life in Relation to Overweight and Body Fat Distribution

## ABSTRACT

**Objectives.** This study quantified the impairment of quality of life attributable to body fatness by using the standardized SF-36 Health Survey.

**Methods.** Tertiles of waist circumference and body mass index (BMI) in 1885 men and 2156 women aged 20 to 59 years in the Netherlands in 1995 were compared.

**Results.** The odds ratios and 95% confidence intervals of subjects with the largest waist circumferences, compared with those in the lowest tertile, were 1.8 (1.3, 2.4) in men and 2.2 (1.7, 2.9) in women with difficulties in bending, kneeling, or stooping; 2.2 (1.4, 3.7) in men and 1.7 (1.2, 2.6) in women with difficulties in walking 500 m; and 1.3 (1.0, 1.9) in men and 1.5 (1.1, 1.9) in women with difficulties in lifting or carrying groceries. Anthropometric measures were less strongly associated with social functioning, role limitations due to physical or emotional problems, mental health, vitality, pain, or health change in 1 year. The relationship between quality of life measures and BMI were similar to those between quality of life measures and waist circumference.

**Conclusions.** Large waist circumferences and high BMIs are more likely to be associated with impaired quality of life and disability affecting basic activities of daily living. (*Am J Public Health*. 1998;88:1814-1820)

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In Western countries, 10% to 20% of men and women have a body mass index above 30 kg/m<sup>2</sup>, and these prevalences have been increasing.<sup>1-3</sup> Since overweight and central fat distribution are associated with increased risks of chronic diseases such as diabetes,<sup>4</sup> cardiovascular diseases,<sup>5,6</sup> cancer,<sup>7,8</sup> and premature death,<sup>9,10</sup> it is surprising that the quality of life in overweight subjects is less well documented than these diseases.

An early study indicated that overweight subjects are more likely to have poorer physical functioning status,<sup>11</sup> a measure of quality of life, but detailed quantification in the present-day population is unavailable. With advancing age, overweight persons are more likely to develop serious limitations in performing basic daily activities.<sup>12</sup> These persons impose an enormous burden on health care resources.<sup>13,14</sup> Poor physical function and quality of life attributable to overweight are important in terms of public health, and they should be addressed by preventive measures and promotion of healthy living. To our knowledge, the quality of life for subjects with adverse fat distribution (i.e., large waists and high waist-to-hip ratios) has not been reported in the literature. The present study quantified the impairment of the quality of life in overweight subjects and in those with large waist circumferences.

## Methods

### Subjects

A total of 1885 men and 2156 women aged 20 to 59 years were randomly chosen from the civil registries of Amsterdam, Maastricht, and Doetinchem for the ongoing 1995 cohort of the MORGEN (Monitoring Risk Factors and Health in The Netherlands) project. To obtain similar numbers of subjects for each age, the sample was stratified by sex and 5-year age group.<sup>15</sup> The numbers

of subjects in the present study represent those who attended their local health centers for measurements, which included anthropometry. Those who did not attend the health centers or were of non-Dutch nationality were excluded from the analyses.

### Anthropometry

All anthropometric measurements were made by trained paramedic personnel in accordance with World Health Organization<sup>16</sup> recommendations. Subjects wore light clothes during measurements; body weight was measured to the nearest 100 g with calibrated scales, height in bare feet to the nearest millimeter, waist circumference at the level between the lowest rib margin and iliac crest, and hip circumference at the widest trochanters to the nearest millimeter. Circumferences were measured twice and average values were used in analysis. The waist-to-hip circumferential ratio was computed, and body mass index was calculated as weight (in kilograms) divided by height (in meters) squared.

### Quality of Life

Nine health concepts were calculated from 36 items, rated by subjects through the standardized RAND-36 questionnaire, Dutch

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This paper was accepted April 9, 1998.

version,<sup>17</sup> which was adapted from the standardized SF-36 Health Survey.<sup>18</sup> These health concepts included measures of *functioning*—the ability to perform daily tasks and activities—and measures of *well-being*—subjective internal states, including how people feel physically and emotionally and how they think and feel about their health.<sup>19</sup> The 9 health concepts were physical functioning (10 items, 3-point scale), role functioning limitations due to poor physical health (4 items, 2-point scale), bodily pain (2 items each, 5- and 6-point scales), general health (5 items, 5-point scale), vitality (4 items, 6-point scale), social functioning (2 items, 5-point scale), role functioning limitations due to poor emotional health (3 items, 2-point scale), mental health (5 items, 6-point scale), and health change in the past year (1 item, 5-point scale).

#### Lifestyle and Demographic Factors as Confounding Factors

Dummy variables for possible confounding factors were created to adjust for the associations between adiposity and health concepts and individual items (data available from the authors upon request).

#### Statistical Methods

Statistical analyses were performed with SAS Version 6.10 software (SAS Institute, Inc, Cary, NC). All 36 items of the 9 health concepts were examined in relation to anthropometric measurements.

**Standardizing scores for the 9 health concepts.** The 36 items of reported health were converted into standardized scores by the equation described by van der Zee and Sanderma<sup>17</sup> and Medical Outcomes Trust<sup>18</sup> (see footnote to Table 1 for equation and example). These items were divided into groups to form the 9 health concepts (Table 1).

**Definition of “good” and “poor” for the 9 health concepts.** Plots of the distributions of standardized scores were examined to determine the cutoffs for the health concepts (for plot of physical functioning, see Figure 1). A subject’s particular health concept was classified as “poor” if its score was below 66.7% of the standardized score and “good” if it was 66.7% or above (i.e., in the upper tertile). (An exception was the health transition concept, for which scores below 50% indicated poor health and 50% or above good health.) By these cutoffs, 10% to 25% of subjects were classified as having poor health for most concepts, except there was a higher proportion of subjects (40%–50%) who had poor vitality and poor general health (data available from authors upon request).

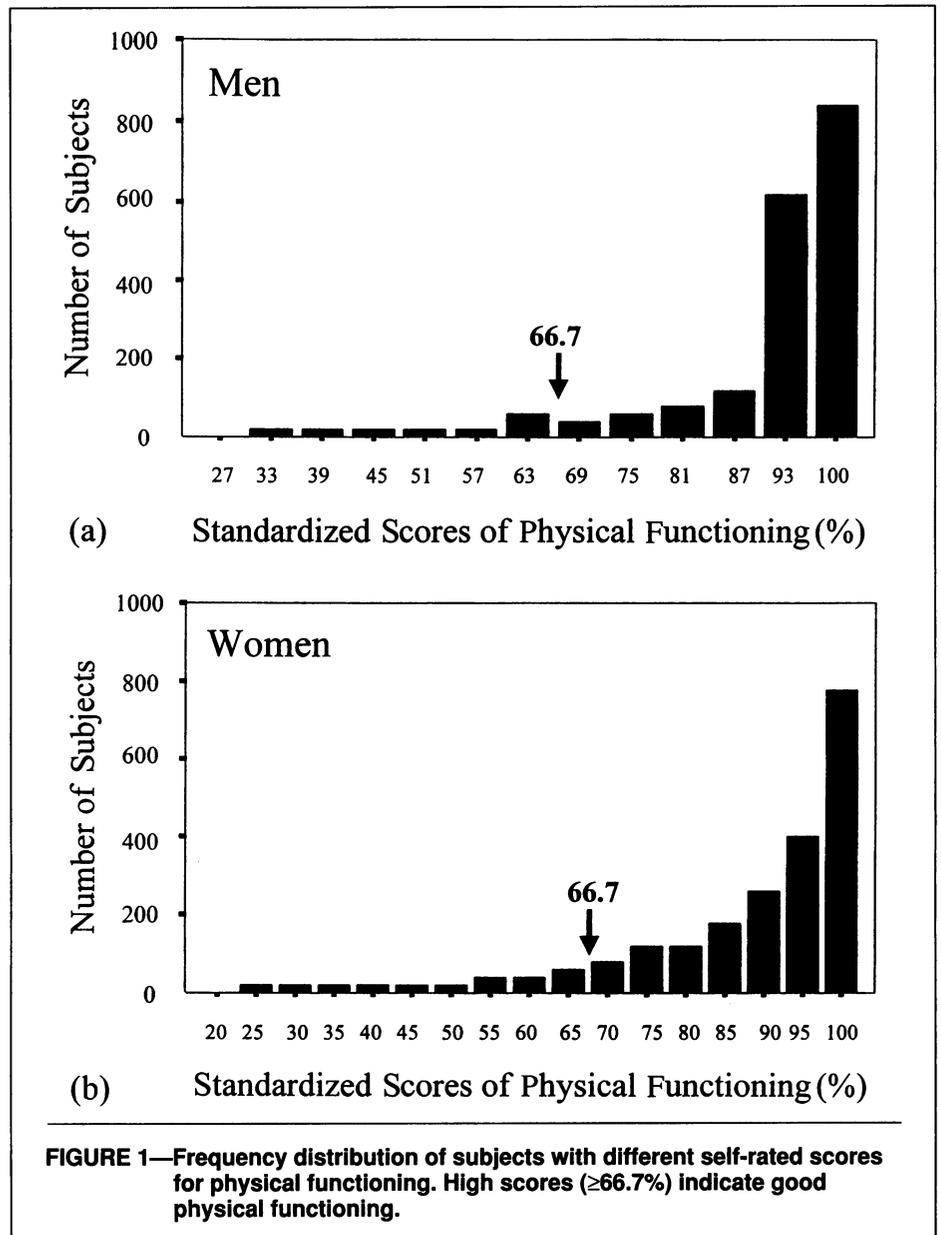


FIGURE 1—Frequency distribution of subjects with different self-rated scores for physical functioning. High scores ( $\geq 66.7\%$ ) indicate good physical functioning.

**Definition of “good” and “poor” health for the 36 individual items.** Each item was dichotomized so that above-average scores for items with an odd-numbered scale (3 or 5 points) were considered “good” health and scores that were average or lower were considered “poor” health. For items with an *even* scale (2, 4, or 6 points), the scores for “good” health and “poor” health were evenly divided.

**Logistic regression analyses.** To estimate the relative risks of poor health in those with large waist circumference and high body mass index, odds ratios and 95% confidence intervals (CIs) were determined by logistic regression analysis. The odds ratios were adjusted for age, lifestyle factors (smoking, alcohol consumption, and physical activity), and demographic factors (education, marital status, employment, household composition, intimate contact [discussing personal matters with other people], and parity [women who

have had live births]). Possible interactions between height and waist circumference were examined by maximum likelihood analysis for the difference of the  $\chi^2$  statistic when the interaction terms (combinations of tertiles) were added to the model, using the tallest subjects who had the lowest (tertile 1) waist circumference as the reference group. Interactions between age and anthropometric measurements regarding health concepts were also examined by using the youngest subjects (20–29 years) in combination with those who had the lowest waist circumference, or the lowest body mass index, or who were tallest, as the reference group.

#### Results

Subject characteristics are shown in Table 1. Cutoffs for tertiles of anthropometric

**TABLE 1—Characteristics and Raw and Standardized Self-Rated Health Scores: The Netherlands, 1995**

	Men (n = 1885)			Women (n = 2156)		
	Mean	SD	Range	Mean	SD	Range
<b>Characteristics</b>						
Age, y	42.7	10.9	20.3–60.0	41.4	11.0	20.2–59.9
Weight, kg	82.2	12.3	45.7–157.0	68.4	11.5	38.6–153.0
Height, m	1.79	0.07	1.52–2.06	1.66	0.07	1.42–1.89
Body mass index, kg/m <sup>2</sup>	25.7	3.6	15.7–50.1	24.8	4.1	16.5–58.3
Waist circumference, cm	92.2	11.0	64.0–155.0	80.9	11.1	60.0–135.5
Hip circumference, cm	101.6	6.8	69.0–150.0	101.8	8.3	74.4–160.0
Waist-to-hip ratio	0.907	0.073	0.621–1.369	0.793	0.072	0.603–1.302
<b>Raw score</b>						
Physical functioning	28.1	3.2	10.0–30.0	27.5	3.4	10.0–30.0
Social functioning	9.0	1.6	2.0–10.0	8.7	1.8	2.0–10.0
Role limitations due to physical problems	7.4	1.2	4.0–8.0	7.2	1.4	4.0–8.0
Role limitations due to emotional problems	5.5	0.9	3.0–6.0	5.4	1.0	3.0–6.0
Mental health	24.0	3.9	6.0–30.0	23.0	4.1	5.0–30.0
Vitality	17.6	3.5	4.0–24.0	16.7	3.6	4.0–24.0
Bodily pain	51.9	10.2	11.0–60.0	50.0	10.7	11.0–60.0
General health	19.2	3.5	5.0–25.0	19.1	3.5	5.0–25.0
Health change in past year	3.0	0.6	1.0–5.0	3.1	0.7	1.0–5.0
	<b>Mean</b>	<b>SD<sup>b</sup></b>	<b>Floor-Ceiling Effects, %<sup>c</sup></b>	<b>Mean</b>	<b>SD<sup>b</sup></b>	<b>Floor-Ceiling Effects, %<sup>c</sup></b>
<b>Standardized score<sup>a</sup></b>						
Physical functioning	90.3	15.8	0, 45.6	87.6	16.8	0, 37.1
Social functioning	86.9	20.4	0, 59.4	83.5	22.1	0.9, 51.0
Role limitations due to physical problems	84.7	29.5	0, 74.3	79.7	34.0	9.3, 67.3
Role limitations due to emotional problems	85.0	30.3	0, 76.4	80.4	34.9	11.6, 71.9
Mental health	76.2	15.6	0, 8.0	72.2	16.4	0, 1.9
Vitality	67.9	17.4	0, 2.1	63.5	17.9	0, 1.4
Bodily pain	83.5	20.9	0, 47.7	79.7	21.9	0, 38.0
General health	70.8	17.4	0, 4.0	70.4	17.7	0, 3.2
Health change in past year	49.6	15.5	0, 1.1	52.2	17.3	0, 4.6

Note. Low scores indicate poor health and high scores indicate good health.

<sup>a</sup>Standardized scores = [(raw score – minimum score) / score range] × 100<sup>17,18</sup>; for example, physical functioning has a minimum score of 10 (10 items × minimum score of 1) and a maximum score of 30 (10 items × maximum score of 3), so the score range = 20. If a subject's raw score for physical functioning is 28, then his or her standardized score is [(28 – 10) / 20] × 100 = 90.

<sup>b</sup>Scores of all health concepts range from 0 to 100, except for mental health, which ranges from 4 to 100.

<sup>c</sup>Floor-ceiling effects indicate the percentage of subjects with standardized scores of 0 (floor) and 100 (ceiling).

variables in the present sample were identified as follows: for waist circumference, 87.3 cm and 96.1 cm in men and 74.8 cm and 84.0 cm in women; for height, 175.5 cm and 181.5 cm in men and 163.0 cm and 168.0 cm in women; for body mass index, 24.15 kg/m<sup>2</sup> and 26.84 kg/m<sup>2</sup> in men and 22.67 kg/m<sup>2</sup> and 25.63 kg/m<sup>2</sup> in women.

The present study examined a wide range of quality of life measures and found that they were similar to indices of adiposity currently in use, including waist circumference and body mass index (Tables 2–4). The results for individual items from the health concepts physical functioning (10 items) and general health (5 items) in relation to waist circumference and body mass index are presented in Tables 3 and 4. We also examined the relationships between quality of life measures and waist-to-hip ratio and found that they were similar to those between quality of life measures and waist circumference and body mass index.

#### *Risks of Poor Health Indicated by the 9 Health Concepts*

Logistic regression analysis (Table 2) showed that after adjustments for age, lifestyle, and demographic factors, those whose waist circumference (Figure 2) or body mass index fell into tertile 3 were about twice as likely to have poor physical functioning (score < 66.7%) as were those whose waist circumference or body mass index fell into tertile 1. Those whose body mass index fell into the highest tertile were also more likely to report bodily pain (both men and women) and poor general health (women). Associations of waist circumference and body mass index with other health concepts were weaker.

#### *Risks of Poor Health Indicated by the 36 Individual Items of Health Concepts*

Results for individual items of physical functioning (10 items) and general health (5

items) are presented in Tables 3 and 4. The odds ratios (adjusted for age, lifestyle, and demographic factors) for limitations in physical functioning were significantly higher for those whose waist circumference or body mass index was in the highest tertile (Table 3); this was most marked in women, who had more problems lifting or carrying groceries, walking 1 flight of stairs, or walking 100 m. Men whose waist circumference or body mass index fell within the highest tertile more often expected their health to get worse and gave an answer of “don't know” or “false” to the question “do you rate your health as excellent.” (Table 4). In women, those with the largest waist circumferences or body mass indexes in the highest tertile considered their health in general as “not good.” Men with body mass indexes in the highest tertile were also more likely to describe themselves as “not happy people,” and women with body mass indexes in the highest tertile were more likely to report that they were “down in the dumps.”

**TABLE 2—Odds Ratios (Adjusted for Age, Lifestyle, and Demographic Factors) of Poor Self-Rated Health Scores (<66.7% of Standardized Scores) for the 9 Health Concepts, by Waist Circumference and Body Mass Index**

	Waist Circumference (cm)					Body Mass Index (kg/m <sup>2</sup> )				
	Tertile 1 <sup>a</sup>	Tertile 2		Tertile 3		Tertile 1 <sup>a</sup>	Tertile 2		Tertile 3	
		OR	95% CI	OR	95% CI		OR	95% CI	OR	95% CI
<b>Men (n = 1885)</b>										
Mean anthropometry (SD)	80.8 (4.6)	91.6 (2.6)		104.3 (7.7)		22.1 (1.6)	25.5 (0.7)		29.6 (2.8)	
Physical functioning	1.00	0.86	0.49, 1.51	2.38***	1.43, 3.93	1.00	1.08	0.63, 1.84	2.37***	1.45, 3.86
Social functioning	1.00	1.07	0.77, 1.50	1.28	0.91, 1.79	1.00	1.20	0.87, 1.65	1.15	0.83, 1.60
Role limitations due to physical problems	1.00	0.77	0.55, 1.08	1.18	0.84, 1.64	1.00	1.03	0.75, 1.41	0.98	0.71, 1.37
Role limitations due to emotional problems	1.00	0.90	0.68, 1.19	1.03	0.77, 1.39	1.00	1.09	0.83, 1.44	1.03	0.77, 1.37
Mental health	1.00	0.88	0.65, 1.18	0.91	0.67, 1.24	1.00	1.15	0.86, 1.53	0.99	0.73, 1.35
Vitality	1.00	0.83	0.65, 1.05	1.03	0.80, 1.33	1.00	0.91	0.72, 1.15	0.93	0.73, 1.19
Bodily pain	1.00	1.04	0.73, 1.48	1.29	0.90, 1.84	1.00	1.15	0.81, 1.64	1.43*	1.02, 2.03
General health	1.00	1.00	0.77, 1.29	1.25	0.95, 1.63	1.00	1.07	0.84, 1.38	1.14	0.88, 1.47
Health change in past year	1.00	0.67	0.47, 0.96	0.92	0.65, 1.32	1.00	0.87	0.61, 1.23	1.21	0.86, 1.71
<b>Women (n = 2156)</b>										
Mean anthropometry (SD)	70.1 (3.3)	79.0 (2.6)		93.5 (8.3)		20.9 (1.3)	24.1 (0.8)		29.4 (3.6)	
Physical functioning	1.00	1.17	0.77, 1.79	1.89**	1.26, 2.81	1.00	1.29	0.85, 1.96	2.11***	1.42, 3.12
Social functioning	1.00	0.99	0.76, 1.28	1.12	0.85, 1.47	1.00	0.77	0.59, 1.00	0.96	0.74, 1.25
Role limitations due to physical problems	1.00	1.22	0.93, 1.59	1.14	0.87, 1.51	1.00	0.91	0.70, 1.19	1.22	0.93, 1.59
Role limitations due to emotional problems	1.00	0.87	0.68, 1.11	0.90	0.70, 1.17	1.00	0.90	0.70, 1.14	0.95	0.74, 1.23
Mental health	1.00	1.16	0.91, 1.47	1.16	0.90, 1.49	1.00	0.96	0.75, 1.21	1.05	0.82, 1.34
Vitality	1.00	1.02	0.82, 1.27	1.07	0.85, 1.35	1.00	0.96	0.75, 1.21	1.05	0.82, 1.34
Bodily pain	1.00	1.05	0.79, 1.39	1.25	0.94, 1.66	1.00	0.94	0.71, 1.25	1.42*	1.08, 1.87
General health	1.00	0.96	0.76, 1.20	1.16	0.91, 1.47	1.00	1.06	0.85, 1.34	1.41*	1.12, 1.78
Health change in past year	1.00	1.23	0.88, 1.71	1.11	0.78, 1.58	1.00	1.22	0.87, 1.70	1.33	0.95, 1.87

Note. Lifestyle and demographic factors are described in the Logistic Regression Analyses section of Statistical Methods.

<sup>a</sup>Reference group.

\*\*\* $P < .001$ ; \*\* $P < .01$ ; \* $P < .05$ .

Of the remaining 21 items—those included in the health concepts social functioning, role limitations due to physical problems or emotional problems, mental health, vitality, bodily pain, and health change in the past year—only a few were related to anthropometry. Significant odds ratios for large waist circumference are reported in this section. Compared to the reference group (subjects with waist circumference in the lowest tertile, the odds ratio for men with waist circumferences in tertile 3 was 1.8 (95% CI = 1.2, 2.3) for feeling worn out a good bit to all the time (vitality item). Women with waist circumferences in tertile 3 had odds ratios of 1.3 (95% CI = 1.0, 1.7) for feeling that they accomplished less than they would like to with work or other regular daily activities during the past 4 weeks as a result of physical health problems (physical role functioning item) and 1.3 (95% CI = 1.0, 1.6) for feeling that they had a lot of energy a good bit to all the time (vitality item).

#### Analysis of Interactions Between Anthropometric Measures and Age

Examination of interactions between anthropometric variables of the 9 health concepts showed that there were weak interactions

( $\chi^2_4 = 8-10$ ,  $P < .05$ ) among both men and women for only a few relationships. Logistic regression analysis was performed to identify the subgroup most related to poor health concepts. Compared with women who both were tallest and had the smallest waists, the odds ratios for women who had poor physical functioning were 2.0 (95% CI = 1.1, 3.8) for those who had the largest waists and were shortest and 3.0 (95% CI = 1.3, 6.7) for those who had the largest waists and were tallest. Adjusted odds ratio for women who had more bodily pain was 2.1 (95% CI = 1.2, 3.6) among the tallest women with the largest waists. The only interaction between anthropometric measurements and age on health concepts was height in women ( $\chi^2_6 = 22.8$ ,  $P < .01$ ). The odds ratio for poor general health was 1.6 (95% CI = 1.0, 2.6) for women aged 50 to 59 years whose heights were in tertile 2, compared with the reference group (women aged 20 to 29 years whose heights were in the highest tertile).

#### Discussion

The present study found that quality of life measures were related both to waist circumference and to body mass index.

Although the findings were not surprising, such data are not available in the literature, particularly data regarding the quality of life of people with increased risks to their health through intra-abdominal fat accumulation reflected by large waist circumference.<sup>20</sup> Subjects with large waist circumferences or high body mass indexes were more likely to have poor physical functions that limited many common, basic activities of daily living, including walking several blocks, bending, kneeling, and stooping. Women with adverse anthropometric measurements had more severe problems than men, such as difficulty walking 1 block (100 meters) or up 1 flight of stairs, lifting, or carrying groceries. The present study analyzed cross-sectional data and thus reflects only the subjects' current quality of life. The lesser effects on other aspects of quality of life were probably due to the relatively young sample (between 20 and 59 years). Thus, these results should be interpreted with caution when referring to other populations, including older subjects.

Examination of items incorporated in the concept "general health" showed that subjects with large waists or high body mass indexes were more likely to expect their health to get worse (men) or to consider their

**TABLE 3—Odds Ratios (Adjusted for Age, Lifestyle, and Demographic Factors) of Poor Self-Rated Health Scores for Each Item of Physical Functioning, by Waist Circumference and Body Mass Index**

	Waist Circumference (cm)					Body Mass Index (kg/m <sup>2</sup> )				
	Tertile 1 <sup>a</sup>	Tertile 2		Tertile 3		Tertile 1 <sup>a</sup>	Tertile 2		Tertile 3	
		OR	95% CI	OR	95% CI		OR	95% CI	OR	95% CI
<b>Men (n = 1885)</b>										
Mean anthropometry (SD)	80.8 (4.6)	91.6 (2.6)		104.3 (7.7)		22.1 (1.6)	25.5 (0.7)		29.6 (2.8)	
Vigorous activities	1.00	1.21	0.95, 1.55	1.68***	1.29, 2.17	1.00	1.26	0.99, 1.61	1.51**	1.17, 1.93
Moderate activities	1.00	1.04	0.70, 1.54	1.58*	1.08, 2.33	1.00	1.17	0.80, 1.72	1.46*	1.01, 2.11
Lifting or carrying groceries	1.00	1.03	0.73, 1.45	1.34	0.95, 1.90	1.00	1.01	0.72, 1.42	1.32	0.95, 1.84
Climbing several flights of stairs	1.00	0.99	0.67, 1.45	2.16***	1.50, 3.11	1.00	1.06	0.73, 1.55	2.03***	1.43, 2.88
Climbing 1 flight of stairs	1.00	0.66	0.37, 1.17	1.27	0.75, 2.13	1.00	0.88	0.51, 1.52	1.33	0.80, 2.22
Bending, kneeling	1.00	1.11	0.82, 1.50	1.75***	1.30, 2.36	1.00	1.03	0.76, 1.38	1.63***	1.22, 2.16
Walking >1 km	1.00	1.28	0.88, 1.87	2.31***	1.60, 3.34	1.00	1.33	0.93, 1.91	1.93***	1.35, 2.74
Walking 500 m	1.00	1.04	0.61, 1.77	2.23**	1.36, 3.65	1.00	0.91	0.54, 1.53	2.09**	1.31, 3.34
Walking 100 m	1.00	0.95	0.52, 1.74	1.71	0.97, 3.01	1.00	0.83	0.46, 1.51	1.60	0.93, 2.73
Self-bathing or dressing	1.00	1.25	0.62, 2.52	1.83	0.93, 3.60	1.00	1.26	0.61, 2.61	2.47**	1.27, 4.82
<b>Women (n = 2156)</b>										
Mean anthropometry (SD)	70.1 (3.3)	79.0 (2.6)		93.5 (8.3)		20.9 (1.3)	24.1 (0.8)		29.4 (3.6)	
Vigorous activities	1.00	1.20	0.96, 1.49	1.68***	1.32, 2.13	1.00	1.17	0.94, 1.46	1.61***	1.27, 2.03
Moderate activities	1.00	1.27	0.95, 1.69	1.78***	1.34, 2.36	1.00	1.12	0.84, 1.48	1.61***	1.22, 2.12
Lifting or carrying groceries	1.00	1.11	0.86, 1.43	1.45**	1.12, 1.87	1.00	1.14	0.88, 1.47	1.48**	1.15, 1.91
Climbing several flights of stairs	1.00	1.19	0.89, 1.60	1.87***	1.40, 2.49	1.00	1.16	0.87, 1.56	2.09***	1.58, 2.77
Climbing 1 flight of stairs	1.00	1.11	0.70, 1.76	1.88**	1.22, 2.90	1.00	1.09	0.68, 1.74	2.19***	1.44, 3.34
Bending, kneeling	1.00	1.24	0.95, 1.63	2.20***	1.68, 2.87	1.00	1.27	0.97, 1.66	2.10***	1.62, 2.73
Walking >1 km	1.00	1.15	0.85, 1.57	1.75***	1.29, 2.38	1.00	1.21	0.89, 1.64	1.77***	1.32, 2.39
Walking 500 m	1.00	1.00	0.65, 1.54	1.73**	1.15, 2.58	1.00	1.24	0.81, 1.91	2.01***	1.34, 2.99
Walking 100 m	1.00	1.01	0.62, 1.66	1.22	0.75, 1.97	1.00	1.39	0.82, 2.34	1.95**	1.19, 3.18
Self-bathing or dressing	1.00	1.04	0.55, 1.99	0.80	0.40, 1.59	1.00	1.10	0.56, 2.16	1.13	0.58, 2.18

Note. Lifestyle and demographic factors are described in the Logistic Regression Analyses section of Statistical Methods.

<sup>a</sup>Reference group.

\*\*\**P* < .001; \*\**P* < .01; \**P* < .05.

health in general as not good (women). The subjects' current indices of adiposity did not relate to reported change in health since 1 year previously, perhaps because some had changed weight and fat distribution as well as their health. Poor subjective health is a determinant of mortality independent of physical health status.<sup>21-24</sup> It has been shown that among elderly subjects who performed activities of daily living with difficulty, risk of death was 2 to 3 times higher.<sup>25</sup> In the present study, unadjusted odds ratios were higher (results not shown), and age had the most powerful confounding effects on the relationships between anthropometric variables and quality of life. We found no important interactions between height and waist circumference or interactions between age and body mass index or waist circumference.

Linear regression analysis was not employed in the present study to determine the relationships between the scores of health concepts and indices of adiposity, because the scores were not normally distributed (Figure 1). We therefore used logistic regression analysis and introduced cutoff points to define "good" and "poor" health for the 9 health concepts; "good health" was defined as equal to or above 66.7% of standardized

scores and "poor health" as below 66.7% (except for the health transition health concept, where the cutoff was 50%). There are no definitive cutoffs for these health concepts, but Stewart et al. have shown that patients with chronic diseases who were more physically active had scores mostly above 66.7% and those who were less active had scores mostly below 66.7%.<sup>19</sup> "Good" health as indicated by the 36 individual items was defined as above-average scores and "poor" health as scores that were average or below. These cutoffs were arbitrary; if good self-rated health were defined more broadly (i.e., average or above scores), then the prevalence of poor self-rated health would be lower. Launer et al. also lumped fair and poor scores together, owing to these scores' strong association with disability.<sup>12</sup> Previous findings have shown that subjects above 65 years old who rated their health as fair had twice the risk of death within 2 years compared with those who rated their health as excellent,<sup>20</sup> and Schoenfeld et al. found that the risks of death for those who rated their health as fair and those who rated it as poor were similar.<sup>26</sup> There may be an overrating of health among those who consider their health as fair.<sup>27,28</sup> Poorly rated health was associated

with adverse adiposity, but questions were not designed to assess the subjects' own perception of this link. Some of the limitations of the present study may be that comorbidity involving diabetes and arthritis was not included in the analyses; however, the prevalences of arthritis (<1%) and diabetes (1.6% for men and 0.9% for women) are relatively low in this age range.<sup>29</sup> The use of odds ratios in some variables with high prevalence (poor vitality or poor general health) may overestimate the relative risks.<sup>30</sup>

Quality of life may include many dimensions—psychosocial health being one example—and its association with overweight and fat distribution has been extensively studied. Negative attitudes toward overweight,<sup>31</sup> peer pressure, and social discrimination put heavy pressure on the overweight.<sup>32,33</sup> Severely overweight men (body mass index > 34 kg/m<sup>2</sup>) and women (body mass index > 38 kg/m<sup>2</sup>) have been shown to rate their current health as poorer and mood states as less positive than nonoverweight subjects.<sup>34</sup> Even at an early age (9 years), overweight children have been shown to have low self-esteem.<sup>35</sup> The fear of being overweight may lead to behavioral changes such as slimming, particularly in women who

**TABLE 4—Odds Ratios (Adjusted for Age, Lifestyle, and Demographic Factors) of Poor Self-Rated Health Scores for Each Item of Mental Health and General Health, by Waist Circumference and Body Mass Index**

	Waist Circumference (cm)					Body Mass Index (kg/m <sup>2</sup> )				
	Tertile 1 <sup>a</sup>	Tertile 2		Tertile 3		Tertile 1 <sup>a</sup>	Tertile 2		Tertile 3	
		OR	95% CI	OR	95% CI		OR	95% CI	OR	95% CI
<b>Men (n = 1885)</b>										
Mean anthropometry (SD)	80.8 (4.6)	91.6 (2.6)		104.3 (7.7)		22.1 (1.6)	25.5 (0.7)		29.6 (2.8)	
<b>Mental health</b>										
Nervous	1.00	0.89	0.59, 1.35	1.01	0.66, 1.54	1.00	0.80	0.53, 1.19	0.86	0.57, 1.29
Down in the dumps	1.00	1.28	0.65, 2.53	1.46	0.74, 2.89	1.00	0.89	0.45, 1.74	1.37	0.72, 2.61
Not calm and peaceful	1.00	0.96	0.71, 1.30	0.99	0.72, 1.36	1.00	1.17	0.87, 1.58	1.14	0.84, 1.56
Downhearted and blue	1.00	1.32	0.79, 2.19	1.38	0.81, 2.35	1.00	1.23	0.74, 2.03	1.45	0.87, 2.41
Not a happy person	1.00	1.01	0.75, 1.37	0.90	0.65, 1.24	1.00	1.12	0.73, 1.71	1.54*	1.02, 2.34
<b>General health</b>										
Poor health in general	1.00	0.81	0.54, 1.20	1.23	0.83, 1.81	1.00	1.04	0.71, 1.53	1.20	0.82, 1.75
Getting sick more easily than others	1.00	1.24	0.88, 1.75	1.23	0.86, 1.75	1.00	1.17	0.84, 1.64	1.22	0.87, 1.72
Not as healthy as others	1.00	0.85	0.66, 1.09	0.97	0.75, 1.27	1.00	1.14	0.89, 1.45	1.06	0.82, 1.37
Expecting worse health	1.00	1.27	1.00, 1.61	1.39*	1.08, 1.80	1.00	1.28*	1.01, 1.62	1.30*	1.02, 1.66
Health not excellent <sup>b</sup>	1.00	1.01	0.75, 1.35	1.35*	1.00, 1.82	1.00	1.30	0.98, 1.73	1.48**	1.11, 1.98
<b>Women (n = 2156)</b>										
Mean anthropometry (SD)	80.8 (4.6)	91.6 (2.6)		104.3 (7.7)		22.1 (1.6)	25.5 (0.7)		29.6 (2.8)	
<b>Mental health</b>										
Nervous	1.00	1.13	0.81, 1.59	1.10	0.77, 1.57	1.00	0.93	0.67, 1.31	1.02	0.73, 1.44
Down in the dumps	1.00	1.15	0.66, 2.01	1.45	0.83, 2.53	1.00	0.97	0.54, 1.75	1.79*	1.05, 3.05
Not calm and peaceful	1.00	1.18	0.93, 1.49	1.19	0.92, 1.52	1.00	1.04	0.82, 1.32	1.10	0.86, 1.40
Downhearted and blue	1.00	1.02	0.69, 1.51	1.09	0.72, 1.65	1.00	0.94	0.63, 1.40	1.22	0.82, 1.81
Not a happy person	1.00	1.13	0.87, 1.47	1.10	0.83, 1.47	1.00	1.05	0.81, 1.36	1.00	0.76, 1.31
<b>General health</b>										
Poor health in general	1.00	1.21	0.87, 1.70	1.52*	1.09, 2.13	1.00	0.91	0.64, 1.27	1.64**	1.19, 2.25
Getting sick more easily than others	1.00	0.97	0.74, 1.28	1.18	0.89, 1.57	1.00	0.85	0.64, 1.12	1.19	0.91, 1.57
Not as healthy as others	1.00	0.93	0.74, 1.18	0.97	0.76, 1.24	1.00	1.11	0.88, 1.40	1.02	0.81, 1.30
Expecting worse health	1.00	1.04	0.83, 1.30	0.96	0.75, 1.21	1.00	1.03	0.82, 1.28	1.18	0.93, 1.48
Health not excellent <sup>b</sup>	1.00	1.11	0.86, 1.43	1.28	0.99, 1.67	1.00	1.09	0.84, 1.41	1.41	1.09, 1.82

Note. Lifestyle and demographic factors are described in the Logistic Regression Analyses section of Statistical Methods.

<sup>a</sup>Reference group.

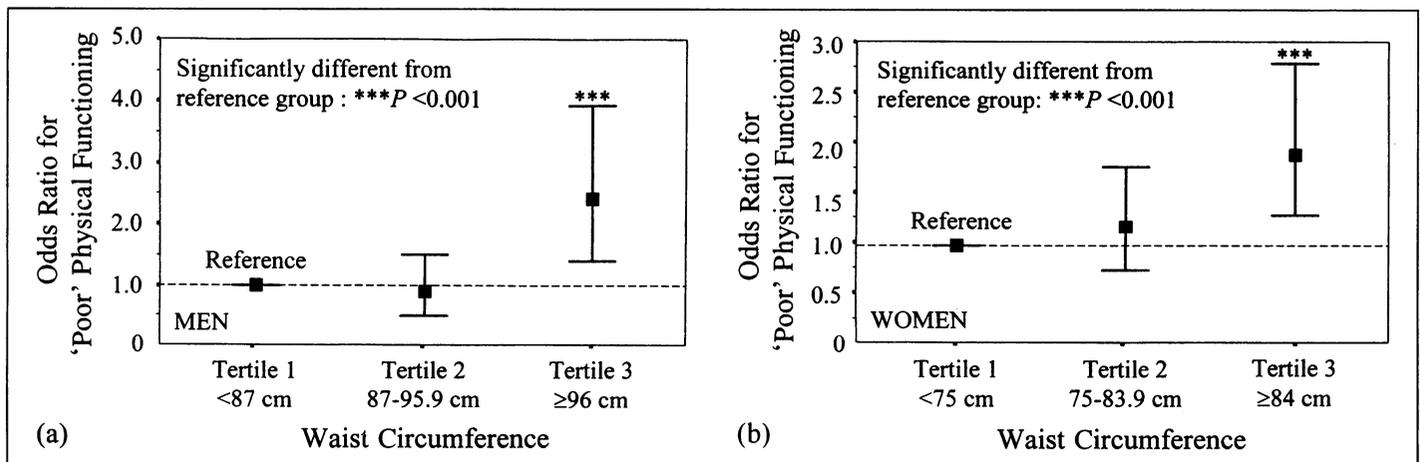
<sup>b</sup>Responded "don't know" or "false" to the question "do you rate your health as excellent? (don't know, true, or false)."

\*\*\*P < .001; \*\*P < .01; \*P < .05.

are not even overweight.<sup>36</sup> The present study has shown that despite the unfavorable perceptions by other people and poor physical

health, there was little evidence to suggest that overweight subjects or those with large waists were having more nonphysical prob-

lems such as poor social functioning, adverse mental health, or role limitations due to emotional problems than were other subjects.



**FIGURE 2—Odds ratios (■) and 95% CIs (vertical bars) for subjects with poor (<66.7% of standardized scores) physical functioning, by different tertiles of waist circumference in men (a) and women (b). Odds ratios were adjusted for age, lifestyle, and demographic factors as described in Methods.**

In conclusion, this study provides evidence that large waist circumference and high body mass index are important indicators of physical difficulties with basic activities of daily living. The data present a very worrisome profile of ill health and disabilities among a large and increasing proportion of adults who are overweight, and these problems do not appear to be attributable to mental ill health. □

## Acknowledgments

Funding was provided by the British Council, the Netherlands (T.S. Han); the Ministry of Public Health, Welfare and Sports of The Netherlands (M. A. R. Tijhuis and J. C. Seidell), and the Rank Foundation and Rank Prize funds (M. E. J. Lean).

We are grateful for Anneke Blokstra for data management. The authors would like to thank the Municipal Health Services in Amsterdam, Doetinchem, and Maastricht for their important contribution to the data collection for this study.

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