OBESITY, A LEADING CAUSE OF preventable deaths, is more prevalent among adults with disabilities.1-4 One contributing factor is physical inactivity since adults with disabilities are more likely to face barriers to regular exercise. Nevertheless, healthy weight and exercise are essential goals for the entire population, and adults with disabilities should derive benefits for health and overall functioning.5-8 We examined the prevalence of obesity, weight loss attempts, and physician exercise counseling among adults with mobility and sensory disabilities and mental illness.

METHODS
We pooled data from the 1994-1995 National Health Interview Survey (NHIS), the 1994-1995 Disability Supplement (NHIS-D), and the 1995 Healthy People 2000 Supplement.9 The NHIS is a continuing household survey of non-institutionalized US adults (including adults in group homes) conducted by the National Center for Health Statistics. In 1994 and 1995, all respondents were asked about sociodemographic factors (core survey) and about specific sensory and physical limitations and psychiatric conditions (disability supplement). One adult from half of the households in 1995 was then asked about 6 chronic medical conditions (diabetes; chronic lung, kidney, liver, or cardiac disease; and cancer), tobacco use, attempts to lose weight and exercise counseling (Healthy People 2000 Supplement). The overall combined response rate was 87% to the core survey and NHIS-D in both years and 94% to the Healthy People 2000 Supplement. Proxies (35%) responded for adults who were unable or unavailable to answer. The National Center for Health Statistics weighted figures to account for nonresponse.9

We classified respondents into 6 categories, as described in detail previously: blind/low vision (blind or serious difficulty seeing); deaf/hard of hearing (difficulty hearing normal conversations or uses hearing aid); lower extremity mobility difficulty (trouble walking, climbing stairs, standing, or using mobility aid); upper extremity mobility difficulty (difficulty reaching); hand dexterity difficulty (difficulty grasping or holding a pen); and serious mental illness (schizophrenia, major depression or paranoid, bipolar or severe personality disorder).10 We divided the physical im-

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OBESITY AMONG ADULTS WITH DISABLING CONDITIONS

pairment groups into 2 severity levels based on self-reports of serious difficulties or use of a wheelchair or scooter. Although we call these “disabilities,” many people with these conditions may not view themselves as disabled.

We used SUDAAN’s direct standardization method to adjust for age with the entire NHIS sample as the standard population. We calculated age-sex standardized rates of obesity (body mass index [BMI] >30 kg/m²), attempted weight loss, and physician exercise counseling in the previous year. We conducted logistic regression analyses of disability and obesity and simultaneously adjusted for relevant demographic factors including age, sex, race/ethnicity, education, living alone, and family income. Among the respondents to the Healthy People 2000 Supplement, we examined weight loss and exercise counseling, adjusting additionally for BMI, current smoking, and available comorbidities. We used SUDAAN to estimate SEs with Taylor series linearization. We assessed for collinearity by comparing SEs from adjusted and unadjusted models.

RESULTS

Of 145007 respondents, 25626 reported at least 1 disability. Lower extremity mobility difficulties were most common. Poverty, living alone, low education, inability to work, and smoking were more frequent among adults with than without disabilities (Table 1).

Among adults with disabling conditions, 24.9% were obese compared to 15.1% among those without disabilities. Mild, moderate, and severe obesity were more prevalent in adults with than without disabilities (Table 2). Rates of overweight were slightly lower among adults with disabilities, except for those who were deaf or hard of hearing. After full adjustment, adults with disabilities remained significantly more likely to be in the obese category; adults with lower extremity mobility difficulties were the most likely to be obese (Table 3). Although adults with upper extremity mobility difficulties were also more likely to be obese, adjusting for other disabilities attenuated this effect (adjusted odds ratios [AORs], 1.2 [95% confidence interval [CI], 1.1-1.4] and 1.1 [95% CI, 1.0-1.3] for some and severe difficulty, respectively). Results were similar when we limited analyses to self-responders.

Respondents with most disabilities were as likely to attempt weight loss as adults without disabilities (Table 4). However, adults with severe lower extremity mobility difficulties were less likely and adults with mental illness were more likely to attempt weight loss. When we limited analyses to obese adults, the results were similar for those with mental illness (AOR, 1.5 [95% CI, 0.9-2.3]); but adults with severe lower extremity mobility difficulty were now as likely to attempt weight loss (AOR, 1.0 [95% CI, 0.6-1.5]). However, overweight adults (BMI, 25-29.9 kg/m²) with severe mobility difficulty were still significantly less likely to attempt weight loss (AOR, 0.4 [95% CI, 0.2-0.8]) than overweight adults without mobility difficulties.

Compared with those without disabilities, most respondents with disabilities were as likely to report exercise counseling. Exceptions included adults with severe upper or lower extremity mobility difficulties (Table 4). When we limited analyses to obese adults, counseling differences for adults with severe upper extremity mobility difficulty were no longer statistically significant (AOR, 0.6 [95% CI, 0.3-1.2]).

COMMENT

We found that obesity was more prevalent in adults with disabling sensory, physical, and mental health conditions than in the general US population. Most adults with disabilities were as likely to attempt weight loss or report exercise counseling as adults without disabilities. However, attempted weight loss was less common for nonobese adults with

Table 1. Distribution of Characteristics by Disability

<table>
<thead>
<tr>
<th>Disability</th>
<th>Sample Size, No.</th>
<th>Age, Mean (SD), y</th>
<th>Female Sex</th>
<th>Nonwhite</th>
<th>Poverty†</th>
<th>Living Alone</th>
<th>Education</th>
<th>&lt;12 y</th>
<th>Cannot Work‡</th>
<th>Current Smoker</th>
<th>Cannot Work‡</th>
<th>Current Smoker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire survey</td>
<td>145 007</td>
<td>44.3 (26.3)</td>
<td>52.3 (0.1)</td>
<td>15.7 (0.4)</td>
<td>9.9 (0.2)</td>
<td>14.4 (0.2)</td>
<td>19.1 (0.2)</td>
<td>6.1 (0.1)</td>
<td>26.3 (0.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any disability</td>
<td>25 626</td>
<td>58.3 (18.4)</td>
<td>54.8 (0.4)</td>
<td>15.6 (0.5)</td>
<td>19.6 (0.5)</td>
<td>18.8 (0.4)</td>
<td>28.1 (0.4)</td>
<td>31.1 (0.5)</td>
<td>38.5 (1.2)</td>
<td></td>
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</tr>
<tr>
<td>Blind/low vision</td>
<td>3538</td>
<td>61.5 (16.5)</td>
<td>53.9 (1.2)</td>
<td>18.1 (1.2)</td>
<td>21.9 (1.1)</td>
<td>17.7 (0.9)</td>
<td>32.8 (1.2)</td>
<td>34.6 (1.4)</td>
<td>33.3 (3.3)</td>
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</tr>
<tr>
<td>Deaf/hard of hearing</td>
<td>8204</td>
<td>62.5 (15.1)</td>
<td>37.1 (0.8)</td>
<td>9.7 (0.7)</td>
<td>15.3 (0.7)</td>
<td>16.9 (0.6)</td>
<td>24.0 (0.8)</td>
<td>15.9 (0.7)</td>
<td>34.8 (2.2)</td>
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<tr>
<td>Lower extremity mobility</td>
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<tr>
<td>Some difficulty</td>
<td>10 945</td>
<td>60.0 (15.7)</td>
<td>62.3 (0.7)</td>
<td>19.7 (0.8)</td>
<td>22.9 (0.7)</td>
<td>19.3 (0.6)</td>
<td>32.1 (0.7)</td>
<td>41.4 (0.9)</td>
<td>38.6 (2.0)</td>
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<tr>
<td>Severe difficulty</td>
<td>4090</td>
<td>67.3 (12.6)</td>
<td>55.6 (1.8)</td>
<td>19.7 (1.3)</td>
<td>26.9 (1.6)</td>
<td>16.1 (1.0)</td>
<td>35.5 (1.6)</td>
<td>73.7 (2.1)</td>
<td>47.3 (4.6)</td>
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<tr>
<td>Upper extremity mobility</td>
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<tr>
<td>Some difficulty</td>
<td>2021</td>
<td>59.1 (13.8)</td>
<td>62.0 (1.7)</td>
<td>15.1 (1.3)</td>
<td>21.5 (1.5)</td>
<td>24.9 (2.3)</td>
<td>29.9 (1.4)</td>
<td>42.8 (2.2)</td>
<td>41.2 (3.9)</td>
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<tr>
<td>Severe difficulty</td>
<td>2111</td>
<td>62.4 (13.6)</td>
<td>59.9 (1.9)</td>
<td>16.6 (1.4)</td>
<td>24.9 (1.7)</td>
<td>18.4 (1.4)</td>
<td>37.0 (1.9)</td>
<td>64.2 (2.5)</td>
<td>39.1 (3.2)</td>
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<tr>
<td>Hand dexterity</td>
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<tr>
<td>Some difficulty</td>
<td>2550</td>
<td>57.9 (13.4)</td>
<td>65.8 (1.3)</td>
<td>16.4 (1.4)</td>
<td>21.6 (1.3)</td>
<td>23.0 (1.4)</td>
<td>26.3 (1.2)</td>
<td>39.5 (1.8)</td>
<td>44.5 (3.0)</td>
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<tr>
<td>Severe difficulty</td>
<td>1696</td>
<td>61.5 (14.0)</td>
<td>57.7 (1.9)</td>
<td>20.2 (1.8)</td>
<td>26.9 (1.9)</td>
<td>18.3 (1.2)</td>
<td>36.5 (1.9)</td>
<td>62.2 (2.4)</td>
<td>29.3 (2.7)</td>
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</tr>
<tr>
<td>Serious mental illness</td>
<td>2981</td>
<td>42.5 (10.2)</td>
<td>61.5 (1.0)</td>
<td>13.6 (0.8)</td>
<td>24.1 (0.9)</td>
<td>27.8 (1.1)</td>
<td>28.6 (0.9)</td>
<td>39.1 (1.1)</td>
<td>48.3 (2.9)</td>
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</tbody>
</table>

*Percentages weighted to reflect US population of 190.4 million and standardized for age and sex. Data from 1994-1995 National Health Interview Survey Disability Supplement.*
†Poverty indicates income below the poverty line.
‡Cannot work indicates unable to work due to health condition.
 Obesity among adults with disabling conditions.

Table 2. Age- and Sex-Adjusted Distribution of Adults in Each Weight Category by Disability

<table>
<thead>
<tr>
<th>Disability</th>
<th>Underweight (n = 7724)</th>
<th>Normal (n = 63 949)</th>
<th>Overweight (n = 48 784)</th>
<th>Mild Obesity (n = 17 557)</th>
<th>Moderate Obesity (n = 5230)</th>
<th>Severe Obesity (n = 2363)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No disability</td>
<td>5.2 (0.1)</td>
<td>46.0 (0.2)</td>
<td>33.8 (0.2)</td>
<td>10.9 (0.12)</td>
<td>2.9 (0.1)</td>
<td>1.1 (0.04)</td>
</tr>
<tr>
<td>Any disability</td>
<td>5.7 (0.2)</td>
<td>36.7 (0.4)</td>
<td>31.7 (0.4)</td>
<td>15.6 (0.3)</td>
<td>6.1 (0.2)</td>
<td>4.2 (0.2)</td>
</tr>
<tr>
<td>Blind/low vision</td>
<td>5.6 (0.5)</td>
<td>38.9 (1.1)</td>
<td>29.1 (1.1)</td>
<td>16.8 (1.0)</td>
<td>6.4 (0.6)</td>
<td>3.2 (0.4)</td>
</tr>
<tr>
<td>Deaf/hard of hearing</td>
<td>5.5 (0.5)</td>
<td>37.3 (0.9)</td>
<td>33.9 (0.9)</td>
<td>15.4 (0.6)</td>
<td>5.4 (0.4)</td>
<td>2.6 (0.3)</td>
</tr>
<tr>
<td>Lower extremity mobility</td>
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<td></td>
</tr>
<tr>
<td>Some difficulty</td>
<td>5.9 (0.4)</td>
<td>32.4 (0.7)</td>
<td>30.3 (0.7)</td>
<td>17.8 (0.5)</td>
<td>7.7 (0.4)</td>
<td>6.2 (0.4)</td>
</tr>
<tr>
<td>Severe difficulty</td>
<td>12.6 (1.3)</td>
<td>32.3 (1.7)</td>
<td>25.8 (1.5)</td>
<td>14.5 (0.9)</td>
<td>8.1 (1.0)</td>
<td>6.7 (0.7)</td>
</tr>
<tr>
<td>Upper extremity mobility</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some difficulty</td>
<td>6.2 (1.1)</td>
<td>37.3 (2.1)</td>
<td>31.4 (1.6)</td>
<td>14.1 (0.9)</td>
<td>6.9 (0.9)</td>
<td>4.0 (0.8)</td>
</tr>
<tr>
<td>Severe difficulty</td>
<td>8.9 (1.3)</td>
<td>34.4 (2.3)</td>
<td>30.7 (1.6)</td>
<td>16.7 (1.5)</td>
<td>6.6 (0.8)</td>
<td>2.8 (0.4)</td>
</tr>
<tr>
<td>Hand dexterity</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Some difficulty</td>
<td>6.4 (0.9)</td>
<td>37.1 (1.7)</td>
<td>30.4 (1.5)</td>
<td>15.4 (1.1)</td>
<td>7.2 (0.8)</td>
<td>3.5 (0.5)</td>
</tr>
<tr>
<td>Severe difficulty</td>
<td>10.9 (1.4)</td>
<td>38.6 (2.0)</td>
<td>26.4 (1.6)</td>
<td>14.6 (1.2)</td>
<td>6.6 (0.9)</td>
<td>3.0 (0.6)</td>
</tr>
<tr>
<td>Serious mental illness</td>
<td>5.9 (0.5)</td>
<td>39.1 (1.3)</td>
<td>31.6 (0.9)</td>
<td>14.2 (0.7)</td>
<td>5.2 (0.4)</td>
<td>4.9 (0.4)</td>
</tr>
</tbody>
</table>

*Body mass indexes in each weight category: underweight, <18.5 kg/m²; normal weight, 18.5-24.9 kg/m²; overweight, 25.0-29.9 kg/m²; mild obesity (Class I), 30.0-34.9 kg/m²; moderate obesity (Class II), 35.0-39.9 kg/m²; severe obesity, 40.0 kg/m². Data from 1994-1995 National Health Interview Survey Disability Supplement.9

Table 3. Adjusted Odds Ratios of Being Obese by Type of Disability (N = 145 007)*

<table>
<thead>
<tr>
<th>Disability</th>
<th>Odds Ratio (95% Confidence Interval)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any disability</td>
<td>1.9 (1.8-2.0)</td>
</tr>
<tr>
<td>Blind/low vision</td>
<td>1.5 (1.3-1.6)</td>
</tr>
<tr>
<td>Deaf/hard of hearing</td>
<td>1.3 (1.2-1.4)</td>
</tr>
<tr>
<td>Lower extremity mobility</td>
<td>2.5 (2.3-2.7)</td>
</tr>
<tr>
<td>Some difficulty</td>
<td>2.4 (2.3-2.5)</td>
</tr>
<tr>
<td>Severe difficulty</td>
<td>2.5 (2.3-2.7)</td>
</tr>
<tr>
<td>Upper extremity mobility</td>
<td>1.6 (1.5-1.8)</td>
</tr>
<tr>
<td>Some difficulty</td>
<td>1.6 (1.4-1.8)</td>
</tr>
<tr>
<td>Severe difficulty</td>
<td>1.5 (1.3-1.7)</td>
</tr>
<tr>
<td>Hand dexterity</td>
<td>1.6 (1.5-1.8)</td>
</tr>
<tr>
<td>Some difficulty</td>
<td>1.5 (1.3-1.7)</td>
</tr>
<tr>
<td>Severe difficulty</td>
<td>1.5 (1.3-1.7)</td>
</tr>
<tr>
<td>Serious mental illness</td>
<td>1.6 (1.4-1.7)</td>
</tr>
</tbody>
</table>

*Analyses were adjusted for age, sex, race/ethnicity, education, income, and living alone. The reference group for each disability category is adults without that specific disability. Data from 1984-1995 National Health Interview Survey Disability Supplement.9

†Outcome dichotomized as adults with obesity (BMI ≥30 kg/m²) and adults without obesity (BMI <30 kg/m²).

Our estimates of higher obesity rates among those with disabilities are likely underestimated because the prevalence of obesity has increased since 1994. Furthermore, we did not consider weight loss associated with drug addiction or eating disorders such as anorexia nervosa or bulimia, particularly among those with some types of mental illness who are likely to have higher rates of these conditions. Interestingly, most adults with disabilities were as likely as those without disabilities to attempt weight loss, which suggests that adults with disabilities share concerns about their weight. The finding that most adults with and without disabilities reported exercise counseling at similar rates is encouraging, but must be interpreted in light of overall low levels of physician counseling about exercise and weight control.17,18

Particularly troubling is the prevalence of obesity in those with mobility difficulties, especially since population-standardized BMI categories likely underestimate health risks for adults with reduced lean muscle mass. Fortunately, obese adults with severe mobility difficulties were as likely to attempt weight loss as obese adults without these difficulties. However, overweight adults with these impairments were substantially less likely to attempt weight loss compared with overweight adults without mobility impairments, even though being overweight confers substantial health risk and predisposes one to developing obesity. Furthermore, regardless of BMI, adults with mobility difficulties were less likely to report exercise counseling. Physicians may hesitate to encourage exercise because they perceive greater impediments to physical activity. Although exercise contributes only moderately to weight loss, it is important for weight maintenance since physical activity contributes to a “vicious cycle” where inactivity contributes to obesity, obesity exacerbates disability, and disability impedes exercise.1,10

Adults with mental illness were also distinct as the only group to attempt weight loss more frequently than the general population. This may be partly due to weight gain induced by psychotropic medications, a common reason for medication nonadherence. Higher weight loss attempts may be provoked by this phenomenon.10

Interestingly, adults who were deaf or hard of hearing were also more likely to lower extremity mobility difficulties and more common for those with mental illness. Adults with severe upper or lower extremity difficulties reported lower rates of physician exercise counseling.

Our results are consistent with previous studies showing an association between obesity and disability. Numerous studies suggest that obesity increases the risk of developing physical disability. However, few studies have examined obesity prevalence in populations with specific types of disabilities and mental illness. Unlike many other studies, which use a broad definition of disability based on limited functioning, we assessed obesity among adults with physical and sensory impairments, and mental health conditions using a national sample.

Obesity is a serious public health concern that not only increases mortality and morbidity, but also diminishes quality of life. Our estimates of higher obesity rates among those with disabilities are likely underestimated because the prevalence of obesity has increased since 1994. Furthermore, we did not consider weight loss associated with drug addiction or eating disorders such as anorexia nervosa or bulimia, particularly among those with some types of mental illness who are likely to have higher rates of these conditions. Interestingly, most adults with disabilities were as likely as those without disabilities to attempt weight loss, which suggests that adults with disabilities share concerns about their weight. The finding that most adults with and without disabilities reported exercise counseling at similar rates is encouraging, but must be interpreted in light of overall low levels of physician counseling about exercise and weight control.

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Interestingly, adults who were deaf or hard of hearing were also more likely to...
be obese. This group may have fewer “ap-
parent” barriers to exercise than adults
with other disabilities, but clearly more
research is needed to understand the rea-
sons for this excess risk of obesity.

Guidelines that recommend obesity
screening presumably apply to adults
with disabilities, but few offer guid-
ance on how to counsel this popula-
tion.15,16 Effective counseling must ad-
dress obstacles to weight control and
exercise, such as time constraints, lim-
ited availability of exercise places or
equipment, and inadequate reimburse-
ment for weight control treatment.21

Furthermore, adults with disabilities
must confront environmental and dis-
ability-specific barriers, such as avai-
lability of accessible facilities and
transportation. Additionally, physical
impairments, including pain and weak-
ness, may hinder or preclude certain
physical activities.

Our study has limitations. Weight and
height figures were self-reported and
may be inaccurate: overweight respon-
ts are more likely to underestimate
weight and overestimate height than
mental health conditions. Phy-
sicians should recognize that patients
with disabilities face increased risks for
obesity and address their weight con-
cerns. Additional studies and more de-
tailed clinical guidelines are needed to
help physicians promote weight con-
trol and exercise among adults with
disabilities.

Author Contributions: Study concept and design: Weil, Wachterman, McCarthy, Davis, O’Day, Iezzoni, Wee. Acquisition of data: McCarthy, Iezzoni. Analysis and interpretation of data: Weil, Wachterman, McCarthy, Davis, O’Day, Iezzoni, Wee. Drafting of the manuscript: Weil, Wachterman, Wee. Critical revision of the manuscript for important in-
tellectual content: Weil, Wachterman, McCarthy, Davis, O’Day, Iezzoni, Wee. Statistical expertise: McCarthy, Davis. Obtained funding: O’Day, Iezzoni. Administrative, technical, or material support: Weil, Wachterman, McCarthy, O’Day. Study supervision: Iezzoni, Wee. Funding/Support: This research was supported by grant RO1 HS10223-03 from the Agency for Healthcare Re-
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Table 4. Adjusted Odds Ratios of Attempting Weight Loss and Receiving Exercise Counseling by Type of Disability*

<table>
<thead>
<tr>
<th>Disability</th>
<th>Attempted Weight Loss, Odds Ratio (95% CI) (n = 17,270)</th>
<th>Received Exercise Counseling, Odds Ratio (95% CI) (n = 9,844)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any disability</td>
<td>1.1 (0.9-1.2)</td>
<td>1.0 (0.8-1.1)</td>
</tr>
<tr>
<td>Blind/low vision</td>
<td>0.9 (0.6-1.3)</td>
<td>1.0 (0.7-1.4)</td>
</tr>
<tr>
<td>Deaf/hard of hearing</td>
<td>1.0 (0.8-1.3)</td>
<td>1.0 (0.8-1.3)</td>
</tr>
<tr>
<td>Lower extremity mobility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some difficulty</td>
<td>1.1 (0.9-1.3)</td>
<td>0.9 (0.8-1.1)</td>
</tr>
<tr>
<td>Severe difficulty</td>
<td>0.7 (0.5-0.9)†</td>
<td>0.5 (0.4-0.7)†</td>
</tr>
<tr>
<td>Upper extremity mobility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some difficulty</td>
<td>1.2 (0.9-1.8)</td>
<td>0.8 (0.6-1.2)</td>
</tr>
<tr>
<td>Severe difficulty</td>
<td>0.8 (0.6-1.2)</td>
<td>0.7 (0.5-1.0)†</td>
</tr>
<tr>
<td>Hand dexterity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some difficulty</td>
<td>0.8 (0.6-1.2)</td>
<td>0.8 (0.6-1.2)</td>
</tr>
<tr>
<td>Severe difficulty</td>
<td>0.8 (0.6-1.2)</td>
<td>0.7 (0.5-1.0)†</td>
</tr>
<tr>
<td>Serious mental illness</td>
<td>1.4 (1.2-1.7)†</td>
<td>1.2 (0.9-1.7)</td>
</tr>
</tbody>
</table>

*Analyses were adjusted for age, sex, race/ethnicity, education; household income; living alone; smoking status; hav-
ing a history of diabetes, chronic lung disease, heart disease, renal disease, liver disease, cancer; and body mass
index. The reference group for each disability category is adults without that specific disability. Data from 1995 Na-
tional Health Interview Survey Disability and Healthy People 2000 Supplements.†P<.05.

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