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Normative Values for the Health Assessment Questionnaire Disability Index

Benchmarking Disability in the General Population

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Objective. **The Health Assessment Questionnaire (HAQ) disability index (DI) has been commonly used in rheumatology to quantify functional disability in patient groups, but current general population values of this index are not available. This study was undertaken to establish normative values for the HAQ DI in a general population and to analyze its correlates.**

Methods. **The HAQ DI (range of scores 0–3) was measured in a random sample of 1,530 adults in the Central Finland District. Prevalence rates of disability by strata of age, sex, education level, body mass index (BMI), and health behaviors (including smoking and exercise habits) were calculated. Pearson's product-moment correlation coefficient and ordinary least squares regression were used to analyze the data.**

Results. **The estimated population mean HAQ DI was 0.25 (95% confidence interval 0.22–0.28), and 32% of respondents had at least some disability. Both for men and for women, functional disability increased exponentially with age. The HAQ DI was correlated with pain (r = 0.58) and global self assessment (r = 0.61). The prevalence of disability decreased with increasing number of years of education, lower BMI, and increasing frequency of physical exercise.**

Conclusion. **Almost one-third of the general population has some functional disability. Functional disability is associated in part with lifestyle choices and increases with age in a nonlinear manner. The normative values of the HAQ DI that we have presented could be used as a reference benchmark for clinical and epidemiologic studies using this measure of disability.**

Over the last 20 years, self reports of functional limitations have become a major component of health status outcomes in rheumatic diseases. The challenge of objectively defining functional disability is not dissimilar to that faced by the protagonist in Robert M. Pirsig's *Zen and the Art of Motorcycle Maintenance*, who lost his mind trying to define the concept of "quality" (1). The Health Assessment Questionnaire (HAQ) is one of the most widely used self-assessment instruments for measuring functional disability in patients with a variety of rheumatic diseases (2,3). This instrument contains questions on functional limitations from which a valid, effective, and sensitive measure of disability, the HAQ disability index (DI), can be computed. The HAQ is a generic questionnaire in the sense that it does not differentiate between disability caused by arthritis and that caused by other disease conditions.

In longitudinal studies of patient populations, functional disability has been observed to increase with time (4–9). However, this increase could be due to sex, age, and age-related comorbidities in addition to disease progression. Discriminating age- and sex-related declines in function from those that are disease-related requires normative data (i.e., the HAQ DI in "normal" general populations as opposed to that in patient groups). The dearth of such data has impeded routine use of the HAQ DI in clinical practice.

The present report presents normative data on the HAQ DI by age and sex from a general population sample in Finland and compares them with data from other studies

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of nonpatient cohorts (10–13). To our knowledge, the only other geographically representative data on the HAQ DI are from the First National Health and Nutrition Examination Survey Epidemiologic Followup Study (NHANES-I Followup Study) performed in the US (14).

SUBJECTS AND METHODS

Subjects, sampling, and power calculation. The Central Finland District is located in the southern part of Finland. Its population of 263,869 in the year 2000 was 5% of the total population of Finland. A sample of 2,000 people who were at least 30 years old and living in the District was drawn from a database that included an identification number, date of birth, demographic data, name, and address of each individual living in Finland. The population sample was originally drawn to identify controls for a case–control study of rheumatoid arthritis (RA) in the District (5). In that study, the arthritis patients had a mean age of 55 years, and 70% were women. To be comparable with these patients, the population sample (n = 2,000) was also designed to have the same age and sex distribution. Thus, individuals from some age–sex strata were deliberately oversampled. However, within each age–sex stratum, the sampling process was purely random, assuring representativeness. An a posteriori power calculation revealed that a sample size of 1,500 would have the power to detect a mean ± SD disability prevalence rate of 32 ± 3% with 99% confidence.

Questionnaires were mailed to a sample of 2,000 individuals in June 2000, and a reminder letter was sent 8 weeks later to those who did not respond. The sampling was performed by the organization Statistics of Finland (online at http://www.stat.fi). This organization administratively operates under the Ministry of Finance and produces two-thirds of all government statistics in Finland. The study was approved by the Ethics Committee of Jyväskylä Central Hospital.

The HAQ. Excellent reviews of the HAQ and its use and validation in various settings are available (3,15). A complete copy of the instrument and coding rules can be downloaded from http://aramis.stanford.edu. The questionnaire is usually self administered, but it may also be completed face-to-face in a clinical setting or in a telephone interview format by trained outcome assessors. The 8 functional categories assessed specifically by the HAQ are 1) dressing and grooming, 2) arising, 3) eating, 4) walking, 5) hygiene, 6) reach, 7) grip, and 8) common daily activities. For each of these domains, patients report the amount of difficulty they have had in performing 2–3 specific activities in the previous week. Items in the HAQ are easy to understand and are entirely self-explanatory. If a question within a domain does not apply (e.g., if an individual doesn't shampoo or take tub baths), then the item is left blank.

There are 4 possible responses and corresponding scores for each question: without any difficulty (score = 0); with some difficulty (score = 1); with much difficulty (score = 2); and unable to do (score = 3). The highest score reported by the patient for any component question in each domain determines the score for that domain. By convention, the disability index is expressed on a scale of 0–3 units, representing an average score across the domains. A HAQ DI of 0 indicates no functional disability, while a HAQ DI of 3 indicates severe functional disability.

The relationships between the disability index and pain as well as global self assessment of general health were also addressed in this study. These 2 characteristics were measured by asking individuals how their pain and general health had usually been over the past week. Respondents marked their responses to each question on separate double-anchored 100-mm visual analog scales. A score of 0 denoted no pain and excellent general health, while a score of 100 indicated worst pain and poorest general health. Data on date of birth, height and weight for calculating the body mass index (BMI; weight [kg]/height [m^2]), years of education, current and previous smoking habits (never/ever), and frequency of physical exercise (walking, skiing, bicycling, swimming, jogging, gym, etc.) with the response alternatives of "≥3 times weekly," "1–2 times weekly," "sometimes (<1 time weekly)," and "not at all" were also collected on the questionnaire by self report.

Statistical analysis. The prevalence of disability was calculated within sex and age groups as the proportion of subjects with a HAQ DI >0. The prevalence rates between groups were compared and tested for statistical significance by chi-square test. Differences in mean HAQ DI between groups were tested using Student's *t*-test. Relationships between HAQ DI, pain, and global health were measured using Pearson's product-moment correlation coefficient (r), which can have a magnitude ranging from 0 to 1, the former denoting no correlation at all and the latter denoting complete correlation. To visualize the nonlinear relationship between the HAQ DI and age, we used fractional polynomial modification ordinary least squares regression (16). For analyzing the predictors of disability (adjusted simultaneously for age and sex), we used logistic regression. Analyses were performed with Stata software (version 7.0 SE; Stata, College Station, TX).

RESULTS

Descriptive characteristics of the sample. A total of 1,530 of 2,000 subjects sampled returned the completed questionnaire, representing a 77% response rate. Age- and sex-specific response rates are shown in Table 1. Women constituted 72% of the responders. The

Table 1. Rates of responses to survey questionnaire, by age and sex

	Response rate, %	
Age group	Women	Men
30–34	72	57
35–39	73	63
40–44	76	71
45–49	80	68
50–54	82	76
55–59	80	72
60–64	87	82
65–69	85	88
70–74	90	79
75–79	78	89
≥80	84	75

Table 2. Health Assessment Questionnaire (HAQ) disability index (DI), by age and sex

Age group	No. of subjects	HAQ DI, mean ± SD
Women		
30–34	83	0.03 ± 0.12
35–39	110	0.09 ± 0.33
40–44	116	0.08 ± 0.29
45–49	133	0.09 ± 0.24
50–54	123	0.16 ± 0.37
55–59	99	0.23 ± 0.43
60–64	118	0.20 ± 0.40
65–69	89	0.33 ± 0.59
70–74	112	0.34 ± 0.64
75–79	50	0.77 ± 0.72
≥80	91	1.49 ± 1.08
Men		
30–34	38	0.05 ± 0.22
35–39	49	0.11 ± 0.35
40–44	47	0.08 ± 0.23
45–49	55	0.15 ± 0.39
50–54	70	0.13 ± 0.26
55–59	38	0.10 ± 0.22
60–64	33	0.17 ± 0.28
65–69	35	0.18 ± 0.39
70–74	34	0.49 ± 0.80
75–79	17	0.68 ± 0.80
≥80	15	1.43 ± 1.08

mean ± SD age of the sample was 55.4 ± 14.9 years, and they had a mean ± SD of 10.8 ± 4.1 years of education. All respondents were Caucasian residents of the Central Finland District. Approximately 9% of the respondents did not participate in physical exercise, 19% participated sometimes, 35% participated 1–2 times a week, and 37% participated in physical exercise at least 3 times a week.

Normative HAQ DI data. Overall, the estimated population mean HAQ DI was 0.25 (95% confidence interval [95% CI] 0.22–0.28). Approximately one-third (n = 482; 32%) of the respondents reported some disability. The estimated population mean HAQ DI values for men and women were 0.18 (95% CI 0.14–0.23) and 0.28 (95% CI 0.24–0.31), respectively. The sex difference in mean HAQ DI was 0.10 units ($P < 0.001$). After adjustment for age, this difference was no longer statistically significant. Table 2 shows the mean HAQ DI in each age and sex stratum.

Figure 1 plots the changes in HAQ DI with age. The fitted disability curve was flat until approximately

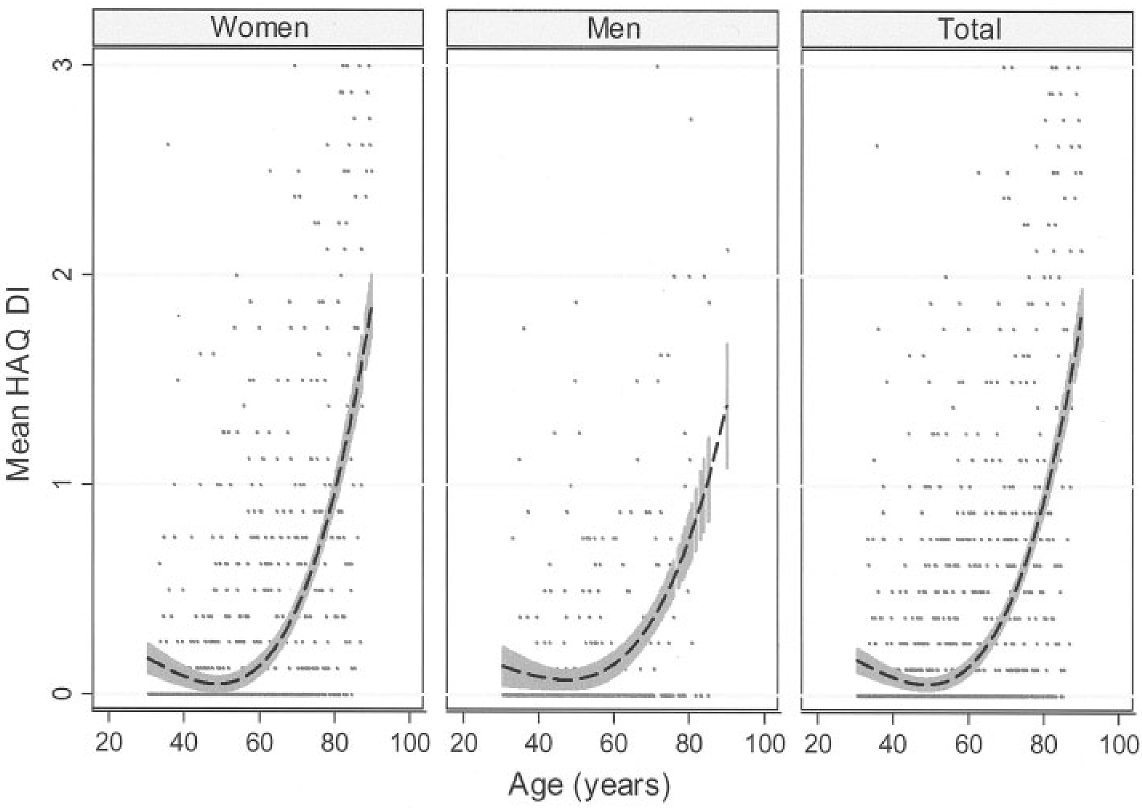

Figure 1. Progression of the mean Health Assessment Questionnaire (HAQ) disability index (DI) with age. The curves with their 95% confidence bands were fitted using fractional polynomial modification of ordinary least squares regression. The decline indicated by the left side of each curve is not statistically significant because of the wide confidence band.

Table 3. Estimated population prevalence rates of functional disability*

Age group	No. of subjects	Disability prevalence rate, % (95% confidence interval)
Women		
30–35	80	8.5 (2.4–14.7)
36–40	107	14.7 (7.9–21.4)
41–45	111	17.4 (10.4–24.4)
46–50	123	25.0 (17.4–32.6)
51–55	117	25.6 (17.7–33.5)
56–60	97	36.7 (27.0–46.4)
61–65	117	33.1 (24.4–41.7)
66–70	84	37.2 (26.8–47.6)
71–75	107	47.7 (38.3–57.2)
76–80	47	79.6 (67.9–91.3)
>80	85	89.7 (83.1–96.2)
Men		
30–35	35	11.1 (0.3–21.9)
36–40	47	18.8 (7.3–30.2)
41–45	44	23.9 (11.1–36.7)
46–50	53	23.6 (12.0–35.2)
51–55	69	27.1 (16.5–37.8)
56–60	37	26.3 (11.6–41.0)
61–65	32	39.4 (21.8–57.0)
66–70	34	25.7 (10.5–40.9)
71–75	34	50.0 (32.3–67.7)
76–80	16	56.3 (28.9–83.6)
>80	15	80.0 (57.1–102.9)

* Defined as a Health Assessment Questionnaire disability index >0.

age 50 years; subsequently, it increased in an exponential manner. This increase with age was apparent in both men and women. Prevalence rates of disability increased with age, with men generally showing greater disability at younger ages than women and women showing greater disability at older ages (Table 3).

The median value and the 75th, 90th, 95th, and 99th percentile values are shown in Table 4. While the median and 75th percentile curves showed a nonlinear pattern, the 95th and 99th percentile curves were linear, showing a steady increase from the youngest to the oldest age groups (Figure 2).

Relationship between pain, global health, and HAQ DI. The HAQ DI was correlated with the global health score (r = 0.61, 95% CI 0.58–0.65) and pain score (r = 0.58, 95% CI 0.55–0.62). The global general health and pain scores were also highly correlated with each other (r = 0.81, 95% CI 0.79–0.83). This was observed in both men and women.

Disability and education, obesity, and exercise. Figure 3 shows that mean disability increased with age in all strata of education. Declines in functional disability with education were seen both in men and in women. After adjusting for age and sex in a logistic regression model, the risk of disability was shown to decline by ~9.6% for each year of education. The prevalence rate of disability was also significantly lower ($P < 0.001$) among those with a BMI ≤30 (28.4%) than among those with a BMI >30 (51.7%). In the age- and sex-adjusted logistic regression model, a BMI >30 was associated with an odds ratio (OR) of 2.41 (95% CI 1.81–3.22) for disability. Increasing disability was found with increasing age at all subgroups of frequency of exercise (Figure 4). As could be expected in a cross-sectional survey, increasing levels of disability were associated with decreasing frequency of exercise (age- and sex-adjusted OR 1.46 [95% CI 1.29–1.64]). There was no significant difference in the prevalence of disability between those who had ever smoked (29% of the population) and those who had never smoked (29.4% and 33.4%, respectively; P = 0.23).

DISCUSSION

Although the HAQ is a widely applied tool, the comparability of the HAQ DI across clinical populations has been hampered by the absence of normative data. Thus, a clinician might ask "How much of the measured HAQ DI of the patients in my practice is due to the disease in question (say, RA) as opposed to that seen in

Table 4. Benchmarks of HAQ DI in the general population*

Age group	Percentile				
	50th	75th	90th	95th	99th
Women					
30–35	0.00	0.00	0.00	0.19	0.75
36–40	0.00	0.00	0.25	0.50	1.50
41–45	0.00	0.00	0.13	0.25	1.00
46–50	0.00	0.00	0.25	0.63	1.00
51–55	0.00	0.00	0.63	1.25	1.75
56–60	0.00	0.25	0.88	1.38	1.88
61–65	0.00	0.25	0.75	1.13	1.50
66–70	0.00	0.38	1.00	1.75	3.00
71–75	0.00	0.38	0.88	1.50	2.38
76–80	0.63	1.13	1.88	2.13	2.63
>80	1.31	2.50	2.88	3.00	3.00
Men					
30–35	0.00	0.00	0.00	0.75	1.13
36–40	0.00	0.00	0.38	0.38	1.75
41–45	0.00	0.00	0.25	0.50	1.25
46–50	0.00	0.00	0.38	1.00	1.88
51–55	0.00	0.13	0.63	0.75	1.25
56–60	0.00	0.06	0.50	0.75	0.75
61–65	0.00	0.25	0.69	0.88	0.88
66–70	0.00	0.00	0.88	1.13	1.50
71–75	0.06	0.63	1.56	1.63	3.00
76–80	0.44	0.88	2.00	2.00	2.00
>80	1.00	2.00	2.44	2.75	2.75

* Shown are the Health Assessment Questionnaire (HAQ) disability index (DI) percentile values, by age and sex.

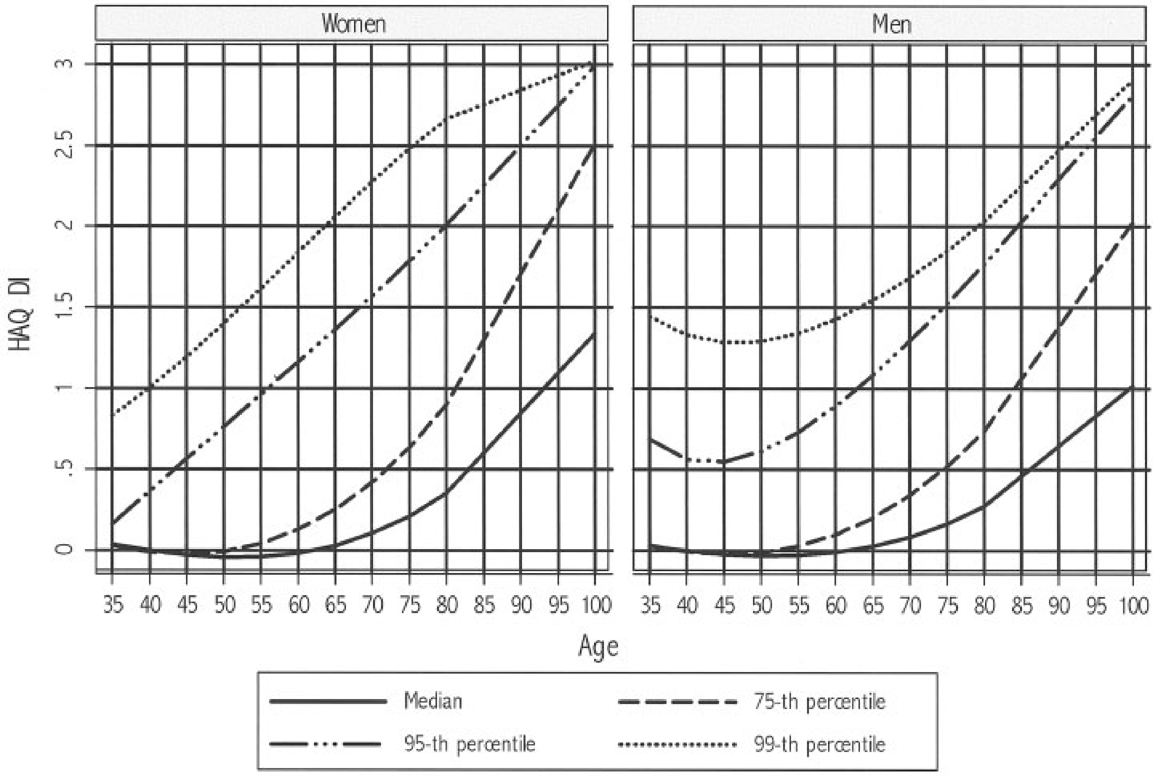

Figure 2. "Percentile curves" of the Health Assessment Questionnaire (HAQ) disability index (DI). The curves were plotted by fitting fractional polynomial regression curves on the percentile values.

the general population?" A researcher might ask "How much of the difference in prevalence rates of disability between clinical populations can be explained by differences in underlying general population disability prevalence?" The normative data we have provided can be used to answer these questions. Our report is among the few in the English language that expressly presents normative data on the HAQ DI, a commonly used disability metric in rheumatology. We have presented the disability data in terms of the mean as well as the median and various higher percentile values for HAQ DI, as well as in terms of absolute prevalence rates. We have also provided percentile growth curves similar to growth curves for infants and children.

There are several ways to apply the information we have provided, both in clinical practice and in observational studies. One way is to calculate Z scores for the HAQ DI, a method similar to that for standardizing bone mineral density. Individual Z scores can then be used to assess relative and absolute progress of individual patients and to establish reasonable therapeutic end points. However, caution must be exercised in doing so, since these metrics assume a Gaussian distribution of the HAQ DI (i.e., a bell curve), which may not be accurate in all situations.

Another way to apply our information is to use the general population data to define disability as an (artificially) dichotomous entity. In this case, the age- and sex-specific prevalence rates of disability in the general population could be applied to the clinical samples to derive the expected number of disabled patients. The ratio of the observed number to the expected number of disabled patients provides the standardized metric that enables comparisons across populations. This metric is also useful for comparisons of functional disability across different diseases, such as osteoarthritis and RA.

The difficulty in this approach is that there is little consensus on what constitutes the cutoff score for designating a significant level of "disability" (i.e., how much disability is disability?). We believe that any of the mean as well as the median and other percentile values of the general population HAQ DI can be used as benchmarks to define disease-attributable disability in

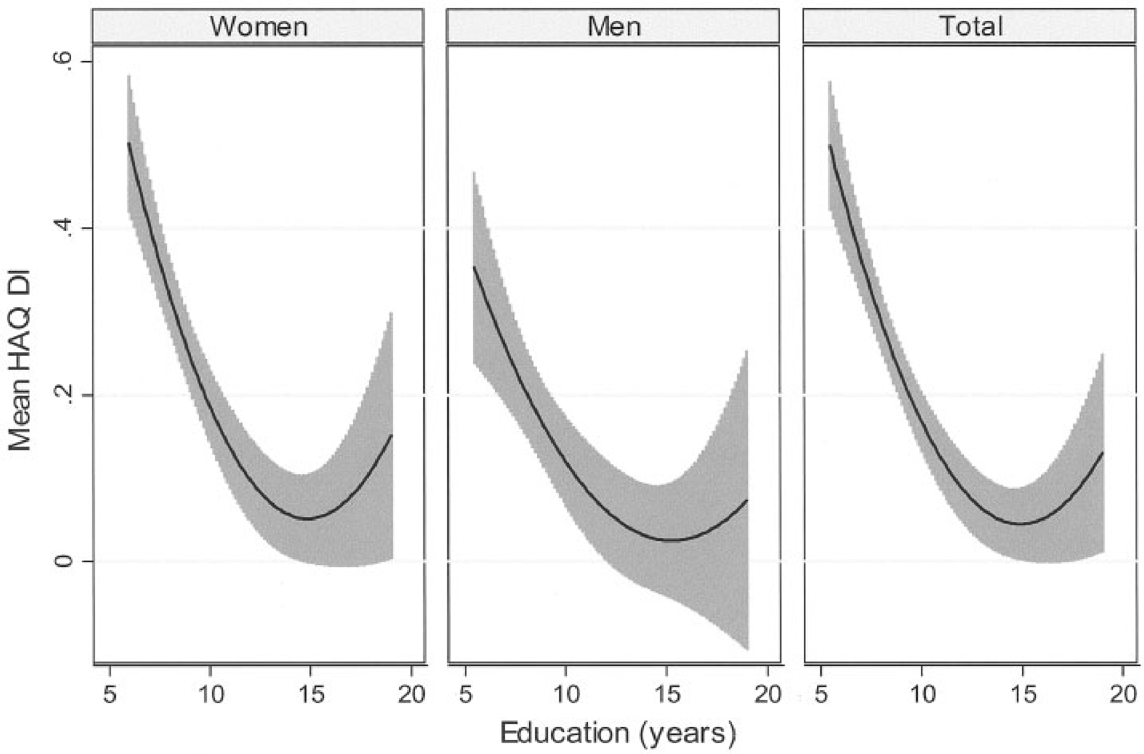

Figure 3. Relationship between education and the Health Assessment Questionnaire (HAQ) disability index (DI). The curves were fitted using fractional polynomial modification of ordinary least squares regression. The increase indicated by the right side of each curve is not statistically significant because of the wide confidence band.

clinical populations. The exact choice of cutoff should be tailored to individual study requirements and patient characteristics. For instance, in a case–control study of RA, we chose to use both the 95th percentile of the HAQ DI in the general population and an HAQ DI $\geq$1.0 as the cutoff values for defining disability (5).

In the present study, we calculated disability rates as the proportion of individuals with a HAQ DI $>$0, as opposed to any other cutoff value, for the following reasons. Instead of asking how much disability is disability, from a clinical stand point we asked "How much disability is 'undisability' or having no disability?" The answer to this question is simple in the case of the HAQ—a HAQ DI equal to 0. This may be a less controversial method than using any other cutoff value for the HAQ DI. Once the individual expresses some difficulty in performing one or more activities (HAQ DI $>$0), then by definition the individual is disabled. We recommend that disability be defined as a HAQ DI $>$0, since this is intuitive and sensitive, has face validity, and is useful and meaningful in all settings.

There is another compelling reason for using a dichotomized measure of functional disability. The distribution of HAQ DI in patient groups and in the general population is not Gaussian, and any measures of central tendency, such as mean or median, are associated with imprecise measures of dispersion, such as standard deviation or interquartile range. Thus, dichotomizing the HAQ DI at 0 would yield a more robust measurement in certain situations and would supplement mean and median measurements. Moreover, given the current aggressive paradigm of treatment with biologics in patients with RA, the goal of therapy is moving toward abolishing disability (HAQ DI = 0). The proportion of persons who have no disability (i.e., HAQ DI = 0) can also be easily calculated from our results for comparative purposes as more effective therapies become available.

Another important observation of our study is the high prevalence of functional disability in this adult community, with 1 in 3 subjects reporting at least some disability in 1 of the 8 domains of daily living. The mean HAQ DI in this general population was 0.25, much higher than that in the control cohort in a study of

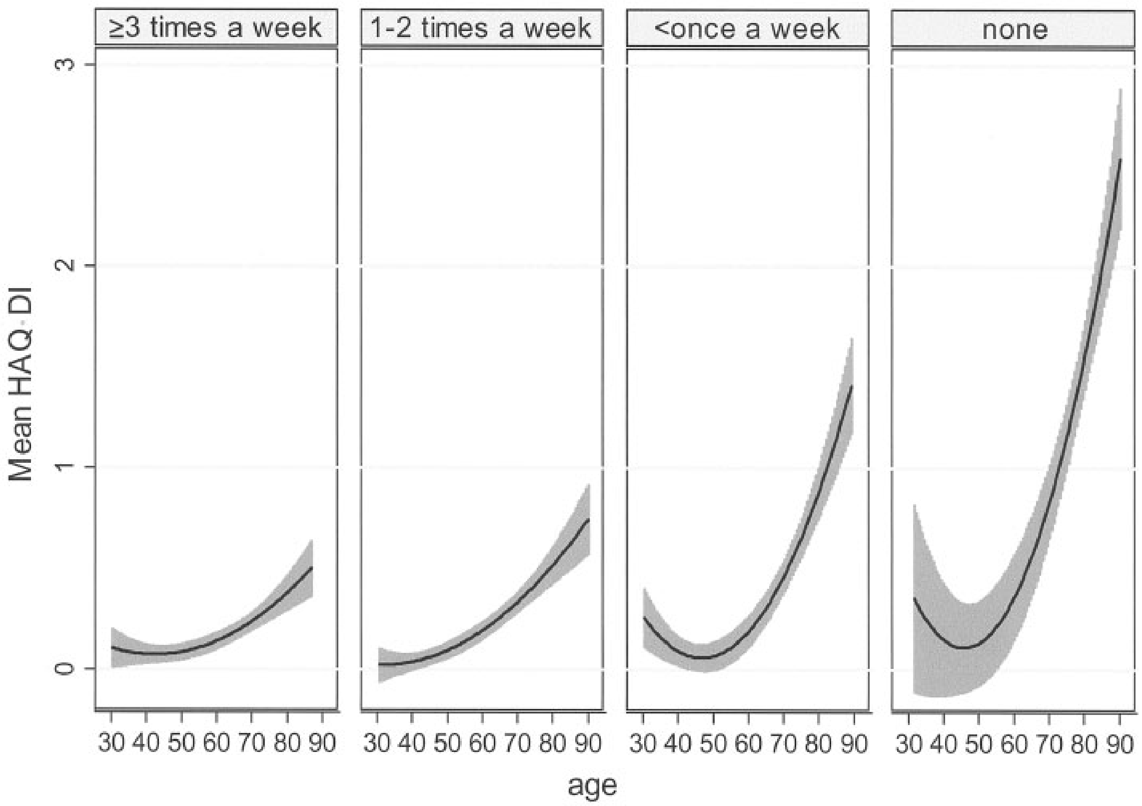

Figure 4. Relationship between age and mean Health Assessment Questionnaire (HAQ) disability index (DI) according to various strata of self-reported exercise. The increase in HAQ DI with decreasing age among those who exercised least (indicated by the left side of the curve) is not statistically significant because of the wide confidence band.

long-term runners (12), but very similar to that reported from the NHANES-I Followup Study (14). In the NHANES-I, the mean HAQ DI of the youngest group (age 60–69 years) in 1971–1975 was 0.20 for white men and 0.30 for white women (11). In a study of university alumni, women also had a higher mean HAQ DI than did men (13), a finding similar to that in the present study, in which the HAQ DI values for women and men were 0.28 and 0.18, respectively. We also found that disability among women increased at a much faster rate than that among men (Figure 1). Although this was not statistically significant after adjusting for age differences, we believe that this could be clinically significant. The estimated mean population HAQ DI among men younger than age 40 and among women younger than age 35 had confidence intervals that included 0. The disability prevalence rates increased with age, from <12% at ages 30–35 years to 80–90% at age >80 years, depending upon sex. This increase in HAQ DI with age is consistent with the findings from the NHANES-1 Followup Study and other studies (11,17).

Consistent with the results of many previous studies, we have shown that increasing frequency of exercise is associated with less disability (11,12,14,18–20). The prevalence of obesity is increasing worldwide, particularly in developed countries, in which approximately half of the population is considered to be overweight (21). In our study, ~20% of the subjects could be classified as obese, and the prevalence of disability was more than doubled in this group. Increasing BMI is linked to worse disability (22). The benefits of physical activity have been shown even in persons who are overweight or obese (23), and physical activity should therefore be encouraged irrespective of current weight.

We observed increasing levels of education to be associated with decreasing prevalence of disability, similar to the findings in men and women in the NHANES-I Followup Study (12). Education is a good surrogate measure for socioeconomic status. Long-term functional disability due to musculoskeletal injuries is known to be increased by 20–50% among smokers (24). Smoking also increases the risk for RA (25). In our survey, probably due to the cross-sectional design, we did not discern any differences in disability rates between those who ever smoked and those who never smoked.

The response rate in our study was high, and random sampling of the general population was obtained. However, several qualifications apply to these results. The study was performed in the Central Finland District, an exclusively Caucasian population at that time; thus, the normative values obtained may not be generalizable to other racial/ethnic groups. While the overall response rate of the survey was high, the nonresponse behavior may not be random but, rather, *informative*. That is, the nonresponders as a group may have had higher or lower HAQ DI values than the respondents, resulting in an overall disability rate for the sample that would be an under- or overestimation of the true population rate. While the stratified sampling technique may also result in a less-reliable overall rate, the individual age–sex strata rates are robust and valid. While the HAQ DI is a well-validated and robust measure of functional disability, the same may not apply to self reports of health-related behaviors described here. Thus, the risk estimates associated with the various risk factor strata have a margin of error. In addition, given the cross-sectional nature of the survey, the observed associations cannot be indicative of causality.

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