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Hoeymans, F.H.G.M.; Feskens, E.J.M.; Kromhout, D.; van den Bos, G.A.M.

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AGEING AND THE RELATIONSHIP BETWEEN FUNCTIONAL STATUS AND SELF-RATED HEALTH IN ELDERLY MEN

N. HOEYMANS,^{1,2*} E. J. M. FESKENS,² D. KROMHOUT² and G. A. M. VAN
DEN BOS¹

¹Institute of Social Medicine, Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands and ²Department of Chronic Disease and Environmental Epidemiology, National Institute of Public Health and the Environment, Bilthoven, The Netherlands

Abstract—Functional status (measured as functional limitations or disabilities) is an important determinant of self-rated health in the elderly. Several issues which are not yet clear in this association are addressed in this study: (i) the modifying effect of age on the association; (ii) the effect of recent changes in disability level on the current level of self-rated health, and (iii) the effect of functional limitations on self-rated health, independent of disabilities. Data were derived from the 1990, 1993 and 1995 surveys of the Zutphen Elderly Study, a longitudinal health study in men born between 1900 and 1920. Analyses of repeated measurements were performed with self-rated health as dependent variable and disabilities, functional limitations, age, survey year, and interaction terms as independent variables. Odds ratios were calculated from these models. Men with disabilities in instrumental activities of daily living had no different health ratings than men without disabilities. Those with disabilities in mobility and basic activities of daily living, however, had an odds ratio on poor self-rated health of 4.7 (95% confidence interval: 2.7–7.9) and 8.9 (4.6–17.1) respectively. This association became weaker with increasing age, leading to an absence of a significant association in the oldest group. The current level of self-rated health was only associated with the current level of disabilities. Information on previous levels of disabilities did not contribute to current self-rated health. Functional limitations had a small, but significant, effect on self-rated health when disabilities were taken into account. This study helps in enhancing insight in the complex relationship between functional status and self-rated health in the elderly. © 1997 Elsevier Science Ltd

Key words—activities of daily living, aged, disability, health status, self-assessment

INTRODUCTION

Functional status and self-rated health are two important indicators of health in old age. Both indicators have proven to be powerful predictors of mortality (Harris *et al.*, 1989; Idler and Kasl, 1991; Pijls *et al.*, 1993; Reuben *et al.*, 1992; Ruigómez *et al.*, 1993; Tsuji *et al.*, 1994) and health services use (Weinberger *et al.*, 1986; Evashwick *et al.*, 1984; Segovia *et al.*, 1989; Harris *et al.*, 1989; Blaum *et al.*, 1994; Koval and Dobie, 1996). They are also important elements of quality of life (Bowling, 1991), and widely used health indicators to calculate healthy life-expectancy or disability-free life expectancy (Ruwaard and Kramers, 1993; Van de Water *et al.*, 1996). Both health indicators concern a different aspect of health: functional status is a more objective indicator, specifying how much difficulty one has with performing actions in daily life (Guralnik *et al.*, 1989; Applegate *et al.*, 1990). Self-

rated health is a more subjective health indicator, specifying one's perception and evaluation of one's own health, based on an interpretation of the objective physical and mental health status, and on expectations and comparisons (Cockerham *et al.*, 1983; Fienberg *et al.*, 1985; Suls *et al.*, 1991; Idler, 1993; Krause and Jay, 1994).

Functional status might be an important determinant of self-rated health. The relationship between functional status and self-rated health in the elderly has been described in two types of studies. On the one hand there are empirical (cross-sectional and longitudinal) studies of the determinants of (changes) in self-rated health. In these studies significant associations were found between self-rated health and functional status (Blazer and Houpt, 1979; Mitrushina and Satz, 1991; Krause and Jay, 1994; Lindgren *et al.*, 1994; Hays *et al.*, 1996). Empirical studies on the predictive value of self-rated health on the onset of disabilities observe a higher risk on subsequent disability in persons with poor self-rated health (Grand *et al.*, 1988; Jagger *et al.*, 1993; Mor *et al.*, 1994; Idler and Kasl, 1995; Wilcox *et al.*, 1996). On the other hand, conceptual studies are conducted that focus on the structure of

*Author for correspondence. Department of Chronic Disease and Environmental Epidemiology, National Institute of Public Health and the Environment, P.O. Box 1, 3720 BA, Bilthoven, The Netherlands.

(physical) health status (Liang, 1986; Liang *et al.*, 1991; Moum, 1992; Johnson and Wolinsky, 1993). According to these studies, physical health consists of three dimensions: the medical model, characterised by signs and symptoms, the functional model, characterised in terms of mobility, self-maintenance and disability, and the psychological model or subjective evaluation. These studies also show the impact of functional status on self-rated health, both direct and indirect. Although both empirical and conceptual studies consistently show that functional status and subjective health ratings are significantly associated, several issues in this relationship have not yet been addressed.

First of all, it is not clear whether the relationship between functional status and self-rated health holds into old age. The two health indicators evolve differently with increasing age. In general, functional status deteriorates with ageing, while self-rated health remains relatively stable after a certain age (Linn and Linn, 1980; Jette and Branch, 1981; Jylhä *et al.*, 1986; Harris *et al.*, 1989; Strawbridge *et al.*, 1992; Idler, 1993; Christensen *et al.*, 1994). In a former study we also found that the percentage of elderly men without disabilities decreased with ageing, whereas self-rated health was not related to age (Hoeymans *et al.*, forthcoming). Based on these findings, we hypothesise that the association between functional status and self-rated health becomes weaker with increasing age. The oldest old might be less inclined to base a judgement of their health on their physical functioning. When their functioning deteriorates, they might accept this as a phenomenon of ageing, and less as a phenomenon of deteriorating health (Fienberg *et al.*, 1985; Idler, 1993; Koval and Dobie, 1996). Furthermore, older persons might base their health ratings more on attitudes or actual behaviours instead of on physical or functional aspects only (Borawski *et al.*, 1996). *This leads to our first research question: What is the modifying effect of age on the association between functional status and self-rated health in the elderly? It is expected that the association weakens with ageing.*

None of the before-mentioned studies on the association between functional status and self-rated health studied the effect of changes in functional status on the current health rating. Self-rated health

might be mainly affected when the functional status deteriorates. After a certain period an adaptation to the situation might take place, leading to a situation in which an impaired physical functioning is integrated in daily functioning. Possibly the mechanism is similar to the mechanism of ageing: those who are disabled for a longer time (similar to those who are older) might base their health ratings less on functional aspects and more on social or behavioural aspects than those who became disabled recently (similar to those who are younger). An indication for this is also found in a study on the psychological status in patients with different chronic diseases (Cassileth *et al.*, 1984). Patients with recently diagnosed illness had poorer mental status than did patients whose illness had been diagnosed more than four months previously. These results suggest that psychological adaptation among patients with chronic illnesses might be effective. The impact of change in functional status on self-rated health might also be viewed in the light of the "comparison process". When people are asked to rate their health they often compare this with the health of (stereotype) others of the same age, or to their past health (Fienberg *et al.*, 1985; Suls *et al.*, 1991). When people rate their health on the basis of their past health, they will rate their health lower if their health status has changed over the last period. *Our second research question is to test whether self-rated health is affected by recent changes in functional status. It is expected that self-rated health is worse when the functional status deteriorated recently than when the functional status is stable.*

Furthermore, it is not clear to what extent different concepts of functional status influence self-rated health. The only study we found is a study by Johnson and Wolinsky (1993), who observed that different concepts of functional status had differential influences on self-rated health. In our study, two different concepts of functional status were assessed, both of which can affect self-rated health (see Fig. 1). These concepts represent different steps in the disablement process, which progresses from pathology to impairments to functional limitations to disability (Nagi, 1991; Verbrugge and Jette, 1994; Lawrence and Jette, 1996). Functional limitations are restrictions in performing fundamental physical actions, for example overall mobility, discrete

Fig. 1. Model of the associations between functional limitations, disabilities and self-rated health.

Table 1. Selected characteristics of participants of the 1990, 1993 and 1995 surveys of the Zutphen Elderly study

	1990	Survey year 1993	1995
Survivors of original cohort (<i>n</i>)	721	544	463
Participated (<i>n</i> (%))	560 (75%)	390 (72%)	343 (74%)
Complete information (<i>n</i>) [*]	492	344	326
Age (mean $\pm$ SD)	75.0 $\pm$ 4.6	77.8 $\pm$ 4.4	79.6 $\pm$ 4.5
Living situation (% independent)	96.5	95.0	90.4
Marital status (% married)	78.0	73.0	69.5
Self-rated health			
healthy (%)	50.0	44.2	36.2
rather healthy (%)	39.0	44.8	49.1
moderately healthy (%)	9.6	8.7	11.3
not healthy (%)	1.4	2.3	3.4
Self-reported disabilities			
No disabilities (%)	53.7	43.3	40.2
IADL only (%)	31.7	35.8	34.0
mobility and IADL (%)	10.8	15.1	19.9
BADL and mobility and IADL (%)	3.9	5.8	5.8
Performance score			
no tests low (%)	47.6	33.1	34.4
1 test low (%)	33.1	38.4	33.1
2 tests low (%)	13.4	19.5	19.0
3-4 tests low (%)	5.9	9.0	13.5

*The rest of the table is based on these numbers.

motions and strengths. Disabilities, however, refer to the expression of a functional limitations in a social context (Verbrugge and Jette, 1994). In our study, functional limitations were assessed by performance tests, which measure actual performance without reference to a social context, whereas disabilities were measured by self-report (Hoeymans *et al.*, 1996). When rating one's own health on the basis of functional status, it is expected that one will take the social context into account. The impact of disabilities on self-rated health will then be more important than the impact of functional limitations, while the impact of functional limitations on self-rated health will be mainly mediated through the association with disabilities. *The third research question is to test whether functional limitations have an impact on self-rated health independent of disabilities. It is expected that the impact of functional limitations on self-rated health is indirect, through their association with disabilities.*

To investigate these three issues in the relationship between functional status and self-rated health we used data from a longitudinal health study in elderly men who were assessed at three points in time (1990, 1993, and 1995). At baseline, these men varied in age between 70 and 90 years. We first quantified the association between functional status and self-rated health in this population. Furthermore, we investigated the three research questions: (i) what is the modifying effect of age on the association between functional status and self-rated health; (ii) what is the impact of a recent change in functional status on the current level of current self-rated health, and (iii) do functional limitations have an impact on self-rated health that is independent of disabilities, according to Fig. 1. In the first two research questions functional status

is operationalised as disabilities; in the last question, disabilities and functional limitations are discerned.

METHODS

Study population

The Zutphen Elderly Study is a longitudinal investigation on life style, chronic diseases and health in elderly men (Feskens *et al.*, 1993). The study started in Zutphen, a small town in the eastern part of the Netherlands, but in follow-up studies the men who moved to other parts of the country were also included. All men were born between 1900 and 1920. In 1985, a random sample of 1266 men was recruited, of whom 939 men (74%) participated. This group formed the cohort of the Zutphen Elderly Study. In 1990, 1993, and 1995 all survivors were invited to participate (Table 1).

Our study population consisted of the men who participated in the surveys of 1990, 1993 and 1995, because in these years self-rated health and functional status were assessed. In 1990, all men were invited to the hospital where a physical examination (including performance tests) took place. Afterwards, the respondents received a questionnaire comprising questions on self-rated health and disability, which was filled out at home and sent back by mail. The questionnaires were checked by trained research assistants and respondents were contacted in case of inconsistencies or missing items. In 1993 and 1995, the questionnaire was mailed to all survivors who were willing to participate. A trained research assistant visited the respondents one week later to check the questionnaire and carry out the performance tests. Complete data on self-rated health, disabilities, and functional limi-

tations were obtained for 492 men in 1990, for 344 men in 1993, and for 326 men in 1995 (Table 1).

Measurements

Self-rated health was defined as the answer to the following question: "We would like to know how you rate your health. Please check what fits best in your case. Do you feel healthy, rather healthy, moderately healthy, or not healthy". The value of this measure of self-rated health as a predictor of mortality was shown in a previous study (Pijls *et al.*, 1993). In the present study, self-rated health is dichotomised into healthy ("healthy" and "rather healthy") and poorly healthy ("moderately healthy" or "not healthy").

Disabilities were assessed as self-reported disabilities in daily activities. The questionnaire consisted of 13 activities, adapted from the WHO-questionnaire (Heikkinen and Waters, 1985) and described in detail in a previous study (Hoeymans *et al.*, 1996). Items were grouped into three dimensions: basic activities of daily living (BADL), mobility, and instrumental activities of daily living (IADL). The BADL dimension consisted of six items: feed oneself, get in and out of bed, use the lavatory, dress and undress, wash and bath oneself, and move between rooms. The mobility dimension consisted of four items: move outdoors, use stairs, walk at least 400 meters, and carry a heavy object for 100 meters. The IADL dimension, consisted of three items: do one's own cooking, do light housework, and do heavy housework. Men were classified as being disabled in a specific dimension if they reported that they needed help with at least one item of this dimension. A hierarchic disability scale was developed (Hoeymans *et al.*, 1996), distinguishing four exclusive categories: (i) not disabled, (ii) disabled in IADL only, (iii) disabled in mobility and IADL, (iv) disabled in BADL, mobility and IADL. Men who did not fit into this hierarchy (2.4%) were classified according to their most disabling dimension. A change in disabilities was defined as moving to another category.

Functional limitations were evaluated by four performance tests: standing balance, walking speed, chair stand, and external shoulder rotation. The tests were adapted from the Established Populations for Epidemiologic Studies of the Elderly (EPESE) studies, and were developed to be applied by lay-interviewers in a home setting with a limited amount of space (Cornoni-Huntley *et al.*, 1986; Guralnik *et al.*, 1994). A videotape, produced by the researchers of EPESE, was used to train our interviewers. The tests have been described previously in detail (Guralnik *et al.*, 1994; Hoeymans *et al.*, 1996). In brief, in the test for standing balance the participant was asked to hold a tandem position for 10 s. In the test for walking speed, each participant was asked to walk a distance of 8 ft (2.44 m) in his usual gait. In the chair stand, the

time required to stand up from a chair five times as quickly as possible was measured. In the test for external shoulder rotation the range in motion of shoulder and arms was assessed. For each test, a cut-off point for low performance was defined. A summary performance score was constructed as the number of tests performed low, as described previously (Hoeymans *et al.*, 1996).

Statistical analyses

Statistical analyses were carried out using SAS, version 6.10. All tests were two-tailed, a *p*-value of 0.05 or lower was considered to be statistically significant. To investigate the association between self-reported disabilities and self-rated health, a repeated measurements model was specified with the Generalised Estimated Equations (GEE), using a SAS Macro for longitudinal data analyses (Version 2.01). In this procedure data from all three surveys can be used, because the correlation within respondents is taken into account. Regression coefficients are estimated without making use of the variance assumptions. We used a model with a logit link function, a binomial distribution of the dependent variable, and a compound symmetry structure for the covariance matrix. This model was specified with self-rated health (0 = healthy or rather healthy, 1 = moderately healthy or not healthy) as dependent variable and age, survey year, and disabilities (as three dummy variables, with no disabilities as reference) as independent variables. Odds ratios and 95% confidence intervals were calculated from this model.

To investigate whether the association between disabilities and self-rated health differed by age (research question 1), a similar repeated measurements model was specified containing age at examination, survey year and disabilities as independent variables together with an interaction term between age at examination and disabilities. When the interaction term was significant the association between disabilities and self-rated health was recognised to differ by age, and age-stratified odds ratios were calculated using logistic regression analyses. The same models were constructed with an interaction term between disabilities and survey year and between disabilities and age at baseline (= birth cohort) to test whether the association between disabilities and self-rated health differed by survey year and birth cohort.

To investigate whether changes in disabilities were predictive of poor self-rated health (research question 2), we assessed the percentage of men who rated their health as poor among those who reported disabilities in mobility or BADL, stratified by previous disability levels. This makes it possible to compare the self-rated health of those who are disabled for a longer time with those who became disabled since the previous measurements. We concentrated on the group with disabilities in BADL or

mobility, because the group with disabilities in BADL only was too small for this type of analysis. Additionally, logistic models were constructed with self-rated health in 1995 as dependent variable and five year change in disabilities between 1990 and 1995 (and a model with two year change: between 1993 and 1995) as independent variable. This change was calculated on the basis of the hierarchic disability scale. Odds ratios on poor self-rated health were calculated for those who deteriorated and those who improved in disability level compared with those who remained stable. The odds ratios for deterioration and improvement were adjusted for current disability level.

To investigate the association between functional limitations and self-rated health (research question 3), a repeated measurements model was specified with age, survey year, and number of tests performed low as independent variables (in dummies, with no test performed low as reference) and self-rated health as dependent variable. We also included interaction terms to examine whether the association depended on age, birth cohort, or survey year. In order to adjust for disabilities, a second model was constructed with the disabilities scale (in dummy variables) as covariate. Odds ratios were calculated from the model with and without adjustment for disabilities. Similar models were constructed for the four separate performance tests (standing balance, walking speed, chair stand, and external shoulder rotation).

RESULTS

The study population can be characterised as non-institutionalised (96% at baseline). Most men were still married (Table 1), although this percentage decreased over the five years of study. The mean age of the men was 75.0 years in 1990, 77.8 years in 1993 and 79.6 years in 1995. The percentage with poor self-rated health ("moderately healthy" or "not healthy") increased from 11.0% in 1990 to 14.7% in 1995. The percentage with disabilities and functional limitations also increased over this time period.

The association between disability level and self-rated health was significant. The Pearson correlation coefficient between the hierarchic disability scale and the four-point self-rated health scale was 0.26 in 1990, 0.30 in 1993, and 0.38 in 1995 (all coefficients were statistically significant: $p < 0.0001$). Table 2 shows that more men with disabilities in mobility or BADL reported poor self-rated health than men without disabilities (odds ratio mobility = 4.7, OR BADL = 8.9). Men with disabilities in IADL only did not report significantly different health ratings than men without disabilities.

Table 3 shows the odds ratios on poor self-rated health stratified by survey year, birth cohort and age group, comparing men with disabilities in mobility or BADL to those with disabilities in IADL only or without disabilities. Age at examination (age) had a significant modifying effect on the association between disabilities and self-rated health (p interaction = 0.004). In each study year the association was strongest for the youngest group, and absent for the oldest group. Age at baseline (birth cohort) was also important for the association between disabilities and self-rated health (p interaction = 0.001). In men from earlier birth cohorts the association was less strong compared with men in later birth cohorts. In the total group a significant time trend was found (p interaction = 0.003). The association was stronger in 1993 and 1995 compared with 1990.

About one third of the men who reported disabilities in mobility or BADL rated their health as being poor. This percentage did not depend on previous levels of disability (Table 4). In other words, those who were already disabled during the previous measurement did not rate their health differently than those who became disabled since the previous measurement. The same result was found in a logistic regression analyses using data from the total population (not only those who reported disabilities). Although the men who had deteriorated in disabilities over the past years rated their current health significantly worse than those who remained stable, this association disappeared when the current level of disabilities was taken into account. The

Table 2. Percentage of men who rated their health as poor and odds ratios (OR and 95% confidence interval) on poor self-rated health according to disabilities, adjusted for age and survey year. The Zutphen Elderly study

	% Poor self-rated health			OR (95% CI) poor health $n = 1162^*$
	1990 $n = 492$	1993 $n = 344$	1995 $n = 326$	
Self-reported disabilities				
No disabilities	7.2	6.0	9.2	1.0
Disabilities in IADL only	11.5	7.6	6.3	1.4 (0.9-2.3)
Disabilities in mobility and IADL	24.5	26.9	26.2	4.7 (2.7-7.9)
Disabilities in BADL, mobility and IADL	21.1	30.0	63.2	8.9 (4.6-17.1)

*OR calculated over all years of study using a repeated measurement model.

Table 3. Survey year and birth cohort stratified odds ratios (and 95% confidence intervals) on poor self-rated health comparing men with disabilities in mobility or BADL with men without disabilities or with disabilities in IADL only. The Zutphen Elderly study

Birth cohort	Age in 1990	1990	1993	1995
1916–1920	70–74	7.4 (3.0–18.3)	8.4 (3.1–22.4)	12.0 (4.6–31.3)
1911–1915	75–79	2.8 (0.8–10.3)	7.6 (2.0–28.5)	7.3 (2.3–23.4)
1900–1910	80–90	0.8 (0.2–4.4)	1.4 (0.2–8.0)	1.1 (0.2–5.9)
Total group	70–90	3.5 (1.8–6.8)	6.1 (2.9–12.6)	6.6 (3.4–12.9)

unadjusted odds ratio on poor self-rated health for those who deteriorated compared with those who remained stable in the period 1990–1995 was 3.5 (95% CI: 1.7–7.0). Adjusted for current level of disabilities the odds ratio was 1.3 (95% CI: 0.5–3.2). The same results are found for a two year period (1993–1995): unadjusted OR = 2.2 (95% CI: 1.0–4.8), adjusted OR = 1.0 (0.4–2.4). Therefore, current self-rated health seems mainly associated with current level of disabilities and information on previous levels of disabilities did not contribute to current self-rated health. The few men who improved in disability level over the five years of study had no different health ratings than the men who remained stable.

Significant associations between functional limitations, measured with performance tests, and self-rated health were observed (Table 5) but these associations were reduced considerably after adjustment for disabilities. Only the association between low performance on more than two tests and self-rated health remained statistically significant (OR = 2.6, 95% CI = 1.4–5.1). The association between functional limitations and self-rated health was stronger in the youngest age groups than in the oldest, but this difference seemed a cohort effect, rather than an age effect (p interaction between summary performance score and age = 0.19; p interaction between summary score and birth cohort = 0.03). No changes in time were observed (p interaction between summary performance score and survey year = 0.34). Concerning the four performance tests separately, all tests were significantly associated with self-rated health (adjusted for age and survey year). However, after additional adjustment for disabilities only the test for walking speed

and chair stand remained significantly associated with self-rated health (walking speed OR (95% CI)_{first versus last quartile} = 3.1 (1.5–6.3), chair stand OR (95% CI)_{first versus last quartile} = 2.3 (1.4–3.9)).

DISCUSSION

This study was conducted to enhance insight into the relationship between functional status and self-rated health in the elderly. We confirmed the importance of disabilities for self-rated health in an elderly population, as was observed by several other investigators in the empirical and conceptual studies referred to in the introduction (Blazer and Houpt, 1979; Grand *et al.*, 1988; Mitrushina and Satz, 1991; Jagger *et al.*, 1993; Krause and Jay, 1994; Lindgren *et al.*, 1994; Liang, 1986; Liang *et al.*, 1991; Moum, 1992; Johnson and Wolinsky, 1993; Mor *et al.*, 1994; Idler and Kasl, 1995; Hays *et al.*, 1996; Wilcox *et al.*, 1996). In our study about 7–14% of the variance in self-rated health could be explained by self-reported disabilities. This percentage is comparable with the 11.6% ($r = 0.34$) Idler and colleagues found in their study among elderly. Other studies, from which a percentage of variance explained could be derived (Moum, 1992; Krause and Jay, 1994; Lindgren *et al.*, 1994; Wilcox *et al.*, 1996) show similar results.

In our study, only disabilities in basic activities of daily living and in mobility had an impact on self-rated health among these elderly males, whereas disabilities in instrumental activities of daily living did not. Apparently the men who stated they were unable to do light or heavy housework or preparing meals without help did not rate their overall health differently than those who stated they could do

Table 4. Percentage of men who rated their health as poor among those with disabilities in BADL or mobility, according to previous levels of disability. The Zutphen Elderly study

Previous disability level	Compared with current disability level	1990–1993		Period 1993–1995		1990–1995	
		<i>n</i>	poor health (%)	<i>n</i>	poor health (%)	<i>n</i>	poor health (%)
No disabilities	Became disabled	17	6 (35.3)	9	2 (22.2)	27	9 (33.3)
	Worsened	20	5 (25.0)	18	6 (33.3)	24	9 (37.5)
Disabled in IADL only	Remained the same	17	5 (29.4)	32	11 (34.4)	14	6 (42.9)
Disabled in mobility or BADL							

Table 5. Percentage of men who rated their health poor according to their performance score, and adjusted odds ratios (95% confidence intervals). The Zutphen Elderly study

	% Poorly healthy			OR (95% CI)*	
	1990	1993	1995	Adjusted for age and survey year	Additionally adjusted for disabilities
Performance score					
No tests low	9.4	3.5	8.9	1.0	1.0
One test low	11.7	9.1	13.9	1.6 (1.0-2.5)	1.4 (0.9-2.2)
Two tests low	10.6	17.9	12.9	2.0 (1.2-3.5)	1.4 (0.8-2.6)
> Two tests low	20.7	32.3	34.1	5.1 (2.9-9.9)	2.6 (1.4-5.1)

*OR calculated over all years of study using a repeated measurement model.

these activities independently. In most studies on the association between disabilities and self-rated health, disabilities in IADL are not taken into account (Blazer and Houpt, 1979; Jagger *et al.*, 1993; Lindgren *et al.*, 1994; Wilcox *et al.*, 1996) or they are not examined separately (Grand *et al.*, 1988; Moum, 1992; Johnson and Wolinsky, 1993; Idler and Kasl, 1995). However, Liang (1986) and Liang *et al.* (1991) observed a significant impact of IADL on self-rated health in a study of men and women over 65 years of age. The IADL items in this study were different from ours, for example driving a car, painting the house, and minor repairs, whereas in our study the IADL items were mainly "women's tasks", i.e. household activities and cooking. Possibly the disabilities in IADL activities are overestimated in our study, to a lack of specificity about the reason help is received (Allen *et al.*, 1993). Many men might receive help with these "women's tasks", simply because they have a wife or daughter who takes care of these activities, and not because they are physically unable. Another reason for the lack of association between IADL disabilities and self-rated health might be that some men do not know whether they are able to accomplish these activities. They might deny any difficulties, when in fact they may be physically incapable in doing these tasks alone or vice versa. Finally, men who are no longer able to do these activities might not label themselves as being unhealthy, because they might not value the capability to perform these activities as an indication of their health. Future studies should indicate whether the impact of disabilities in IADL on self-rated health is important in women.

As hypothesised, the association between disabilities (and to a lesser extent functional limitations) and self-rated health became less strong with increasing age. In the oldest old disabilities and self-rated health were no longer associated. This seemed to be owing to both differences between age groups and birth cohorts. The finding of an age effect in the association between functional status and self-rated health supports the results reported in a study by Borawski *et al.* (1996), who conducted a study on the attributions underlying health appraisals by older adults, aged 73-98. This study

observed that older persons were significantly more likely to base their health appraisal on attitude and behaviour than on conditions, symptoms, or functioning compared with their younger counterparts. At older ages respondents based their health ratings more on their psychological outlook (e.g. "I think positive") as well as on their life style (e.g. "I exercise" or "I eat healthy"). This finding was explained by a process, called the "late-life developmental stage of bodily preoccupation". This process is the older persons' way of dealing with the challenge of moderating their physical problems by changing their conceptualisation of health from a physical or functional orientation to one based on personal or social characteristics. The finding that older birth cohorts base their self-rated health less on functional status than younger birth cohorts might be explained by different interpretations and expectations of older birth cohorts regarding their health (Idler, 1993; Spiers *et al.*, 1996).

Earlier age-period-cohort analyses in this same population showed that the proportion of men who rated themselves "healthy" decreased between 1990 and 1995, while self-rated health was not associated with age, nor with birth cohort. The observed decrease in self-rated health could only be explained by a time trend (Hoeymans *et al.*, forthcoming). In this same study the proportion of men without disabilities also decreased in the same follow-up period, but this increase was totally explained by ageing of the population, and no time trend was observed. In the present analyses, we observed a time trend in the association between self-rated health and disabilities: the association became stronger over the five years of study. Although the population aged five years, this was probably not an ageing effect, since we already showed that the association between disabilities and self-rated health weakened with ageing. A possible reason for this time trend in self-rated health and in the association between disabilities and self-rated health is that the tendency to report health problems changed in time owing to participation in the health study. When the participants were asked to rate their health, they might have taken their objective health status more into account at the end of the study compared with the beginning of the study, because they are so

well informed about their health. Researchers of follow-up studies on health should be aware of a possible time effect in the study on subjective health ratings.

In contrast to our expectations, the men in our study only took their current disability level into account when rating their current health, and not whether this had changed in the past two or five years. The literature suggests that self-ratings of health are for a large part based on objective health status, but other mechanisms also play a role. One of these mechanisms is *adaptation* to the worsening health conditions. When the functional status deteriorates people might adapt to this with changing their expectations and norms (Idler, 1993). Another mechanism is *comparison process*: respondents might compare their current health with their health at previous times (Fienberg *et al.*, 1985; Suls *et al.*, 1991). Our finding that recent changes in disability level did not contribute to health ratings might be owing to the fact that the period between two measurements was too long to find an effect of change on self-ratings of health. The adaptation process may take a few weeks or months, while the period in our study between two measurements was at least two years. Another explanation might be that functional status often deteriorates with ageing very gradually. Therefore people can slowly adapt to these conditions, and adjust their norms and expectations gradually, without changing their health rating. More research on the effects of recent changes in functional status on self-rated health is recommended.

Although the association between functional limitations, measured with performance tests, and self-rated health was largely mediated by self-reported disabilities, we still observed an independent effect of functional limitations on self-rated health. Probably, when people are only limited in their functioning and not disabled, they take these limitations into account when rating their health. Another explanation for the independent effect of performance tests on self-rated health might be that not all disabilities are measured. People who score low on the performance tests might be disabled in a way that was not detectable by the questionnaire we used. A third explanation for the independent impact of functional limitations on self-rated health comes from a former study we performed on the association between functional limitations and disabilities (Hoeymans *et al.*, 1996). We found that these two concepts of functional status are only associated at modest levels with each other, and that they do not measure the same construct. A similar finding was reported in a study by Johnson and Wolinsky (1993), in which a model was constructed dealing with the multidimensionality of health. The first stage of this model is disease, the next contains the functional limitations (in their study referred to as physical limitations, and measured as upper

body limitations and lower body limitations), that are caused by the underlying disease burden. The third stage in the model represents the disabilities (in their study referred to as functional limitations, and measured as basic ADLs, household ADLs, and advanced ADLs) that may or may not result from the underlying disease and physical limitations. The final stage of this model is perceived health. The direct and indirect effects of functional limitations and disabilities on perceived health were investigated. They observed, like we did, that functional limitations and disabilities are different constructs and exhibit differential influences on each other and on perceived health.

To summarise, disability level and self-rated health were significantly associated in this elderly population, but the association weakened with age, leading to an absence of the association in the oldest old. Ratings of the current level of health were mainly based on the current level of disabilities, and not on changes in disability level over the past two to five years. Although a large part of the effects of functional limitations were mediated through the association with disabilities, functional limitations had an independent effect on self-rated health.

It should be noted that our results might have been biased owing to selective non-response or drop-out of the study. A small non-response survey was carried out during the 1993 survey. Those participants who indicated that they were not willing to participate in the large survey ($n = 154$) received a shortened questionnaire containing questions on self-rated health and disabilities. The 99 men who returned this questionnaire were less healthy in terms of self-rated health and functional status than respondents. Because of the larger variance in these health indicators in the non-respondents, the association between disabilities and self-rated health was stronger in this group ($r = 0.46$) than in the respondents ($r = 0.30$). Therefore, the association reported in the present study is probably an underestimation. An underestimation might also occur in the association between functional limitations and self-rated health. The modifying effect of age is probably less biased, because the non-respondents did not differ in age from the respondents. We do not think that the finding that the association between disabilities and functional status became stronger during follow-up can be attributed to selective drop-out.

This study contributes to a further insight in the complex relationship between functional status and self-rated health in the elderly. Self-rated health and functional status, powerful predictors of quality of life, mortality and health care utilisation, are usually included in population health surveys. Data on self-rated health and functional status produce the basis for the calculation of the healthy life expectancy, a tool frequently used by policy makers (Ruwaard and Kramers, 1993; Van de Water *et al.*,

1996). Important information for both researchers and policy makers is our finding that at older ages self-rated health is based less on "objective" health. The relative concept of self-rated health makes it difficult to use this indicator in studying trends in healthy life expectancies owing to greying of the population.

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