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Changes in the work ability of active employees over an 11-year period

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Objectives Changes in the work ability of active employees were followed over a period of 11 years.
Methods Men and women in the same occupation (N = 818) in 1981—1992 assessed their work ability according to an index on current work ability, physical and mental work demands, diagnosed diseases, work impairment from disease, sickness absence, work ability prognosis, and psychological resources. Their mean initial age was 46.9 (range 44—51) years. The means and standard deviations of the work ability index and the prevalence rates of 4 work ability categories were followed with respect to age, gender, and job content.
Results The mean work ability index declined significantly in 11 years for both genders. Its association with age and work was strong. Age of ≥ 51 years and physical work load were critical factors affecting the work ability of both genders. At the mean age of 58 years, at least 25% of the installation, auxiliary, or transport workers had a poor work ability rating, as did the women doing kitchen supervision, auxiliary, and home care work. The annual rate of decline in work ability was highest for women aged 51 years at the onset of the study. Female teachers showed a less dramatic decline in work ability than male teachers.
Conclusions Work does not seem to prevent a decline in the work ability of men and women as they age. Therefore, measures to promote work ability should be started before the age of 51 years, especially for workers in physically demanding jobs.

Key terms age, follow-up, occupation, work content.

The different interactions between biological aging, health, life-style, and work strongly affect work ability. As a consequence, the work force over 45 years of age is a very heterogeneous population in relation to functional capacity and work ability. The individual differences are large before retirement (1). The numbers of actively working men and women over 55 years of age are declining, and a growing proportion of the population has been leaving the labor force before the standard retirement age. In most countries in the European Union, the demographic change in the age structure of the population has created concerns about whether there will be enough people of working age to support the growing population of retirees (2).

Work ability is a complex factor to measure. Its assessment should be based on both objective findings and on workers' subjective estimations of their resources in relation to work demands. Because no feasible and comprehensive methods for assessing work ability were available for epidemiologic studies, a work ability index was constructed at the onset of our follow-up studies in 1981 (3). Its conceptual definition represented the question "How good are workers at present and in the near future and how able are they to do their job with respect to work demands, health, and mental resources?" The work ability index was derived as the sum of 7 items. It was evaluated against the clinical assessment of health status and work ability (4). The associations between functional capacity and work ability were also studied (5). A poor rating on the work ability index was a good predictor of work disability in 4 years (6). Our results also showed that the work ability index was systematically lower for workers of the same age in physically demanding jobs than it was for workers in mentally demanding work. In addition, the mean score of the index declined between the ages of 51 and 55 years in all the occupational groups studied.

The purpose of the present study was to determine (i) changes in work ability over 11 years among employees who continued to work during the entire follow-up period, (ii) the means at which changes in the work ability index were related to gender and work content, and (iii) changes in the work ability index classifications (poor through excellent) for the men and women and for the

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different categories of work content. Finally, the individual changes in work ability were described for certain occupations.

Subjects and methods

The study comprised 818 men and women who worked in the same occupation through the entire follow-up period from 1981 to 1992. They answered a questionnaire that included the index in 1981, 1985, and 1992. Their work was analyzed in 1981 by the AET (Arbeitswissenschaftliche Erhebungsverfahren zur Tätigkeitsanalyse) method (7) and clustered according to basic work content (3 groups) and job profile (13 groups) (8). The same cluster groups were used in the analyses in 1992. The mean age of the subjects was 46.9 (range 44—51) years in 1981, 51.2 (range 48—56) years in 1985, and 58.3 (range 55—62) years in 1992.

The work ability index was derived as the sum of the scores of 7 items (table 1). The range of the summative index was 7—49, which was divided into the following 4 categories: (i) poor work ability (score 7—27), (ii) moderate work ability (score 28—36), (iii) good work ability (score 37—43), and (iv) excellent work ability (score 44—49). The cut-off points for poor and excellent work ability were chosen as the 15th percentile of the index distribution of the total population in 1981 (3).

The means of the index and the distribution of the index scores in the 4 work ability categories were used for describing the changes in work ability during the follow-up period. Depending on the question studied, either the results of 3 time points (1981, 1985, 1992) or 2 time points (1981, 1992) were used. For analyzing the annual rate of decline in work ability, the mean values of 2-year age groups were used for the men and the women separately. The differences in the mean index values (1981 versus 1992) of the physical and mental work content groups were tested by the t-test.

The percentage of subjects in the 4 work ability categories was calculated by age and gender. Special attention was given to the rate of poor work ability in the different work categories at 3 time points. The results of poor work ability in the job profile groups were age-adjusted by the direct standardization method.

For describing individual differences within the same occupational group during the follow-up (1981—1992), we chose 2 physically demanding, 2 mixed physically and mentally demanding, and 2 mentally demanding work groups. For this study we selected auxiliary work (men, women), kitchen supervision (women), transport work (men), and teaching work (men, women).

Results

The mean index value of the whole study population decreased from 40 in 1981 to 37 in 1985 to 34 in 1992. The decline during the follow-up was highly significant ($P < 0.0001$). The index mean did not, however, differ between the age groups at 1 study point (eg, for subjects 55—61 years of age in 1992) (figure 1). The standard deviation of the means was largest in 1992, when the subjects were 55—61 years of age.

The mean index value decreased significantly for both the men ($P < 0.001$) and the women ($P < 0.0001$)

Table 1. Work ability index.[a]

Item	Scale	Explanation
1. Subjective estimation of present work ability compared with the lifetime best	1—10	0 = very poor 10 = very good
2. Subjective work ability in relation to both physical and mental demands of the work	2—10	2 = very poor 10 = very good
3. Number of diagnosed diseases	1—7	1 = 5 or more diseases 2 = 4 diseases 3 = 3 diseases 4 = 2 diseases 5 = 1 disease 7 = no disease
4. Subjective estimation of work impairment due to disease	1—6	1 = fully impaired 6 = no impairment
5. Sickness absence during past year	1—5	1 = 100 days or more 2 = 25—99 days 3 = 10—24 days 4 = 1—9 days 5 = 0 days
6. Own prognosis of work ability after two years	1, 4, 7	1 = hardly able to work 4 = not sure 7 = fairly sure
7. Psychological resources (enjoying daily tasks, activity and life spirit, optimistic about the future)	1—4	1 = very poor 4 = very good

[a] Score range 7—49: poor work ability = 7—27, moderate work ability 28—36, good work ability = 37—43, and excellent work ability = 44—49.

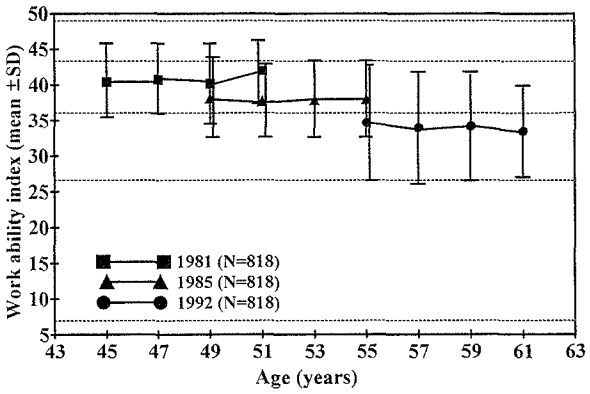

Figure 1. Work ability index by age and time of follow-up.

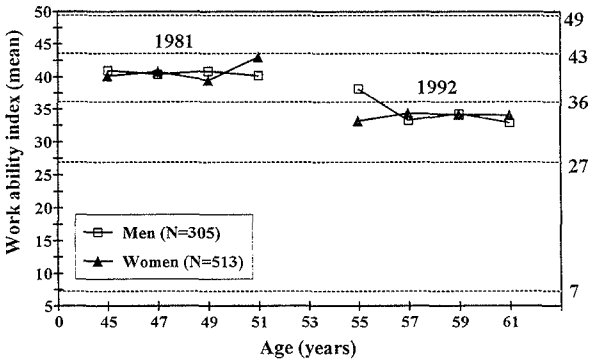

Figure 2. Work ability index of the men and women in 1981 and 1992 by age.

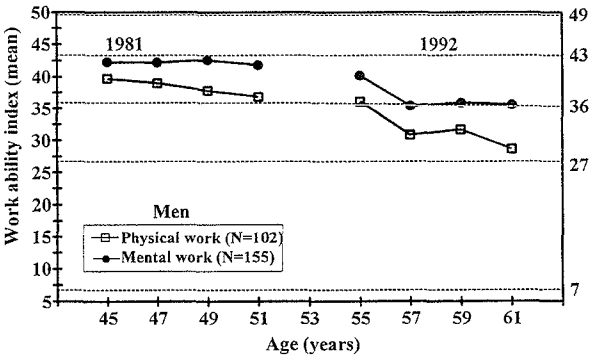

Figure 3. Work ability index of the men who did physical or mental work in 1981 and 1992 by age.

during the follow-up. It was at the same level for both genders in the age range of 45—51 years and also later in the age range of 55—61 years (figure 2).

Among the men, the differences in the mean index values of the subjects doing mentally and physically demanding work were significant in all the age groups. The differences were largest in the age group of 51 years (mental work 41.8 versus physical work 36.8, $P < 0.01$) and in the age group of 61 years (mental work 35.6 versus physical work 28.7, $P < 0.001$) (figure 3, table 2). The mean index value declined significantly after the age of 55 years for the men in physical work, but not for the women.

The mean index values were systematically highest for the women in mental work and lowest for the women in physical work, the women in mixed work (both physically and mentally demanding) falling in between (table 2). The differences in the mean index were statistically significant between the women doing mental and physical work in the age groups of 45, 47, 49, 55, and 57 years.

The annual rate of decline in the index rating over the 11-year period was similar for the men aged 47, 49, and 51 years at the onset of the follow-up, ranging from 0.60 to 0.66 per year. The decline of the younger men (45 years) was, however, the slowest (0.25 per year) (figure 4a). For the women, work ability declined about 0.49 to 0.63 per year in the youngest age groups, women 51 years of age showing the highest rate (0.81 per year) (figure 4b).

About 20% of the men were classified as having poor or moderate work ability and about 30% had excellent

Table 2. Mean values of the work ability index by age, gender, and work content.

Gender	N	Age in 1981				Age in 1992			
		45 years	47 years	49 years	51 years	55 years	57 years	59 years	61 years
Men	305	41.0	40.4	40.9	40.2	38.2	33.3	34.3	32.9
Physical work	102	39.8*	39.0**	37.8**	36.8**	36.1*	30.9*	31.7*	28.7***
Mixed physical and mental work	48	39.9	38.4	..[b]	..[b]	..[b]	33.1	34.5	..[b]
Mental work	155	42.3	42.2	42.6	41.8	40.2	35.4	35.9	35.6
Women	513	40.2	40.8	39.5	43.0	33.2	34.4	34.2	34.1
Physical work	130	37.7***	38.7***	36.9*[a]	40.4[NS]	29.6***	32.9*	31.9[NS]	32.2[NS]
Mixed physical and mental work	143	39.8	41.5	38.3	43.8	32.9	34.2	35.8	32.6
Mental work	240	42.0	41.8	41.0	43.6	43.6	35.4	34.8	35.7
All	818	40.4	40.7	40.2	42.0	34.7	34.0	34.2	33.5

[a] t-tests: physical versus mental work.
[b] N < 10.
* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, NS = not significant.

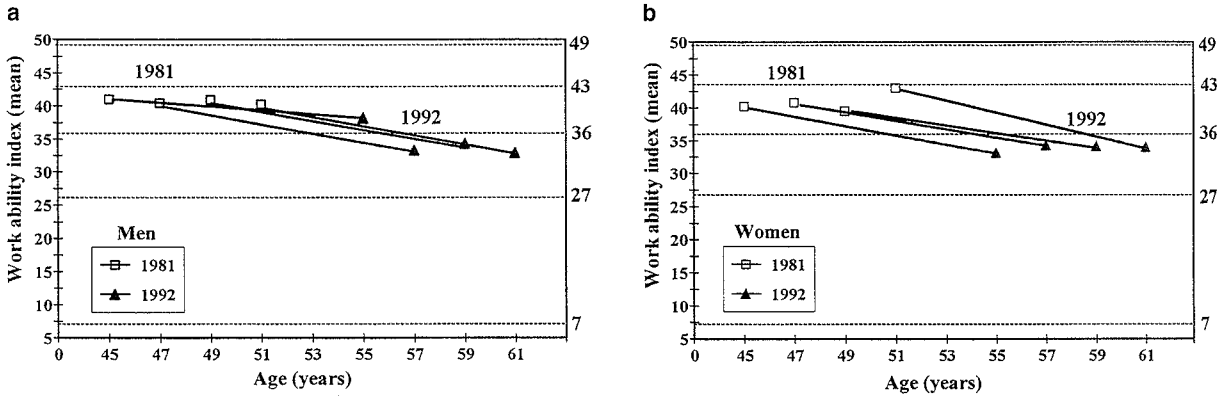

Figure 4. Annual rate of decline in the work ability index of the men (a) and women (b) by age.

work ability at the age of 45, 47, and 49 years; those aged 51 years had the best overall index scores (figure 5a). Ten years later about 40% of the men aged 55 years and about 70% of those aged 61 years had a poor or moderate rating. The men with excellent work ability had decreased from 30% at 55 years of age to less than 5% at 61 years of age. At the same time, the proportion of the men with a poor index rating had increased to about 20% (figure 5).

A similar change, but with less clear differences between the single age groups, was observed for the women. For the women with a work ability index that was lower than the average (poor or moderate) (20%) and those that had an excellent work ability (30%) in the age groups of 45 to 51 years (figure 5b) the picture changed. Eleven years later about 60% of the women had a lower than average rating, and only about 10% had a work ability that was rated as excellent. After the age of 55 years about 20% had a poorer than average rating (figure 5b).

The age-standardized prevalence of poor work ability increased similarly among the men and the women. At a mean age of 47 years, 1.7% of the men and women had a poor rating (scores 7—27). At 51 years the corresponding figure was 3.3%, whereas at 58 years it was 18.2% and 18.3%, respectively (figure 6a).

Less than 6% of the men doing physical, mixed physical and mental, or mental work had a poor work ability index at the mean ages of 47 and 51 years. After 51 years of age, the highest increase in the poor rating was found for the men doing physical work, and the lowest occurred for the men doing mental work. At the mean age

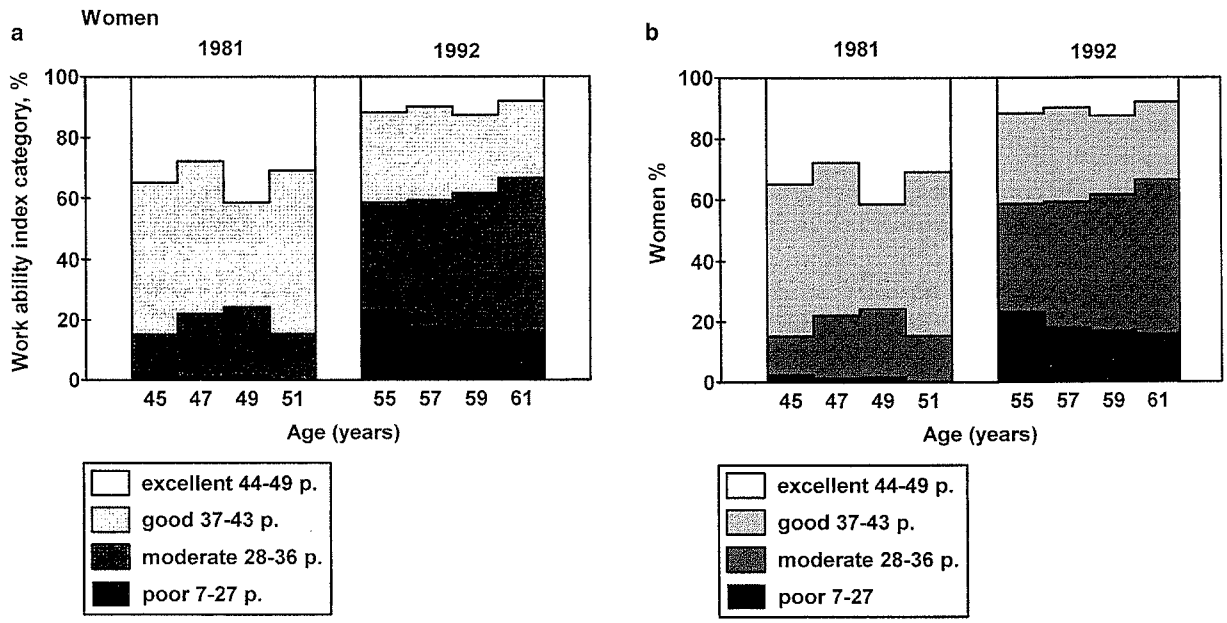

Figure 5. Distribution of the men (a) and women (b) in the work ability index categories by age and time of follow-up.

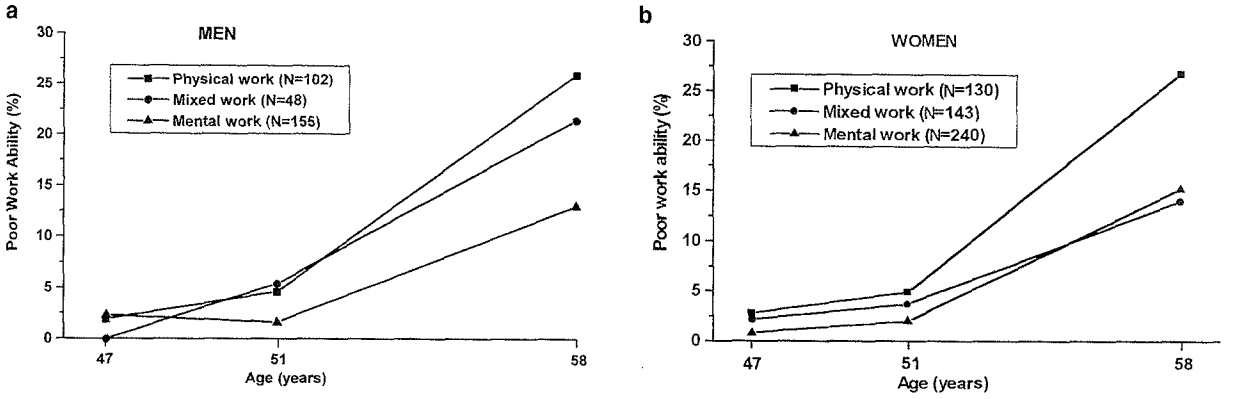

Figure 6. Distribution of the men (a) and women (b) in the poor category of work ability index by type of work and age.

of 58 years 26.0% of the men in physical work, 21.5% of those in mixed physical and mental work, and 13.0% of those in mental work had a poor work ability (figure 6a).

A similar change in the rate of poor work ability was seen for the women. The prevalence of poor work ability in the 3 work content groups was less than 5% at the mean ages of 47 and 51 years. After 51 years, the women doing physical work had the highest rate of poor work ability, up to 26.8%. Among the women doing mixed physical and mental or mental work, a similar increase was found at the mean age of 58 years, the prevalence rates being 14.0% and 15.2%, respectively (figure 6b).

The age-standardized prevalence of poor work ability in the different job profile groups was low at the age of 51 years but high in several profile groups at the age of 58 years (table 3). The men doing installation, auxiliary, or transport work showed the highest prevalence of poor work ability in 1992 (mean age 58.3 years), more than 25% of the men having poor work ability. Teachers also had a higher rate than the average. Male physicians and men in administrative work had a low rate of poor work ability after the follow-up period.

Women doing kitchen supervision, auxiliary work, or home care work had the highest prevalence rates of poor work ability at the age of 58 years. Women doing office work also had a higher rate than the average. Exceptionally, the kitchen supervisors (cooks) had a higher rate of poor work ability than the other groups already at the age of 51 years. Female teachers, dentists, and physicians had the lowest proportion of poor work ability at the end of the follow-up (table 3).

Most of the men doing auxiliary work (unskilled assistants, painters, construction workers, streetsweepers, park workers, laborers) had a higher than average work ability (scores >36) at 44—51 years of age. About 11 years later most of the same men had a lower than average work ability (figure 7a). About 25% of the men doing auxiliary work had poor work ability (scores <28) at the age of 56—62 years. Similar figures were seen for

Table 3. Prevalence of poor work ability (score < 27) by age, gender and work profile.

Gender	N	Age		
		47 years	51 years	58 years
Men				
Installation work	62	3.0	3.0	25.6
Auxiliary work	40	0.0	7.2	25.3
Transport work	38	0.0	4.6	25.0
Teaching work	44	0.0	3.1	22.8
Technical supervision	36	6.2	3.1	18.6
Administrative work	45	2.8	0.0	7.4
Physician's work	28	0.0	0.0	0.0
Women				
Kitchen supervision	25	1.6	15.7	26.8
Auxiliary work	74	3.4	2.8	26.4
Home care work	56	1.5	8.0	26.3
Office work	86	2.0	3.3	19.4
Administrative work	106	0.0	0.0	15.3
Nursing work	94	5.2	1.5	15.0
Teaching work	39	0.0	4.7	9.5
Physicians	9	0.0	0.0	9.3
Dentist's work	24	0.0	0.0	5.5
All	818	1.6	3.3	18.5

the women in auxiliary work (cleaners, hospital aides, kitchen helpers, construction workers, streetsweepers, park workers) in that the number of workers in the good or excellent classes at the age of 45—51 years had decreased after 11 years, most having a lower work ability than the average and about 25% having poor work ability at 55—62 years of age (figure 7b).

Before 51 years of age most of the men in transport work had a good or excellent work ability, and none of them were classified as having a poor work ability. However, 11 years later, about 25% of them had poor work ability (figure 8). Among the kitchen supervisors (cooks) an excellent work ability was rare already before the age of 51 years. When the supervisors were 11 years older, none of them had excellent work ability, and almost all of them had a poor or moderate work ability (figure 9).

Almost all the male teachers (vocational schools, secondary schools) had an excellent or good work ability in

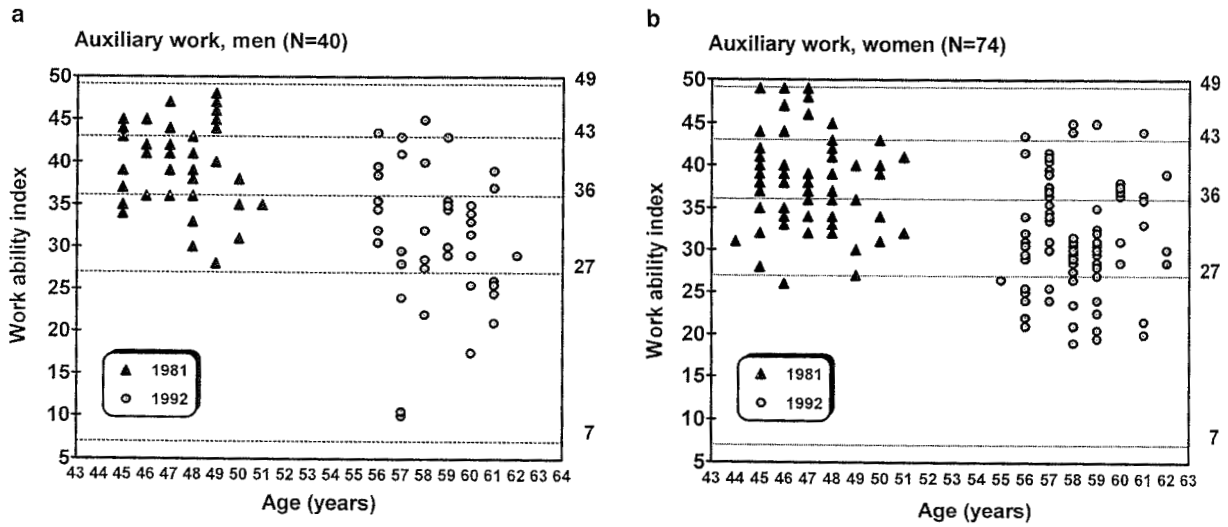

Figure 7. Individual scores of the work ability index of the men (a) and women (b) who did auxiliary work by age. Same subjects in 1981 (left panel) and 1992 (right panel).

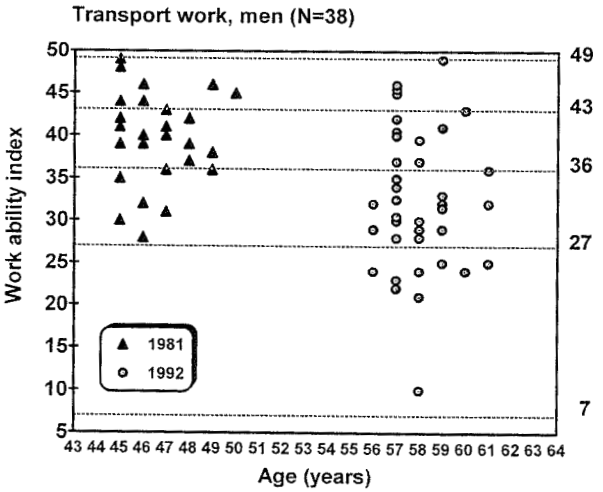

Figure 8. Individual scores of the work ability index of the men in transport work by age.

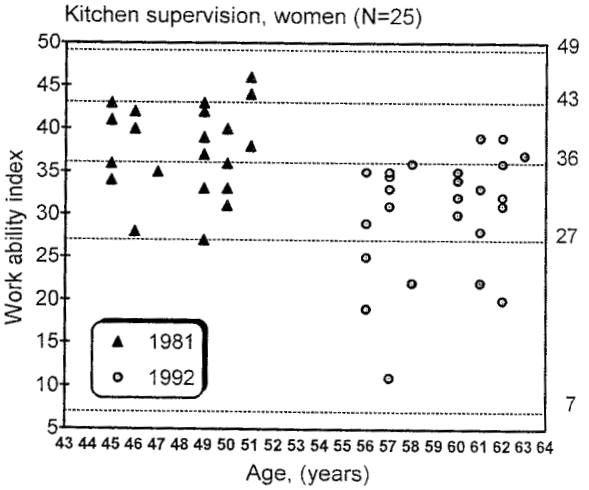

Figure 9. Individual scores of the work ability index of the women in kitchen supervision by age.

the beginning of the follow-up. After 11 years an excellent work ability was rare, and about 25% had poor work ability (figure 10a). The change in work ability differed for the female teachers (vocational schools, secondary schools, day care centers). It did not decrease to the level of poor as frequently as among the men (figure 10b).

Discussion

Our main observation was that, according to the work ability index, work ability declined significantly among the employees who continued working in the same profession for a period of about 11 years. Generally speaking, the results suggest that strong associations exist between age and work content. The period after the age of 51 years was found to be critical, as was the role of physical load of the work done by the subjects. More than 25% of the men in installation, auxiliary, or transport work had a poor work ability rating at the mean age of 58 years, as did the women in kitchen supervision, auxiliary, and home care work. The decline in work ability was very similar among the men and the women. However, some gender-specific features were found. For example, the annual rate of decline was usually highest among the women aged 51 years at the onset of the follow-up; however, the female teachers showed a less dramatic decline than the male teachers.

The decline in work ability with age was expected because the rates of work disability also increase with age. The work ability was shown to have a high predic-

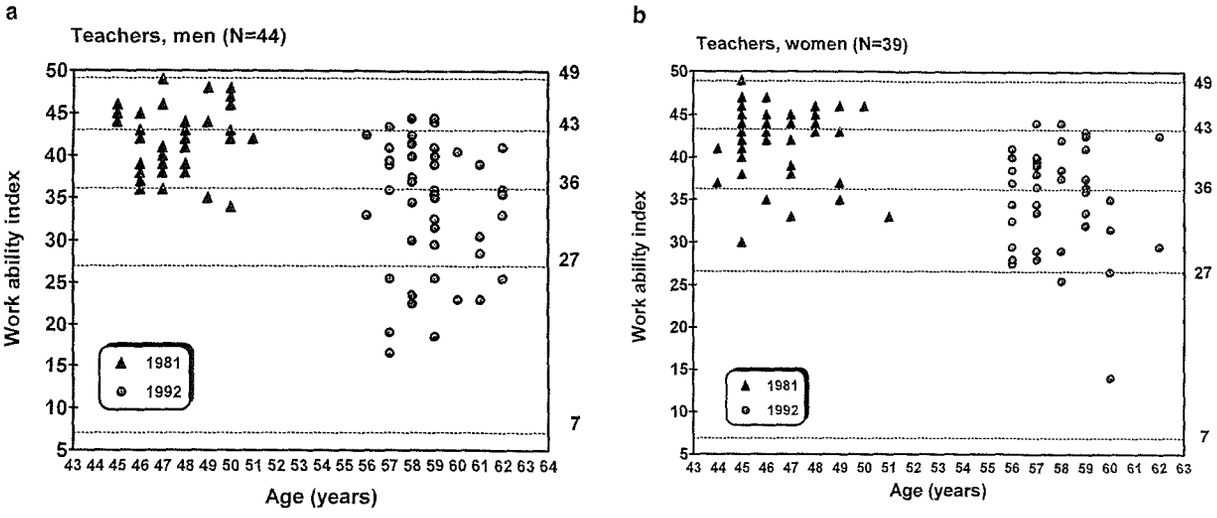

Figure 10. Individual scores of the work ability index of the men (a) and women (b) in teaching work by age.

tive value for work disability in that about 60% of those who had a poor rating when 51 years of age were granted a work disability pension before 63 years of age (9). Surprisingly, employees who were able to manage their work during the entire follow-up period also showed a significant decline in work ability. This finding suggests that work participation alone does not prevent work ability from declining with age. It should be pointed out, however, that about 40% of the men and women had a good or excellent rating, and only about 20% had a poor rating after the age of 55 years.

The period from 51 to 58 years was more critical than the period from 47 to 51 years with respect to the decline in work ability. It is understandable that work ability declined more during a 7-year period than during a 4-year period, especially since the mean age of the employees was higher. The factors, other than age, that influence work ability are life-style, work, and health (1). Other reports in this issue of the *Scandinavian Journal of Work, Environment & Health* show that the lifestyle of our subjects remained either unchanged or improved (eg, the addition of brisk leisure-time physical activity to their life) and thus — if anything — delayed the decline in work ability (10). In general, the stress and strain perceived by the employees increased with age in every occupation (11, 12). On the other hand, the job analysis showed that no marked changes occurred in job content or job demand during the follow-up period (13). The changes in the health status of the employees had obviously the strongest impact on work ability.

Because the prevalence and incidence rates of diseases increased significantly during the follow-up period (14), more information on the role of different diseases with respect to work ability should be obtained with further analyses.

The present 11-year results confirmed the results of the earlier 4-year follow-up study (15). Work ability was dependent on job content. The greater the physical demand at work, the greater the decline in work ability with aging. The most critical jobs for the men were installation, auxiliary, and transport work; for the women kitchen supervision, auxiliary, and home care work (ie, all jobs with physical demands) filled this role. These findings provoke several questions. For example, has the physical load at work (such as the use of muscle strength, lifting and carrying, sudden peak loads, twisted and bent work postures) actually decreased at all? Or is the possible trend of decreasing physical demands not yet sufficient to result in health benefits? Is the aged body more vulnerable to the same local physical load than a younger body? What is the role of life-long physical work, and what is the role of a dramatic decline in physical work capacity and the negligence of regular physical exercise? Why are employees more vulnerable physically than mentally as they age? It can be argued that eliminating physical load from work can prevent a premature decline in work ability and work disability rates. The transfer from jobs with heavy physical demands to physically less demanding work should take place no later than at the age of 47—51 years.

This 11-year follow-up study also suggests that factors other than physical load influence work ability. Mentally loading jobs like technical supervision and teaching among the men and office work among the women showed relatively high prevalence rates of poor work ability after the age of 51 years. Mental disorders were the main reason for work disability pensions in mentally demanding jobs, and poor mental capacity in relation to work demands predicted work disability (Klockars et al. unpublished results). This finding suggests that new so-

lutions that better fit the work to age should be created in all types of jobs. In work that included both physical and mental demands, there was a lower risk of poor work ability after 51 years of age than in physically demanding work. Therefore, one solution for physical demanding work would be to include some mental components (training of younger colleagues, etc) into the work content. On the other hand, physical exercise could be a beneficial tool to maintain and improve human resources in mental demanding work.

Younger men (45 years) had the slowest and older women (51 years) the highest annual declining rate in work ability (0.25 versus 0.63 of the work ability index per year) during this 11-year period. The reasons differ. For instance, the role of physiological and mental changes associated with menopause among women should be studied. Work career development can influence work ability, particularly among younger men. Another type of gender difference was observed in teaching work. A good base-line work ability among the men was followed by a dramatic decline in 11 years. Several male teachers but no female teachers had a poor work ability after the follow-up. Whether the reasons are due to different changes in health, work, or life-style factors should also be investigated further. To clarify the role of work, the rate of decline in work ability should be analyzed at the work content and job profile group level.

The division of work ability according to 4 work ability ratings showed that remarkable changes occurred at the individual level during the follow-up. The proportion of employees with excellent work ability decreased, and those with a moderate or poor work ability increased dramatically during 11 years. The results of employees with moderate and poor work ability suggest that almost 60% of employees over 55 years of age need for work ability to be promoted through care and measures taken by health service professionals or other experts. Otherwise the quality of work and productivity, as well as the quality of life and well-being at the individual level, will decrease and the work disability rates will increase.

The individual differences in work ability increased with age in all the studied groups. The increased heterogeneity within 1 occupational group suggests that more individual and flexible solutions should be available to help workers manage at work. The work ability index can be recommended as a means to identify persons needing support to promote their work ability. The effects of workplace measures can also be monitored by the work ability index.

In this study, work ability was evaluated by the work ability index at 3 points in time for the same subjects. It was therefore not possible to identify exactly the critical age at which work ability showed the most marked decline in different occupational groups. However, the actions needed to promote work ability should be started as early as possible. Good examples are available that show that work ability can be promoted during aging (16).

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References

1. World Health Organization (WHO). Ageing and working capacity. Geneva: WHO, 1993. Technical report series, no 835.
2. Organisation for Economic Co-operation and Development (OECD). The labor market and older workers. Paris: OECD, 1995. Social policy studies, no 17.
3. Tuomi K, Ilmarinen J, Eskelinen L, Järvinen E, Toikkanen J, Klockars M. Prevalence and incidence rates of diseases and work ability in different work categories of municipal occupations. Scand J Work Environ Health 1991;17 suppl 1:67—74.
4. Eskelinen L, Kohvakka A, Merisalo T, Hurri H, Wägar G. Relationship between the self-assessment and clinical assessment of health status and work ability. Scand J Work Environ health 1991;17 suppl 1: 40—7.
5. Nygård C-H, Eskelinen L, Suvanto S, Tuomi K, Ilmarinen J. Associations between functional capacity and work ability among elderly municipal employees. Scand J Work Environ Health 1991;17 suppl 1:122—7.
6. Ilmarinen J, Tuomi K, Eskelinen L, Nygård C-H, Huuhtanen P, Klockars M. Summary and recommendations of a project involving cross-sectional and follow-up studies on the aging worker in Finnish municipal occupations (1981—1985). Scand J Work Environ Health 1991;17 suppl 1:135—41.
7. Rohmert W, Landau K. Das Arbeitswissenschaftliche Erhebungsverfahren zur Tätigkeitsanalyse (AET): handbuch. Bern, Stuttgart, Wien: Verlag Hans Huber, 1979:226 p.
8. Ilmarinen J, Suurnäkki T, Nygård C-H, Landau K. Classification of municipal occupations. Scand J Work Environ Health 1991;17 suppl 1:12—29.
9. Tuomi K, Ilmarinen J, Seitsamo J, Huuhtanen P, Martikainen R, Nygård C-H, et al. Summary of the Finnish research project (1981—1992) to promote the health and work ability of aging workers. Scand J Work Environ Health 1997;23 suppl 1:66—71.
10. Seitsamo J, Ilmarinen J. Life-style, aging and work ability among active Finnish workers. Scand J Work Environ Health 1997;23 suppl 1:20—6.
11. Huuhtanen P, Nygård C-H, Tuomi K, Martikainen R. Changes in stress symptoms and their relationship to changes at work in 1981—1992 among elderly workers in municipal occupations. Scand J Work Environ Health 1997:23 suppl 1:36—48.
12. Nygård C-H, Huuhtanen P, Tuomi K, Martikainen R. Perceived work changes between 1981 and 1992 among aging workers. Scand J Work Environ Health 1997;23 suppl 1:12—9.
13. Nygård C-H, Suurnäkki T, Peltomaa T, Ilmarinen J. Objectively assessed job demands among elderly employees in 1981

and 1993. In: Kumashiro M, editor. The paths to productive aging: proceedings of the XIVth UOEH and IIES international symposium; Kitakyushu October 1994. London, Bristol: Taylor & Francis, 1995:325—30.
14. Seitsamo J, Klockars M. Aging and change in health. Scand J Work Environ Health 1997;22 suppl 1:27—35.
15. Ilmarinen J, editor. The aging worker. Scand J Work Environ Health 1991; 17 suppl 1:141 p.
16. Ilmarinen J. Aging and work: the role of ergonomics for maintaining work ability during aging. In: Bittner AC, Champney PC, editors. Advances in industrial ergonomics and safety VII. London and Bristol: Taylor & Francis, 1995:3—17.