Physical functioning and use of health services in a young and old sample

The influence of fatigue

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ABSTRACT

Introduction: The purpose was to analyse 1) whether fatigue is related to physical functioning and utilization of health services at one-year follow-up in a young and old sample and 2) to compare the results of two different measures of fatigue.

Methodology: The study is a longitudinal cohort study based on 182 young (age 20-35) and 199 older (age 70-85) community-dwelling individuals recruited from nine general practitioners in Aarhus, Denmark. Physical functioning was measured by the physical health scale from the SF-12-questionnaire. Data on health care utilization were extracted from the county's central register during one year. Fatigue was measured as Vitality-Tiredness by a question from the SF-12 questionnaire and Mobility-Tiredness by the Avlund Mobility-Tiredness Scale on fatigue in six daily activities.

Results: The predictive value of the two measures varied by the age of the participants. The Vitality-Tiredness Scale was related to the outcome measures in both samples, while the Mobility-Tiredness Scale was only predictive in the old population. In the young sample the associations were attenuated by the covariates, while the estimates in the old sample remained strong and significant in the adjusted analyses.

Conclusion: Fatigue is related to subsequent physical functioning and use of health services at one year follow-up, both in young and old individuals.

Early indicators of disability are increasingly used for targeting interventions aiming to maintain independent functioning at people who will most likely benefit from them. Recent studies based on data from the Nordic countries have shown that fatigue in daily activities is an indicator of an early stage of disablement in older adults. It predicts onset of functional limitations [1] and disability [2, 3], use of social and health services [4] and mortality [2, 3]. The findings have demonstrated the significance of fatigue among the young-old and the old-old, among men and women, and among older adults in different populations, i.e. in different counties in Denmark e.g. [2, 3] and in Jyväskylä, Finland [1, 2]. The studies referred to above have used follow-up periods of 1.5 to 15 years. However, it has not yet been studied whether fatigue is also predictive of physical functioning with shorter follow-up periods.

The studies have used one specific measure of fatigue in relation to mobility (The Mobility-Tiredness Scale) [5]. This measure is based on questions on fatigue in relation to daily mobility activities. It is well-established that measures of mobility have much better discriminatory power in older than in younger populations e.g. [6]. It is thus possible that a more global measure of fatigue, which is not related to single activities, is more predictive of unfavourable health outcomes in a young population.

Further, most studies on fatigue have focused on older adults and there is limited research on the predictive value of fatigue in younger populations. Nilsson et al. [7] showed that fatigue in 40 year-old women was a significant predictor of early menopause, which may be seen as an indicator of premature aging. Schultz et al. [8] showed that low vitality among workers was predictive for not returning to work 4-6 weeks after low back injury. Using a measure of fatigue which reflects feelings of exhaustion, several studies showed that fatigue in the general adult population is positively related to incident non-fatal heart disease [9, 10], fatal myocardial infarction [10], stroke [11] and all-cause mortality [9]. However, it is not known whether fatigue in younger age groups is predictive of general physical functioning and use of health services.

It may be useful both in younger and older age groups to identify individuals at risk of general deterioration in physical functioning. This could potentially provide a simple and direct way of capturing early signs of health deterioration regardless of specific cause.

The aims of the present study were 1) to analyse whether fatigue is related to physical functioning and utilization of health services at one-year follow-up in a sample of young and old, and 2) to compare the results of two different measures of fatigue.

MATERIAL AND METHODS

STUDY POPULATION

The participants were recruited from nine different general practitioners in Aarhus County, Denmark. The potential participants were extracted by computer from the County's central register of GP-lists of patients in the appropriate age groups. The list included all patients aged 70-85 years and a random selection of patients aged 20-35 years. Inclusion in the study was based on the following criteria: 1) Mobility: ability to get to the examination site, 2) Language: ability to speak, understand and read Danish, 3) Mental health: no history of psychotic episodes, mental debilitation or dementia. Since the participants were also included in a study of immune function other exclusion criteria were: Pregnancy, diagnosed diseases and use of medicine specifically related to the immune system. Thus, the study sample was generally in good health.

A total of 1759 patients were invited to take part in the study. The 774 patients indicating willingness to participate (44%) were enrolled in the study until a total of 510 was reached (response rate 29%). This number was calculated to give sufficient statistical power for the main research hypotheses. They included 196 young aged 20-35 years and 314 older individuals aged 70-85 years. The sample was community dwelling and representative for these age groups of the Danish population on major socio-demographic variables [12].

At baseline 483 participants consented to be contacted for follow-up. We contacted only a subsample (n = 262) of the initial sample for follow-up study because half of the initial sample would provide sufficient statistical power for the research questions [12]. This subsample was equally distributed between the two age groups, but otherwise randomly selected by taking every second participant from a randomly organised computer file. Seven participants could not be reached because they had moved or had died; 255 participants received the questionnaire; 96 young and 110 older persons returned the questionnaires (response rate of 81%). The follow-up sample did not differ significantly from the baseline sample on marital status, education, income, negative affect and self-reported physical health [12]. The present analyses are based on data for individuals who had completed all included items. The analyses with physical functioning (questionnaire) as outcome thus included 93 young and 87 old participants, and the analyses of health service utilisation (register data) included 182 young and 199 old participants.

MAIN VARIABLES

Physical functioning was measured at baseline and at one-year follow-up using two questions from the Medical Outcome Study Short-Form General Health Survey in a 12-item version (SF-12) [13]: Does your health now limit you in: 1) Moderate activities, such as moving a table, pushing a vacuum cleaner or bicycling? 2) Climbing several flights of stairs. Response categories were: a) limited a lot (score 1), b) limited a little (score 2), c) not limited at all (score 3). The raw summation score (range 0-6) was transformed to a final score (range 0-100). Studies in a representative Danish population showed satisfactory validity and reliability for the physical functioning scale in all age groups [14].

Two measures of fatigue were included: 1) Vitality-Tiredness was measured by a question on vitality from the SF-12 questionnaire: "How much of the time during the past four weeks did you have a lot of energy?" There were six response categories ranging from "All the time" to "None of the time". The raw summation score (range 0-6) was transformed to a final score (range 0-100). Satisfactory validity and reliability have previously been found in a representative Danish sample for the vitality component in all age groups [14]. In addition, the vitality component had high discriminatory power in all age groups. 2) Mobility-Tiredness was measured at baseline by the Avlund Mob-T Scale [5]. The participants were asked whether they felt fatigued after performing the following six activities: 1) transfer, 2) walk indoors, 3) get outdoors, 4) walk out of doors in nice weather, 5) walk out of doors in poor weather, 6) manage stairs. The answers were combined in the Mob-T Scale, which counts the number of activities managed without fatigue (range 0-6). The Rasch model for item analysis has shown that the items in the Mob-T Scale are homogeneous in relation to age, gender, household composition and self-rated health [5]. The scale is reliable, and fatigue as measured by the scale is strongly associated with diagnosed diseases, isometric muscle strength and physical performance [2].

Data on health care utilization were extracted from the county's central register for the one year follow-up period. This register has been created for financial purposes, as the Danish general practitioners are – in part – paid on a fee-for-service basis. The information was retrieved from the register using the unique national identification number for each Danish citizen (The Central Personal Registration number) of the participants in the study. In the present study, the variable "Health Care Utilization" included contacts with the general practitioners: Consultations (54%), telephone advice (40%) and home visits and telephone contacts with the out-of hours service (6%). Since preliminary analyses showed no differences in directions or magnitude in correlations between the respective types of services and our independent variables, we chose to add all services to one. The measure of use of health services at follow-up thus included number of health services used during a one-year-period starting 3-9 months after inclusion.

COVARIATES

Age: Young sample: Range 20-35. Old sample: Range 70-85.

Use of medicine may be seen as a proxy measure of both mental and physical health. The participants were asked to bring their medication to the examination and were interviewed about frequency of use and dose of each product. The variable counts number of prescribed drugs.

Cognitive function was estimated by the Mini Mental State Examination (MMSE) [15] to screen for signs of cognitive impairment. The MMSE includes 19 questions measuring different aspects of cognition, like orientation, recall and naming. The scale yields a total score of 30 if all items are answered correctly.

Depressive mood was measured by the depression-dejection subscale of the Profile of Mood States [16]. The participant was asked to indicate whether he/she felt "unhappy, sad, blue, hopeless, discouraged, miserable, helpless, worthless" during the previous week on a five-point Likert scale ranging from "not at all" to "very much". The answers are summarized into a subscale. The Danish translation has been shown to have satisfactory internal reliability with a Cronbach's alpha of 0.90 [12].

Education was measured with questions about basic and ongoing school and vocational training.

STATISTICAL ANALYSIS

We made combined analyses for men and women and included gender as a covariate, because preliminary analyses indicated that patterns of associations between fatigue and the outcome measures were of the same kind for men and women, thus retaining the statistical power in the analyses. The first step in the statistical analyses was to perform crude linear regression analyses to test whether fatigue and the covariates were associated with the outcomes measures. The following factors were entered stepwise in the multivariate regression model to analyse whether they influenced the association between fatigue and the outcome measures: 1) sex and age, 2) physical functioning at baseline, 3) use of medicine (only in the analyses with physical functioning as outcome) and 4) depressive mood. Education and cognitive function at baseline were not related to any of the outcome measures and did not attenuate the estimates. Consequently they were not included in the shown analyses.

The study was approved by the local ethic committee and the Danish Data Protection Agency.

RESULTS

Table 1 shows the distributions of the main characteristics of the young and old participants, both in the smaller sample with physical functioning as outcome and in the larger sample with health services as outcome. There are broad variations in reported fatigue when using the Vitality-Tiredness measure in both age groups, whereas less than 10% of the younger sample report being fatigued when using the Mobility-Tiredness Scale. Compared to the younger sample a significantly higher proportion of the older participants felt fatigued (using both measures), had less education, poorer physical functioning, lower cognitive function, and used more prescribed drugs at baseline. There was no significant difference in depressive mood between the two age groups in the smaller sample used for the analyses of physical functioning at follow-up. However, in the larger sample used for the analyses with health service utilisation as outcome mean of depressive mood is higher in the young compared to the older study sample. At one year follow-up significantly more in the older sample had poor physical functioning and used more health services compared to the younger sample.

Table 2 shows the associations between fatigue measured by two different measures and physical functioning at one year follow-up – in the young and old study sample. The crude analyses showed that Vitality-Tiredness was significantly related to physical functioning at follow-up in both the young and old sample. In the adjusted analyses the association disappeared in the young sample, but remained significant in the old sample. Mobility-Tiredness was not related to physical functioning in the young sample. In the old sample the association between Mobility-Tiredness and physical functioning at follow-up was strong and significant, also in the adjusted analyses.

Table 3 shows the associations between fatigue measured by two different measures and use of health services at one year follow-up – in the young and old study population. The crude analyses showed that Vitality-Tiredness was significantly related to health service utilisation at follow-up in both the young and old sample. In the adjusted analyses the association between fatigue and health service utilisation disappeared in the young study sample. In the old sample the estimates were attenuated, and the associations became non-significant. Mobility-Tiredness was not related to use of health services in the young group. In the old sample the association between Mobility-Tiredness and use of health services was strong and significant, also in the adjusted analyses.

Table 1. Distributions of the main characteristics in the young and old study population

	Sample with physical functioning as outcome			Sample with use of health services as outcome		
	young (n = 93)	old (n = 87)	P	young (n = 182)	old (n = 199)	P
Baseline						
Vitality-Tiredness, %						
0-19 (low)	2	0		2	2	
20-39	10	9		10	11	
40-59	15	15		16	16	
60-79	24	22		26	25	
80-99	48	43		46	36	
100 (high)	1	12	0.080[a]	1	12	0.0006[a]
Mobility-Tiredness, %						
Tired in all activities	0	4		0	5	
Tired in 5 activities	0	3		0	3	
Tired in 4 activities	0	1		0	4	
Tired in 3 activities	0	4		0	4	
Tired in 2 activities	3	3		3	4	
Tired in 1 activity	3	7		5	8	
Not tired in any activities	94	76	0.020[a]	92	75	<0.0001[a]
Education, %						
7-10 yrs	2	48		2	52	
11-12 yrs	47	22		49	21	
12+ yrs	51	31	<0.0001[a]	49	27	<0.0001[a]
Physical functioning, %						
0-24	0	10		6	10	
25-49	1	9		1	11	
50-74	4	18		5	18	
75-99	8	15		7	14	
100	87	49	<0.0001[a]	86	49	<0.0001[a]
MMSE (mean)	29.09	28.19		29.21	28.43	
	(0.930)	(1.38)	<0.0001[b]	(0.90)	(1.37)	<0.0001[b]
Number of prescribed drugs (mean)	0.72	1.99		0.67	2.12	
	(1.30)	(2.05)	<0.0001[b]	(1.67)	(2.09)	<0.0001[b]
Depression (mean)	2.19	2.15		3.20	2.15	
	(4.25)	(3.59)	0.229[b]	(4.45)	(3.39)	0.0009[b]
1-year follow-up						
Physical functioning, %						
0-24	3	7				
25-49	1	1				
50-74	4	25				
75-99	9	18				
100	83	49	<.0001[a]			
Number of health services (mean)				4.85	10.16	
				(6.00)	(9.43)	<.0001[b]

a) chi-square tests for equal distribution between the young and old study population.
b) t-tests for equal distribution between the young and old study population.

Table 2. The associations between fatigue at baseline (two different measures) and physical functioning at one-year follow-up. By multivariate linear regression analysis.

	Analyses with fatigue = Vitality-Tiredness							Analyses with fatigue = Mobility-Tiredness						
	crude			adjusted[a]				crude			adjusted[a]			
	beta	(SE)	P[b]	beta	(SE)	P[b]	adjusted R^2	beta	(SE)	P[b]	beta	(SE)	P[b]	adjusted R^2
Young sample (n=93)														
Fatigue	0.289	(0.096)	*0.003*	0.081	(0.124)	0.513	0.138	8.847	(5.787)	0.130	–4.462	(6.519)	0.500	0.138
Sex	–4.890	(4.532)	0.284	1.387	(4.829)	0.775		–4.890	(4.532)	0.284	0.579	(4.802)	0.904	
Age	–0.676	(0.530)	0.206	–0.673	(0.500)	0.775		–0.676	(0.530)	0.206	–0.694	(0.501)	0.169	
Physical functioning at baseline	0.561	(0.154)	*0.001*	0.345	(0.178)	*0.056*		0.561	(0.154)	*0.001*	0.424	(0.187)	0.026	
Medicine	–3.849	(1.714)	*0.001*	–1.454	(1.878)	0.441		–3.849	(1.714)	*0.001*	–1.234	(1.921)	0.522	
Depression	–1.673	(0.508)	*0.001*	–0.913	(0.645)	0.161		–1.673	(0.508)	*0.001*	–1.236	(0.605)	*0.044*	
Older sample (n=87)														
Fatigue	0.564	(0.149)	*0.0003*	0.337	(0.151)	*0.030*	0.416	11.604	(1.802)	*<0.0001*	7.611	(1.904)	*0.0002*	0.500
Sex	–18.592	(7.095)	*0.011*	–12.551	(5.854)	*0.036*		–18.592	(7.095)	*0.011*	–8.767	(5.516)	0.117	
Age	–2.732	(0.829)	*0.002*	–1.862	(0.747)	*0.015*		–2.732	(0.829)	*0.002*	–1.332	(0.688)	0.057	
Physical functioning at baseline	0.384	(0.097)	*0.0002*	0.124	(0.095)	0.197		0.384	(0.097)	*0.0002*	0.116	(0.087)	0.186	
Medicine	–6.407	(1.647)	*0.0002*	–4.361	(1.482)	*0.005*		–6.407	(1.647)	*0.0002*	–2.847	(1.450)	0.185	
Depression	–1.937	(1.015)	0.061	–0.444	(0.934)	0.637		–1.937	(1.015)	0.061	–1.367	(0.752)	0.074	

a) Adjusted by sex, age, physical functioning and depression at baseline.
b) Significance is marked by italics.

Table 3. The associations between fatigue at baseline (two different measures) and use of health services at one-year follow-up. By multivariate linear regression analysis.

	Analyses with fatigue = Vitality-Tiredness							Analyses with fatigue = Mobility-Tiredness						
	crude			adjusted[a]			adjusted	crude			adjusted[a]			adjusted
	beta	(SE)	P[b]	beta	(SE)	P[b]	R^2	beta	(SE)	P[b]	beta	(SE)	P[b]	R^2
Young sample (n=182)														
Fatigue	–0.056	(0.020)	*0.005*	–0.026	(0.024)	0.278	0.122	–0.367	(1.088)	0.737	1.463	(1.164)	0.210	0.124
Sex	4.023	(0.849)	*<0.0001*	3.612	(0.879)	*<0.0001*		4.023	(0.849)	*<0.0001*	3.752	(0.875)	*<0.0001*	
Age	0.109	(0.103)	0.291	0.107	(0.098)	0.276		0.109	(0.103)	0.291	0.107	(0.098)	0.275	
Physical functioning at baseline	–0.026	(0.025)	0.305	–0.026	(0.024)	0.279		–0.026	(0.025)	0.305	–0.044	(0.025)	0.084	
Depression	0.269	(0.098)	*0.007*	0.120	(0.117)	0.387		0.269	(0.098)	*0.007*	0.209	(0.120)	*0.042*	
Older sample (n=199)														
Fatigue	–0.096	(0.026)	*0.0003*	–0.055	(0.029)	0.063	0.118	–1.928	(0.382)	*<0.0001*	–1.449	(0.414)	*0.0006*	0.156
Sex	4.338	(1.301)	*0.001*	3.854	(1.259)	*0.003*		4.338	(1.301)	*0.001*	3.628	(1.234)	*0.004*	
Age	0.209	(0.172)	*0.0004*	0.045	(0.167)	0.787		0.209	(0.172)	*0.0004*	0.035	(0.163)	0.831	
Physical functioning at baseline	–0.067	(0.019)	*0.0004*	–0.043	(0.020)	*0.030*		–0.067	(0.019)	*0.0004*	–0.029	(0.020)	0.154	
Depression	0.480	(0.194)	*0.014*	0.264	(0.200)	0.187		0.480	(0.194)	*0.014*	0.314	(0.184)	0.091	

a) Adjusted by sex, age, physical functioning and depression at baseline.
b) Significance is marked by italics.

An additional result was that female sex was strongly related to use of health services in both age groups.

DISCUSSION

Our main finding was that fatigue was related to subsequent physical functioning and use of health services, but the patterns of associations depended on the age of the study participants and on the used measurement of fatigue.

The predictive value of the two measures varied by the age of the participants. The Vitality-Tiredness Scale was related to the outcome measures in both samples, while the Mobility-Tiredness Scale was only predictive in the old sample. The most obvious explanation for this may be that the Mobility-Tiredness Scale shows much less variation in levels of fatigue in the young sample compared to the older population, whereas the component of vitality from the SF-12 measure was able to discriminate between different levels of fatigue in both young and old persons. Other studies have shown that among the eight dimensions in the SF-36 scale the vitality scale is the one with the best discriminatory power in all age groups and within a whole range of symptoms and diseases [6].

In the young sample the associations were attenuated by the covariates, while the estimates in the old sample remained strong and significant (except for Vitality-Tiredness in relation to use of health services). This could indicate that fatigue in young cohorts may be an indicator of poor health and depression, whereas fatigue in older cohorts may be a much more multifaceted indicator of all the factors influencing the aging process.

Other studies in younger samples have shown that specific diseases e.g. [17], physical symptoms [18], adverse effects of medicine, psychological factors (e.g. anxiety, sleep disorders), social factors [18] are related to fatigue both in younger and older populations. However, a recent study showed that fatigue in older persons is also strongly influenced by comorbidity, poor cognitive function and decreased muscle strength [17]. The present findings that the association between fatigue and physical functioning in the young sample is attenuated when adjusted by physical functioning, use of medication and depression underlines that fatigue may be seen as a specific indicator of poor health in younger adults. In contrast, the association between fatigue and physical functioning in the old sample was not attenuated by depressive mood and use of medicine, which could indicate that fatigue in old persons reflects other factors than physical and mental health to a much higher degree than in young samples.

In agreement with several other studies e.g. [19] being female was strongly related to use of health services in the old population. The most important explanations for this may be that 1) differences in socialization of boys and girls lead women to become more perceptive of their symptoms and possibly more open to act earlier on these symptoms [20] and that 2) females may be more aware of healthy behaviours throughout life because of a more continuous contact with the preventive and health services caused by pregnancies and childbirths [20].

It might be considered a weakness that the study population is very small, considering the number of persons invited in the first run. As the study had financial limits it was necessary to restrict the size of the study sample to what was considered sufficient to obtain sufficient power for the analyses. Therefore, the proportion of non-participants in the study includes both persons who did not want to participate and persons who were not invited, among those who originally had accepted to participate. The largest loss of participants was at the selection into the study, but these non-participants did not differ from the participants on major socio-demographic variables. The follow-up sample did not differ from the baseline sample on marital status, education, income, negative affect and self-reported physical health. On this basis there is no reason to believe that the associations found would be systematically more different among the non-participants than among the participants.

Unfortunately we did not have data on the full 4-item scale on vitality from the SF-36 measure. The single item used here is based on a question on energy, which may reflect a slightly different concept than fatigue. Another shortcoming is that some of the activities in the Mobility-T Scale resemble the activities in the physical functioning scale (e.g. climbing stairs). However, it does strengthen the validity of the results that we used two outcome measures, self-reported physical functioning and register based data on use of health services, and that the results were in the same direction for the two outcome measures. Physical functioning was measured by the SF-12 subscale, which is a shorter version of the widely used and well-validated Danish translation of the SF-36 measure [14]. Studies have shown a high degree of correspondence between summary physical health measures estimated using the SF-12 and the SF-36 [13]. Consequently, it seems appropriate to use the SF-12 as a practical alternative to the SF-36 when the focus is on overall physical health outcomes.

Fatigue is related to physical functioning and health service utilisation at one-year follow-up, both in young and old individuals. These findings underline that it should be taken seriously when young and old adults complain about fatigue as such individuals may be at higher risk of not maintaining their physical functioning.

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