Limitations in physical functioning among older people as a predictor of subsequent disability in instrumental activities of daily living

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Abstract

Background: physical functioning describes the underlying abilities that make activities necessary for independent living in the community possible.
Objective: to test self-reported and objective measures of physical functioning in predicting subsequent disability in cooking, shopping and housework.

Design: we used data from the first and second waves of the Survey of Health, Ageing and Retirement in Europe. The respondents were asked about physical functioning (climbing, pulling/pushing, stooping/crouching/kneeling, lifting/carrying and reaching/extendng were comparable) and they had their grip strength and walking speed measured.

Participants: men and women aged 65 years or over who reported no disability in cooking, shopping and housework at baseline were included in the analysis. There were 6,841 individuals for whom data on disability status at follow-up were available.

Methods: Poisson regression was used to calculated relative risks for the associations between self-reported and objective measures of physical functioning with disability at 2 years, adjusting for age, gender, education level, cognitive function and chronic conditions.

Results: those with limitations in physical functioning at baseline more frequently reported subsequent disability. Walking ability was most strongly associated with disability; climbing, pulling/pushing, lifting/carrying and reaching/extendng were comparable (picking was non-significant). Similar results were obtained with grip strength and walking speed.

Conclusions: both self-reports and objective measures capture information on the functional ability of older people that can be used to predict disability onset. Objective measures offer little to the development of intervention strategies, whereas self-reports provide some insight into the demands of the environment, being more amenable to interventions.

Keywords: physical functioning, disability, instrumental activities of daily living, elderly

Introduction

The implications of population ageing are of particular concern with regard to disability and independent living. Independence is usually measured in terms of functional ability in basic activities of daily living (BADLs) and instrumental activities of daily living (IADLs). BADLs consist of bathing, dressing, going to toilet, transferring, continence and feeding [1]. While an integral part of diagnosing age-related diseases, these tasks are not indicative of whether someone is able to live independently [2]. More appropriate are the IADLs, which include using the telephone, shopping, cooking, housework, doing laundry, using transportation, managing medication and handling finances [3].

IADLs are heterogeneous with respect to the abilities required for their performance [4]. Difficulties with handling finances, managing medication and using the telephone more obviously point to problems in cognitive function, whereas difficulties with shopping, cooking, housework, laundry and transportation to problems in physical function [5]. Whittle and Goldenberg [6] found health perception to be significantly associated with IADLs of the physical domain, and we previously showed that older people disabled in these activities do rarely improve or recover their ability [7]. The disablement process [8] implies that limitations in sensory, cognitive and motor abilities would precede disability. However, it has been suggested that it is primarily motor ability which has an independent effect on IADL disability among older people, and this is exacerbated by vision and hearing loss [9].

Self-reports have traditionally been used to assess the functional ability of older people; they are generally quick to use, inexpensive and easy to administer. Nevertheless, the information provided might be different from objective measures where performance is monitored during a test. Owing to concerns that self-reports are inaccurate, objective measures of physical functioning were developed that may include counting repetitions or timing the activity [10]. Though initially developed for laboratory studies, many of these measures have been adapted for use in home settings, for example, the ‘chair stand test’ where the time to complete stand-to-sit transfers is recorded [11].

There are data to suggest that some discordance must be expected between self-reports and objective measures since both provide different types of information [12]. Self-reports encompass subjective factors and assess perceived functioning or experienced difficulty, whereas objective measures assess functional capacity in a test situation [11]. In a study by Fors et al. [13], women and individuals with cognitive impairment were more likely to show discordance between self-reports and objective measures of physical functioning. Age and education were also associated, but their effects disappeared in the presence of other variables.

Objective measures such as the chair stand test have been shown to be predictors of disability in BADLs [14]; however, the relationship between measures of physical functioning and subsequent disability in IADLs is less well studied. Such knowledge might help to better understand the level of environmental challenge experienced by older individuals so that interventions can be designed to delay the onset of disability. The first objective of this study was to investigate whether self-reported measures capture information on the functional ability of older non-disabled people that can be used to predict subsequent disability in IADLs. The second objective was to test whether objective measures of physical functioning have different predictive values than self-reports.
Material and methods

Study design

The Survey of Health, Ageing and Retirement in Europe (SHARE) is a multi-disciplinary, cross-national study conducted in two Scandinavian (Denmark and Sweden), six central European (Austria, Belgium, France, Germany, Netherlands and Switzerland) and three Mediterranean countries (Greece, Italy and Spain). Börsch-Supan and Jürges [15] provide a full description of the methodology used. SHARE drew probability samples in each participating country to provide 1,500 primary interviews. Different sampling methods were employed: (i) stratified simple random sampling using national registers; (ii) multi-stage sampling using regional registers and (iii) single or multi-stage sampling using telephone directories and field screening.

The target population was defined as non-institutionalised individuals aged 50 years or over who were usually resident and spoke the country’s official language. The period of the baseline survey was between May and October 2004, with the exception of France (October–November 2004) and Belgium (January–July 2005). The overall response was 62%, being highest in France (74%) and lowest in Switzerland (38%). A follow-up interview was conducted approximately 2 years later (in 2006–07).

Interviews

Respondents were interviewed in their own homes. Each respondent completed the main instrument supplemented by a self-administered questionnaire on more sensitive issues. Proxy interviews were conducted in case of hearing, speaking or concentration difficulties (<5%), and show-cards were used to help with questions that had many or complex response categories. A grip strength test was performed twice (for both hands if possible) by squeezing a handle with the maximum value as the outcome. Walking speed was measured as the time taken to walk a distance of 2.5 m at usual walking pace in those aged 75 years or over.

Variable definitions

Disability was assessed by asking the respondents whether they had difficulty with any of 13 activities, including the three IADLs cooking (‘preparing a hot meal’), shopping (‘shopping for groceries’) and housework (‘doing work around the house or garden’). A binary variable was generated to indicate disability in any of the three IADLs (see Supplementary data are available in Age and Ageing online on the definition of disability).

Limitations in physical functioning were assessed in the same way for the following tasks: ‘climbing one flight of stairs without resting’; ‘walking 100 m’; ‘pulling or pushing large objects like a living room chair’; ‘stooping, crouching or kneeling’; ‘lifiting or carrying weights over 10 pounds/5 kilos like a heavy bag of groceries’; ‘reaching or extending the arms above shoulder level’ and ‘picking up a small coin from a table’.

Grip strength was divided into tertiles (≤25, 26–36 and ≥37 kg) and walking speed into ‘normal’ (>0.4 m/s) and ‘slow’ (≤0.4 m/s). As suggested by Guralnik and Ferrucci [16], if a person was unable to complete the grip strength (n = 168) or walking speed test (n = 512), this was not considered missing data but incorporated into the results by replacing the values with the worst result observed in those who completed the test.

International Standard Classification of Education levels zero to two (lower secondary education and below) were defined as ‘low’ and levels three to six (upper secondary education and above) as ‘high’. SHARE assessed orientation and numeracy skills on scales ranging from zero (‘poor’) to four (‘good’). A variable was created to indicate limited cognitive function as defined by scores of 0–2 on the orientation scale and/or 0–1 on the numeracy scale. Several chronic conditions have been associated with functional status decline in community-living older people, primarily hypertension, chest pain, heart problem, stroke, diabetes, arthritis, hip fracture, joint/back pain, cancer and chronic lung disease [17]. The presence of these conditions was ascertained from the respondent’s report.

Finally, the subjects were asked to rate whether they had difficulty reading newsprint (using glasses if required) on a scale from one (‘excellent’) to five (‘poor’); scores of four and five were categorised as having a limitation. Hearing was assessed by difficulty following a conversation despite background noise (using a hearing aid if required).

Sample

The sample was restricted to individuals with complete data aged 65 years or over with no disability in cooking, shopping and housework at baseline (n = 10,272). Of these, 262 (3%) died during the 2-year follow-up and another 2,818 (27%) either refused or moved. Around 5% (n = 349) had no data on disability at 2 years and were also excluded, leaving 6,841. The respondents who were lost to follow-up tended to be older and female as well as having limited cognitive function, but were comparable in terms of educational level and chronic conditions (Table 1).

Statistical analysis

Disability in the IADLs cooking, shopping and housework at 2 years was analysed according to baseline physical functioning. Poisson regression was used to assess the independent associations between the self-reported and objective measures with disability status at follow-up, adjusting for age, gender, educational level, cognitive function and chronic conditions. The models were weighted to take the sampling design into account and to adjust for attrition and mortality between the first and second waves of SHARE (the results were almost identical in unweighted models).
All analyses were performed in STATA version 9.1 (College Station, TX, USA).

Results

The 6,841 individuals who were not disabled at baseline had a mean age of 72 years with standard deviation of 6 years. Of these, 875 (13%) reported IADL disability at the two-year follow-up. Incident disability was higher among older individuals, women, those with low educational level, limited cognitive function and 2 or more chronic conditions (not shown).

Table 2. Disability at follow-up by physical functioning at baseline

<table>
<thead>
<tr>
<th>Variable</th>
<th>No disability</th>
<th>Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n  (%)</td>
<td>n  (%)</td>
</tr>
<tr>
<td>Climb</td>
<td>Normal</td>
<td>5,526 (92.6)</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>440 (7.4)</td>
</tr>
<tr>
<td>Walk</td>
<td>Normal</td>
<td>5,641 (94.6)</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>325 (5.5)</td>
</tr>
<tr>
<td>Pull/push</td>
<td>Normal</td>
<td>5,481 (91.9)</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>485 (8.1)</td>
</tr>
<tr>
<td>Stoop/crouch/knee</td>
<td>Normal</td>
<td>4,323 (72.5)</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>1,643 (27.5)</td>
</tr>
<tr>
<td>Lift/carry</td>
<td>Normal</td>
<td>5,158 (86.5)</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>808 (13.5)</td>
</tr>
<tr>
<td>Reach/extend</td>
<td>Normal</td>
<td>5,668 (95.0)</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>298 (5.0)</td>
</tr>
<tr>
<td>Pick up</td>
<td>Normal</td>
<td>5,846 (98.0)</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>120 (2.0)</td>
</tr>
<tr>
<td>Grip strength</td>
<td>≥37 kg</td>
<td>1,977 (34.0)</td>
</tr>
<tr>
<td></td>
<td>26–36 kg</td>
<td>1,990 (34.2)</td>
</tr>
<tr>
<td></td>
<td>≤25 kg</td>
<td>1,856 (31.9)</td>
</tr>
<tr>
<td>Walking speed</td>
<td>&gt;0.4 m/s</td>
<td>928 (66.5)</td>
</tr>
<tr>
<td></td>
<td>≤0.4 m/s</td>
<td>468 (33.5)</td>
</tr>
</tbody>
</table>

Note: Walking speed was only measured in those aged 75+ years. kg, kilogramme; m/s, metre/second.

The results of the regression models estimating the RR of disability at 2 years are given in Table 3. Walking ability was most strongly associated in unadjusted analyses, the risk of disability being increased 3.2-fold. The variables climbing, pulling/pushing and lifting/carrying were similarly associated (unadjusted RR range: 2.5–2.7); weaker associations were found for reaching/extending and picking (unadjusted RR range: 1.9–2.1). When controlling for potential confounders, the associations were attenuated but remained statistically significant (the exception being picking which was non-significant). Walking ability still showed the strongest association with subsequent disability (RR = 2.0), while all other variables were comparable (adjusted RR range: 1.6–1.8).

Grip strength values of 26–36 kg (RR = 1.4) and, in particular, ≤25 kg (RR = 2.5) were also associated with an elevated risk of disability; slow walking speed increased the risk by 50%. These associations were attenuated after adjustment (the former association being no longer significant), although that with walking speed remained stable.

When vision and hearing were included in the regression models, the results were largely unchanged. To determine whether the associations were moderated by vision and hearing loss, interaction terms were included for all measures, that is, the product of the corresponding variables. None of the interaction terms was significant (not shown).

Discussion

This study examined associations between measures of physical functioning and subsequent disability in the IADLs cooking, shopping and housework. The magnitude of the associations was moderate and comparable across
the range of variables tested. Similar results were obtained with self-reports and objective measures (which was still true after restricting the sample to individuals without missing data for any of the variables and adjusting for all measures of physical functioning), suggesting that both identified older people with an early stage of disability who may benefit from interventions.

Reynolds and Silverstein [18] constructed a variable to indicate the number of limitations in standard physical functioning items, which predicted increasing likelihood of disability over time (ranging from 17% for cooking to 27% for shopping per additional limitation). Another study found that functional limitation (as measured by difficulty pulling/pushing, stooping/crouching/kneeling, reaching/ extending and picking) was associated with a 2.5-fold increased risk of IADL disability at 2 years [19]. Such findings confirm those reported here but they provide no information about individual variables, thus masking potentially useful interventions.

Evidence from cross-sectional studies suggests that older people with dual sensory impairment are more likely to have IADL disability [20, 21]. Nevertheless, the findings from a longitudinal study indicate that progression of vision and hearing impairment is not associated with change in IADL disability [22]. The moderating effects of vision and hearing loss in the current study were at best minimal. Both variables were weakly associated with the outcome and usually non-significant (not shown).

Cognitive impairment has been reported to be a 'strong' predictor of disability in cooking, shopping and housework over a 3-year period [23], although adjustment was only made for age, gender and educational level and not chronic conditions. Our study, in contrast, adjusted for a wide range of chronic conditions that have been associated with functional status decline and cognitive impairment was significantly associated in all models, increasing the risk of disability by 20–30%.

Walking speed was only assessed in respondents aged 75 years or over. Although incident disability was higher in the older age group (22%) than in the younger age group (8%), grip strength turned out to be a better predictor. An investigation by Giampaoli et al. [24] supports that grip strength is a good predictor of disability. In their study, a decrease in grip strength was associated with incident disability at 4 years, adjusting for potential confounders.

SHARE assessed disability in a rigorous way by excluding those cases where the problem was expected to last <3 months. This acknowledges the fact that older people may acquire disability only temporarily [7], but it is likely to yield lower estimates of prevalence and incidence. Also, the questions in SHARE were asked without reference to whether coping strategies should be considered. Such questions do not seem to identify individuals who somehow accommodated their underlying deficits in functioning [25]. For example, older people may change the frequency or manner of performing activities, even though they do not necessarily report difficulty [26].

The low response rate of SHARE could have introduced selection bias towards unrepresentative samples. Fernandes et al. [27] used data from two other surveys that have a similar interview structure: the US Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA). Respondents in the HRS reported considerably more difficulty with physical tasks than those in ELSA and, particularly, SHARE. Large differences were observed for stooping/crouching/kneeling, less so for walking and lifting/carrying. Although variations in data collection may have affected response choices, it is possible that subjects who participated in SHARE had fewer limitations than those who did not participate. Nevertheless, as our analyses were based on those who reported no functional limitations at baseline, this issue is unlikely to produce significant bias in our results. More importantly, nearly a third of the respondents were lost at 2 years. Although we used weights to adjust for attrition and mortality between the two waves, it is not possible to say the degree to which this affected the results. The suggestion by Guralnik and Ferrucci [16] that missing values for individuals unable to complete the grip strength and walking speed tests should be replaced by the worst value observed may not necessarily be valid. However, the results were
very similar when the individuals were excluded for whom missing values were replaced.

Objective measures provide information not available from self-reports, such as on people with a low level of disability [28], but they offer little to the development of interventions for actual environments. Self-reports, on the other hand, provide some insight into the demands of the environment. For example, respondents with difficulty stooping/crouching/kneeling at baseline were more likely to report disability at follow-up, suggesting that the need to bend down should be avoided during cooking, shopping and housework. Research is needed that can be used to formulate such design principles.

**Key points**

- Physical functioning describes the underlying abilities that make activities necessary for independent living in the community, such as cooking, shopping and housework, possible.
- Self-reports and objective measures of physical functioning both identified older people at greater risk of losing their independence in cooking, shopping and housework.
- Objective measures offer little to the development of intervention strategies whereas self-reports provide some insight into the demands of the environment, being more amenable to interventions.

**Acknowledgements**

This paper used data from SHARE release 2.3.0, as of November 13th 2009.

**Funding**

SHARE data collection in 2004–07 was primarily funded by the European Commission through its 5th and 6th framework programmes (project numbers QLK6-CT-2001-00360; RII-CT- 2006-062193; CIT5-CT-2005-028857). Additional funding by the US National Institute on Aging (grant numbers U01 AG09740-13S2; P01 AG005842; P01 AG08291; P30 AG12815; Y1-AO-4553-01; OGHA 04-064; R21 AG025169) as well as by various national sources is gratefully acknowledged (see [http://www.share-project.org](http://www.share-project.org) for a full list of funding institutions).

**Supplementary data**

Supplementary data mentioned in the text is available to subscribers in *Age and Ageing* online.

**References**

Longitudinal evidence on the association between interleukin-6 and C-reactive protein with the loss of total appendicular skeletal muscle in free-living older men and women

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Abstract

Background: there is no longitudinal evidence about the association between the loss of total appendicular skeletal muscle (TASM) and cytokines.

Objective: to investigate whether high levels of the inflammatory markers such as interleukin-6 (IL-6) and C-reactive protein (CRP) are associated with the loss of TASM in free-living non-sarcopenic older people.

Design: five-year prospective cohort study.

Subjects: one hundred and fifteen free-living non-sarcopenic older men and women aged 60–84 years at baseline and 5-year follow-up were included.

Methods: TASM was measured by dual-energy X-ray absorptiometry, and the relative change in TASM was calculated. The response variable was the loss of TASM defined as the lowest sex-specific 15th percentile of the cohort distribution of percentage of change in TASM. The exposure variables were the baseline serum IL-6 and CRP levels measured by ELISA.