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13. Suzuki T, Sonoda S, Misawa K et al. Incidence and consequence of falls in inpatient rehabilitation of stroke patients. Exp Aging Res 2005; 31: 457–69.

14. Zdobysz JA, Boradia P, Ennis J et al. The relationship between functional independence scores on admission and patient falls after stroke. Top Stroke Rehabil 2005; 12: 65–71.

15. Teasell R, McRae M, Foley N et al. The incidence and consequences of falls in stroke patients during inpatient rehabilitation: factors associated with high risk. Arch Phys Med Rehabil 2002; 83: 329–33.

16. Lee JE, Stokic DS. Risk factors for falls during inpatient rehabilitation. Am J Phys Med Rehabil 2008; 87: 341–50.

17. Pollak N, Rheault W, Stoecker JL. Reliability and validity of the FIM for persons aged 80 years and above from a multilevel continuing care retirement community. Arch Phys Med Rehabil 1996; 77: 1056–61.

18. Ottenbacher KJ, Mann WC, Granger CV et al. Inter-rater agreement and stability of functional assessment in the community-based elderly. Arch Phys Med Rehabil 1994; 75: 1297–301.

19. Ottenbacher KJ, Hsu Y, Granger CV et al. The reliability of the functional independence measure: a quantitative review. Arch Phys Med Rehabil 1996; 77: 1226–32.

20. Cohen ME, Marino RJ. The tools of disability outcomes research functional status measures. Arch Phys Med Rehabil 2000; 81: S21–9.

21. Uniform Data System for Medical Rehabilitation. Available at http://www.udsmr.org/ (14 February 2010, date last accessed).

22. von Renteln-Kruse W, Krause T. Fall events in geriatric hospital in-patients. Results of prospective recording over a 3 year period. Z Gerontol Geriatr 2004; 37: 9–14.

23. Schwendimann R, Buhler H, De Geest S et al. Falls and consequent injuries in hospitalized patients: effects of an interdisciplinary falls prevention program. BMC Health Serv Res 2006; 6: 69.

24. Beauchet O, Annweiler C, Dubost V et al. Stops walking when talking: a predictor of falls in older adults? Eur J Neurol 2009; 16: 786–95.

25. Kressig RW, Herrmann FR, Grandjean R et al. Gait variability while dual-tasking: fall predictor in older inpatients? Aging Clin Exp Res 2008; 20: 123–30.

26. Wyatt J, Altman D. Prognostic models: clinically useful or quickly forgotten? BMJ 1995; 311: 539–41.

Handgrip strength as a predictor of functional, psychological and social health. A prospective population-based study among the oldest old

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Abstract

Background: muscle wasting is associated with a detrimental outcome in older people. Muscle strength measurements could be useful as part of a clinical evaluation of oldest old patients to determine who are most at risk of accelerated decline in the near future.
Objective: this study aimed to assess if handgrip strength predicts changes in functional, psychological and social health among oldest old.
Design: the Leiden 85-plus Study is a prospective population-based follow-up study.
Subjects: five-hundred fifty-five, all aged 85 years at baseline, participated in the study.

Methods: handgrip strength was measured with a handgrip strength dynamometer. Functional, psychological and social health were assessed annually. Baseline data on chronic diseases were obtained from the treating physician, pharmacist, electrocardiogram and blood sample analysis.

Results: at age 85, lower handgrip strength was correlated with poorer scores in functional, psychological and social health domains (all, $P < 0.001$). Lower baseline handgrip strength predicted an accelerated decline in activities of daily living (ADL) and cognition (both, $P \leq 0.001$), but not in social health ($P > 0.30$).

Conclusion: poor handgrip strength predicts accelerated dependency in ADL and cognitive decline in oldest old. Measuring handgrip strength could be a useful instrument in geriatric practice to identify those oldest old patients at risk for this accelerated decline.

Introduction

Muscle wasting is a dominant feature of old age and is commonly referred to as sarcopenia. Estimates of the prevalence of sarcopenia range depending on the definition from 18% to over 60% in the general population of the oldest old [1]. Due to a rapid growth of the number of oldest old in our societies, sarcopenia will become a common health problem [1].

Muscle wasting is associated with detrimental outcome in the elderly, such as disability and mortality [2]. Several recent cross-sectional studies have shown associations between muscle strength and physical fitness, disability or cognition [3–6]. A number of prospective studies have described the association of handgrip strength and health decline in the elderly, predominantly describing its association with functional disability [7–12] and mortality [13, 14]. A limited number of studies report on the associations between muscle strength and cognition [15–17].

All these associations raise the question about the value of muscle strength as a potential predictor of declining health in the oldest old. Muscle strength measurements could be useful as part of a clinical evaluation of the oldest old patients in determining which patients are most at risk of accelerated decline in the near future. Therefore we have studied the impact of muscle weakness on three health domains, functional, psychological and social health. Handgrip strength was used as a proxy for muscle strength in this study [3].

Methods

Participants and procedures

The Leiden 85-plus Study is a community-based prospective follow-up study of inhabitants of the city of Leiden, The Netherlands. Enrolment took place between 1997 and 1999. All inhabitants, including nursing home residents, who reached the age of 85 were eligible to participate. There were no selection criteria on health or demographic characteristics [18]. In total 599 persons participated, 87% of all eligible inhabitants. At baseline, a research nurse visited participants at their place of residence. During these visits, socio-demographic characteristics including gender, marital status and living situation were recorded, performance tests were conducted, blood samples collected and an electrocardiogram (ECG) was recorded. The medical history was obtained from the general practitioner or nursing home physician. Follow-up visits were performed annually. The Medical Ethical Committee of the Leiden University Medical Center approved the study. All participants gave informed consent. In case of severe cognitive impairment, a guardian gave informed consent.

Handgrip strength

At ages 85 and 89, handgrip strength was measured with a Jamar hand dynamometer (Sammons Preston Inc., Bolingbrook, IL). The participant was asked to stand up and hold the dynamometer in the dominant hand with the arm parallel to the body without squeezing the arm against the body. The width of the handle was adjusted to the size of the hand to make sure that the middle phalanx rested on the inner handle. The participant was allowed to perform one test trial. After this, three trials followed and the best score was used for analysis. Handgrip strength was expressed in kilogrammes (Kg). Only handgrip strength measurements that were assessed as reliable by the research nurse were included in the analysis. The research nurse judged the effort according to the following criteria: refusal of participation, physical impairment, cognitive impairment, inability to follow the instructions and technical difficulties.

Items of functional health

Competence in daily functioning was measured with the Groningen Activity Restriction Scale (GARS) [19]. The GARS is a questionnaire that assesses disabilities in competence in the area of nine basic activities of daily living (ADL) and nine instrumental activities of daily living (IADL). A sum score was calculated separately for ADL and IADL. Hence, each sum score ranged from nine (competent in all activities) to 36 (unable to perform any activity without help). Walking speed was assessed with a standardised 6-m walking test as used in other longitudinal

ageing studies [20]. Participants were requested to walk 3 m back and forth as quickly as possible. The use of a walking aid was allowed during this test. The time for the walking test was measured in seconds.

Items of psychological health

Cognitive functioning was measured with the Mini-Mental State Examination (MMSE) [21]. The 15-item Geriatric Depression Scale (GDS-15) was used as a screening instrument for depression [22]. As the validity and reliability of the GDS-15 may be reduced in subjects with impaired cognitive function, this questionnaire was restricted to those with MMSE scores above 18 points ($n = 482$) [23, 24].

Items of social health

Social functioning was measured with the Time Spending Pattern questionnaire (TSP). The TSP lists involvement in social and leisure activities leading to a sum score for these activities [25]. The questionnaire consists of 23 items (e.g. bathing a spouse, cycling, gardening, reading a book or watching television) scored from 0 (no activities) to 4 (participating in activity on a daily basis).

Feelings of loneliness were annually assessed by the Loneliness Scale [26], an 11-item questionnaire especially developed for use in elderly populations. Scale scores range from 0 (absence of loneliness) to 11 (severe loneliness). The Loneliness Scale was also restricted to those with MMSE scores above 18 points.

Potential confounders

Data on common chronic diseases were obtained from the general practitioner, pharmacist's records, ECG and blood sample analysis [27].

Chronic diseases included stroke, angina pectoris, myocardial infarction, intermittent claudication, peripheral arterial surgery, diabetes mellitus, obstructive pulmonary disease, malignancy and arthritis. Multi-morbidity was defined as the sum score of these somatic diseases.

Statistical analysis

Baseline cross-sectional associations at age 85 were assessed between tertiles of handgrip strength and items of health, using ANOVA (Analyses of variance). Handgrip strength was ranked and divided into tertiles for men and women separately.

The prospective association between handgrip strength and the items of health was analysed with linear mixed models. The flexibility of mixed models makes them the preferred choice for the analysis of repeated-measures data [28]. The used models included estimates for 'handgrip strength', 'time' and 'handgrip strength * time'. The estimate for 'handgrip strength' indicates the baseline as-

Table 1. Characteristics of participants ($n = 555$) at baseline (85 years)

Men (%)	194 (35.0)
Widowed (%)	314 (56.6)
Living arrangements	
Independent (%)	319 (57.5)
Sheltered (%)	156 (28.1)
Institutionalised (%)	80 (14.4)
General health	
≥3 chronic diseases[a] (%)	135 (24.3)
Body mass index <20 (%)	24 (4.5)
Functional health domain (median, ITR)[b]	
ADL disability (points)[c]	10 (9.0–11.0)
IADL disability (points)[c]	17 (13.8–22.0)
Walking speed (seconds)[d]	11.6 (9.4–14.2)
Psychological health domain (median, ITR)	
Cognition (MMSE, points)[e]	26 (24–28)
Depression (GDS, points)[f]	2 (1–3)
Social health domain (median, ITR)	
Time spending pattern (points)[g]	48 (43–51)
Loneliness (points)[h]	1 (0–2)

[a]Chronic diseases included stroke, angina pectoris, myocardial infarction, intermittent claudication, peripheral arterial surgery, diabetes mellitus, obstructive pulmonary disease, malignancy and arthritis.
[b]ITR, intertertile range.
[c]GARS, possible scores range from 9 to 36 points (best to worst).
[d]6-m walking test, scores ranged from 4.16 to 76.47 s (best to worst).
[e]MMSE, possible scores range from 0 to 30 points (worst to best).
[f]GDS-15, possible scores range from 0 to 15 points (best to worst).
[g]TSP, possible scores range from 0 to 92 points (worst to best).
[h]de Jong-Gierveld Loneliness Scale, possible scores range from 0 to 11 points (best to worst).

sociation between handgrip strength and health item scores (presented in Table 3 as 'baseline difference'). This estimate indicates the change in health items per kilogramme increase in handgrip strength. The estimate for 'time' indicates the annual change in performance for those participants with mean handgrip strength levels (presented in Table 3 as 'annual change'). The estimate for 'handgrip strength * time' indicates the accelerated annual decline in health items per kilogramme decrease of handgrip strength at baseline (presented in Table 3 as 'accelerated decline'). All estimates were adjusted for gender, height, weight and income. Estimates were standardised per kilogramme change of grip strength by using the formula: (individual handgrip strength − mean handgrip strength in study population).

SPSS 16.0 for Windows was used for all analyses. P-values < 0.05 were considered statistically significant.

Results

Participants characteristics

Reliable scores for handgrip strength were available for 555 (92.6%) participants at age 85. At baseline, there were 44 non-completed handgrip strength measurements due to refusal to participate ($n = 3$), physical impairment ($n = 17$), cognitive impairment ($n = 9$), inability to follow instructions ($n = 5$) and other reasons ($n = 10$). There were 73 (12.9%)

Table 2. Items of health according to handgrip strength tertiles at age 85

Domain	Handgrip strength[a]			P for trend[b]
	Highest tertile 34–54 kg men 21–32 kg women n = 194	Middle tertile 20–33 kg men 17–20 kg women n = 177	Lowest tertile 10–27 kg men 1–16 kg women n = 184	
Functional health				
ADL-disability (points)[c]	10.2 (0.2)	11.1 (0.2)	14.1 (0.5)	<0.001
IADL-disability (points)[c]	21.8 (0.8)	18.3 (0.5)	23.6 (0.7)	<0.001
Walking speed (seconds)[d]	10.9 (0.7)	14.8 (0.7)	18.8 (1.1)	<0.001
Psychological health				
Cognition (points)[e]	26.3 (0.3)	25.4 (0.3)	22.3 (0.5)	<0.001
Depression (points)[f]	2.4 (0.3)	2.4 (0.2)	3.0 (0.2)	<0.001
Social health				
Time spending pattern (points)[g]	50.3 (0.5)	48.3 (0.5)	44.3 (0.5)	<0.001
Loneliness (points)[h]	1.6 (0.2)	1.5 (0.2)	2.1 (0.2)	0.03

[a]Data presented as mean (SE, standard error). Handgrip strength was ranked and divided into tertiles for men and women separately.
[b]ANOVA.
[c]GARS, possible scores range from 9 to 36 points (best to worst).
[d]6-m walking test, scores ranged from 4.16 to 76.47 s (best to worst).
[e]MMSE, possible scores range from 0 to 30 points (worst to best).
[f]GDS-15, possible scores range from 0 to 15 points (best to worst).
[g]TSP, possible scores range from 0 to 92 points (worst to best).
[h]de Jong-Gierveld Loneliness Scale, possible scores range from 0 to 11 points (best to worst).

participants with an MMSE score ≤ 18 points, being indicative of cognitive impairment. Depressive symptoms (GDS score ≥ 4 points) were present in 114 (20.5%) of the participants. The other baseline characteristics of the study population are shown in Table 1.

Functional, psychological, and social health domain

The cross-sectional analyses at age 85 of functional, psychological and social items of health are shown in Table 2 for each tertile of handgrip strength. Lower handgrip strength was significantly correlated with poorer health item scores at baseline (Table 2, all $P \leq 0.03$).

To analyse the prospective association between baseline handgrip strength and changes in the various health domains, we used linear mixed models (Table 3). In line with the cross-sectional results, we confirmed the association between handgrip strength and health item scores at baseline as indicated by 'baseline difference'. Over time all health items, except loneliness, declined as indicated by

Table 3. Changes in items of health according to handgrip strength at 85 (per kg)[a]

Domain	Baseline difference		Annual change		Accelerated decline	
	Estimate (SE)[b]	P-value	Estimate (SE)[b]	P-value	Estimate (SE)[b]	P-value
Functional health						
ADL-disability (points)[c]	−0.27 (0.04)	<0.001	1.28 (0.05)	<0.001	−0.02 (0.01)	<0.001
IADL-disability (points)[c]	−0.46 (0.05)	<0.001	2.25 (0.06)	<0.001	0.01 (0.01)	0.385
Walking speed (seconds)[d]	−0.50 (0.08)	<0.001	0.35 (0.17)	0.04	0.01 (0.02)	0.471
Psychological health						
Cognition (points)[e]	0.25 (0.04)	<0.001	−0.75 (0.04)	<0.001	0.01 (0.004)	0.001
Depression (points)[f]	−0.08 (0.02)	<0.001	0.29 (0.03)	<0.001	0.002 (0.003)	0.626
Social health						
Time spending pattern (points)[g]	0.40 (0.05)	<0.001	−1.38 (0.06)	<0.001	−0.004 (0.01)	0.560
Loneliness (points)[h]	−0.05 (0.02)	<0.001	0.02 (0.02)	0.252	0.001 (0.002)	0.968

[a]Linear mixed model adjusted for gender, height, weight, income and multi-morbidity, n = 555. The estimate for 'baseline difference' indicates the baseline association between handgrip strength and health item scores. The estimate for 'annual change' indicates the annual change in performance for those participants with mean handgrip strength levels. The estimate for 'accelerated decline' indicates the accelerated annual change in health items per kilogramme change of handgrip strength at baseline.
[b]SE, standard error.
[c]GARS, possible scores range from 9 to 36 points (best to worst).
[d]6-m walking test, scores ranged from 4.16 to 76.47 s (best to worst).
[e]MMSE, possible scores range from 0 to 30 points (worst to best).
[f]GDS-15, possible scores range from 9 to 36 points (best to worst).
[g]TSP, possible scores range from 0 to 92 points (worst to best).
[h]de Jong-Gierveld Loneliness Scale, possible scores range from 0 to 11 points (best to worst).

the estimate 'annual change'. Finally, we assessed if lower handgrip strength at baseline predicted an accelerated decline in the health domains as assessed by the estimate 'accelerated decline'. Where such an estimate is significant, this indicates a predictive relationship in the model. Lower handgrip strength predicted an accelerated decline in ADL-disability in the functional health domain (0.02 points increase in GARS score per kilogramme loss of handgrip strength, $P \leq 0.001$) and cognition in the psychological health domain (0.01 points decline in MMSE score per kilogramme loss of handgrip strength, $P = 0.001$), but not in other items of health (all $P > 0.30$). Additional adjustments for baseline MMSE and GDS scores did not change the prospective results of the functional health items. The prospective results of the psychological health items did not change after adjustment for baseline scores of ADL disability, IADL disability and walking speed. The results of the social health items were not influenced by adjustment for baseline functional health items or baseline psychological items.

Discussion

The aim of the present study was to explore if handgrip strength predicts decline in functional, psychological and social health in the oldest old. Our findings show that lower handgrip strength predicted an accelerated decline in ADL-disability and cognition, and thus contributes to increasing dependency in old age.

To our knowledge, our study is the first to report on the prospective associations between handgrip strength and three health domains in a cohort of oldest old participants. A number of other studies have reported on prospective associations between handgrip strength and functional ability, or cognition in the elderly, but the mean age of participants in these prospective studies was younger and none of these included all three health domains [7–12, 15–17]. Some of these studies were limited to men [7, 8] or women [12, 13].

We confirmed the predictive value of handgrip strength in the functional health domain in oldest old participants. No predictive association was found between handgrip strength and IADL disability, which had been shown to be a predictor in Japanese community-dwelling elderly in participants aged 65 years and older [9]. For walking speed, we could not confirm a predictive value of handgrip strength, which were associated with each other in a comprehensive cross-sectional study [3].

For the association between muscle strength and functional health, one would expect that interventions aimed at improving muscle strength are beneficial. A recent review [29] has assessed the effect of resistance training on physical functioning in subjects over 60 years old. High intensity strength training, three times a week, significantly improved muscle strength, and was associated with improvement in physical ability.

Our finding that low handgrip strength predicts accelerated cognitive decline has been reported by others, but again

in younger study participants [15–17]. Changes in handgrip strength did not predict changes in depression, possibly because of a process of psychological adaptation during ageing in elderly people [30].

In the social health domain, no predictive association was found with the item loneliness. This might be explained by the fact that the need for care results in regular contact with caregivers, thereby stimulating psychological well being as suggested by a cross-sectional Scandinavian study among elderly nursing home residents [31].

This study has several key strengths to studying consequences of sarcopenia in elderly people. The Leiden 85-plus Study is a longitudinal population-based cohort study with extensive measures for health and functioning. Therefore the results can be generalised to the western population of oldest old. Furthermore, the longitudinal design with repeated measurements of diverse items of health allowed us to demonstrate a temporal association.

A possible weakness of our study could be that our participants appear to be relatively fit. For very frail elderly people, measuring handgrip strength might be difficult and the results could not be applicable to this group. But, only 44 (7.3%) measurements of handgrip strength were excluded from our study because these were deemed unreliable. Of which, 31 (5.2%) were the result of physical or cognitive impairment. We don't know if our participants are fitter compared to other oldest old. Comparison of participant characteristics of the Leiden 85-plus Study with other prospective studies on ageing is difficult because of age differences and different methodology. The Newcastle 85-plus Study started in 2006 [32] and is comparable in design to the Leiden 85-plus Study. The characteristics of the subjects from the Newcastle pilot study are similar to our study participants with regard to living arrangements, cognitive ability and depressive symptoms [33]. Another weakness of the study could be that the questionnaires on depression and loneliness were limited to those participants without cognitive decline which could have underestimated the associations between handgrip strength and the psychological indicators. However, only 73 (13%) of the participants were excluded due to an MMSE score of 18 points or lower. One could also argue that the chosen health domains are indirectly related to one another; however, further adjustment of the linear mixed model for this possible confounding did not change the results.

Functional measurements, as walking or gait speed, chair stand test and balance, have also been shown to predict functional limitations of the lower body [12, 20, 34], and cognition [35] in older subjects. As yet it is unclear whether muscle strength or functional measurements are the stronger predictor, and which causal pathways are involved. An advantage of handgrip strength could be that it is easy to use in clinical practice.

We conclude that poor handgrip strength is a predictor of accelerated dependency in ADL and cognitive decline in oldest old. Based on these findings, we conclude that measuring handgrip strength could be a useful instrument

in geriatric clinical practice to identify those oldest old patients at risk for accelerated decline in ADL ability and cognition.

Key points

- Poor handgrip strength predicts accelerated dependency in ADL and cognitive decline in oldest old.
- Measuring handgrip strength can be useful to identify those oldest old patients at risk for future decline.
- Handgrip strength measurement is an easy to use instrument in clinical geriatric practice.

Acknowledgements

Conflicts of interest

None.

References

1. Doherty TJ. Invited review: aging and sarcopenia. J Appl Physiol 2003; 95: 1717–27.
2. Fisher AL. Of worms and women: sarcopenia and its role in disability and mortality. J Am Geriatr Soc 2004; 52: 1185–90.
3. Lauretani F, Russo CR, Bandinelli S et al. Age-associated changes in skeletal muscles and their effect on mobility: an operational diagnosis of sarcopenia. J Appl Physiol 2003; 95: 1851–60.
4. Jeune B, Skytthe A, Cournil A et al. Handgrip strength among nonagenarians and centenarians in three European regions. J Gerontol A Biol Sci Med Sci 2006; 61: 707–12.
5. Hasegawa R, Islam MM, Lee SC et al. Threshold of lower body muscular strength necessary to perform ADL independently in community-dwelling older adults. Clin Rehabil 2008; 22: 902–10.
6. Takata Y, Ansai T, Soh I et al. Physical fitness and cognitive function in an 85-year-old community-dwelling population. Gerontology 2008; 54: 354–60.
7. Giampaoli S, Ferrucci L, Cecchi F et al. Hand-grip strength predicts incident disability in non-disabled older men. Age Ageing 1999; 28: 283–8.
8. Rantanen T, Guralnik JM, Foley D et al. Midlife hand grip strength as a predictor of old age disability. JAMA 1999; 281: 558–60.
9. Ishizaki T, Watanabe S, Suzuki T et al. Predictors for functional decline among nondisabled older Japanese living in a community during a 3-year follow-up. J Am Geriatr Soc 2000; 8: 424–9.
10. Rantanen T, Avlund K, Suominen H et al. Muscle strength as a predictor of onset of ADL dependence in people aged 75 years. Aging Clin Exp Res 2002; 14: 10–5.
11. Al Snih S, Markides KS, Ray L et al. Handgrip strength and mortality in older Mexican Americans. J Am Geriatr Soc 2002; 50: 1250–6.
12. Onder G, Penninx BW, Ferrucci L et al. Measures of physical performance and risk for progressive and catastrophic disability: results from the Women's Health and Aging Study. J Gerontol A Biol Sci Med Sci 2005; 60: 74–9.
13. Rantanen T, Volpato S, Ferrucci L et al. Handgrip strength and cause-specific and total mortality in older disabled women: exploring the mechanism. J Am Geriatr Soc 2003; 51: 636–41.
14. Al Snih S, Markides KS, Ottenbacher KJ et al. Hand grip strength and incident ADL disability in elderly Mexican Americans over a seven-year period. Aging Clin Exp Res 2004; 16: 481–6.
15. Christensen H, Korten AE, Mackinnon AJ et al. Are changes in sensory disability, reaction time, and grip strength associated with changes in memory and crystallized Intelligence? A longitudinal analysis in an elderly community sample. Gerontology 2000; 46: 276–92.
16. Alfaro-Acha A, Al Snih S, Raji MA et al. Handgrip strength and cognitive decline in older Mexican Americans. J Gerontol A Biol Sci Med Sci 2006; 61: 859–65.
17. Buchman AS, Wilson RS, Boyle PA et al. Grip strength and the risk of incident Alzheimer's disease. Neuroepidimiology 2007; 29: 66–73.
18. Bootsma-van der Wiel A, van Exel E, de Craen AJM et al. A high response is not essential to prevent selection bias: results from the Leiden 85-plus Study. J Clin Epidemiol 2002; 55: 1119–25.
19. Kempen GI, Miedema I, Ormel J et al. The assessment of disability with the Groningen Activity Restriction Scale. Conceptual framework and psychometric properties. Soc Sci Med 1996; 43: 1601–10.
20. Guralnik M, Simonsick EM, Ferruci L et al. A short physical performance battery assessing lower extremity function: association with self reported disability and prediction of mortality and nursing home admission. J Gerontol 1994; 49: M85–94.
21. Folstein MF, Folstein SE, McHugh PR. "Mini-Mental State". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975; 12: 189–98.
22. Yesavage JA, Brink TL, Rose TL et al. Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr Res 1982; 17: 37–49.
23. Tombaugh TN, McIntyre NJ. The Mini-Mental State Examination. A comprehensive review. J Am Geriatr Soc 1992; 40: 922–35.
24. van Exel E, de Craen AJ, Remarque EJ et al. Interaction of atherosclerosis and inflammation in elderly subjects with poor cognitive function. Neurology 2003; 61: 1695–701.
25. van Eijk L. Activity and Well-being in the Elderly. The Netherlands: University of Groningen. Thesis.
26. de Jong-Gierveld J, Kamphuis F. The development of a Rasch-type loneliness scale. Appl Psychol Measur 1985; 9: 289–99.
27. Bootsma-van der Wiel A, Gussekloo J, de Craen AJM et al. Common chronic diseases and general impairments as determinants of walking disability in the oldest-old population. J Am Geriatr Soc 2002; 50: 1405–10.

28. Gueorguieva R, Krystal JH. Move over ANOVA: progress in analyzing repeated-measures data and its reflection in papers published in the Archives of General Psychiatry. Arch Gen Psychiatry 2004; 61: 310–7.
29. Liu CJ, Latham NK. Progressive resistance strength training for improving physical function in older adults. Cochrane Database Syst Rev 2009, Issue 3.
30. von Faber M, Bootsma-van der Wiel A, van Exel E et al. Successful aging in the oldest old. Who can be characterized as successfully aged? Arch Intern Med 2001; 161: 2694–700.
31. Drageset J. The importance of activities of daily living and social contact for loneliness: a survey among residents in nursing homes. Scand J Caring Sci 2004; 18: 65–71.
32. Adamson AJ, Collerton J, Davies K et al. Nutrition in advanced age: dietary assessment in the Newcastle 85+ study. Eur J Clin Nutr 2009; 63: S6–18.
33. Collerton J, Barrass K, Bond J et al. The Newcastle 85+ study: biological, clinical and psychosocial factors associated with healthy ageing: study protocol. BMC Geriatr 2007; 7: 14.
34. Vasunilashorn S, Coppin AK, Patel KV et al. Use of the Short Physical Performance Battery Score to predict loss of ability to walk 400 meters: analysis from the in CHIANTI Study. J Gerontol A Biol Sci Med Sci 2009; 64: 223–9.
35. Deshpande N, Metter EJ, Bandinelli S et al. Gait speed under varied challenges and cognitive decline in older persons: a prospective study. Age Ageing 2009; 38: 509–14.

Trends in disability prevalence over 10 years in older people living in Gloucestershire

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Abstract

Introduction: life expectancy in the UK appears to be growing faster than healthy life expectancy, which may imply that there are increasing years of disability. There are few sequential studies examining changes in disability amongst older people within a defined locality.

Methods: the population aged 75 and over of 10 general practices in Gloucestershire was surveyed using a validated postal questionnaire for disability called the Elderly At Risk Rating Scale. Surveys were carried out in 1998 and 2008. Age-adjusted disability prevalences were measured. Care home residents were under-represented in the 1998 survey, and missing data was supplied from a countywide census of care home residents in 2000.

Results: response rates of 81 and 74% were achieved. Reductions in disability prevalence were found for mobility, vision and self-care, but there was no significant change in a measure of self-rated health. Higher rates of independence were found in both genders and across the age range in 2008. The improvements suggested that the latter sample was equivalent to subjects being 3.8 years 'younger' than 10 years before and entering dependency on care 2.1 years later.

Discussion: the prevalence of disability affecting activities of daily living appears to have reduced over 10 years in older people in Gloucestershire. If generalisable, these results provide some optimism for current trends in ageing in England.

Keywords: cohorts, disability, older people, self-rated health

Introduction

In the UK, as in many other developed nations, the population aged over 80 years is growing rapidly: in the last 10 years, there has been a growth of around 20%, and further dramatic rises are expected in the coming decade. Life expectancy has increased by almost 3.2 years for men and 2.2 years for women during this decade, but estimated