Archives of Gerontology and Geriatrics 56 (2013) 160–168

Contents lists available at SciVerse ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

Prevalence and predictors of falls and dizziness in people younger and older than 80 years of age—A longitudinal cohort study

U. Olsson Möller [a,b,*], P. Midlöv [a,c], J. Kristensson [d], C. Ekdahl [d], J. Berglund [e], U. Jakobsson [a,c]

[a] Center for Primary Health Care Research, Faculty of Medicine, Lund University, SE-205 02 Malmö, Sweden
[b] Vårdalinstitutet, The Swedish Institute for Health Sciences, Lund University, P.O. Box 187, SE-221 00 Lund, Sweden
[c] Department of Clinical Sciences in Malmö, Faculty of Medicine, Lund University, SE-205 02 Malmö, Sweden
[d] Department of Health Sciences, Faculty of Medicine, Lund University, P.O. Box 157, SE-221 00 Lund, Sweden
[e] School of Health Science, Blekinge Institute of Technology, SE-371 79 Karlskrona, Sweden

ARTICLE INFO

Article history:
Received 30 May 2012
Received in revised form 21 August 2012
Accepted 23 August 2012
Available online 19 September 2012

Keywords:
Aged
Accidental falls
Dizziness
Longitudinal study
SNAC

ABSTRACT

The objectives were to investigate the prevalence and predictors for falls and dizziness among people younger and older than 80 years of age. The sample was drawn from the Swedish National study on Aging and Care (SNAC) and comprised 973 and 1273 subjects with data on the occurrence of falls and dizziness respectively at baseline. Follow-ups were made after 3- and 6-years. Data included socio-demographics, physical function, health complaints, cognition, quality of life and medications. The prevalence of falls was 16.5% in those under aged 80 and 31.7% in those 80+ years while dizziness was reported by 17.8% and 31.0% respectively. Predictors for falls in those under aged 80 were neuroleptics, dependency in personal activities of daily living (PADL), a history of falling, vision impairment and higher age, and in those 80+ years a history of falling, dependency in instrumental activities of daily living (IADL), fatigue and higher age. Factors predicting dizziness in those under aged 80 were a history of dizziness, feeling nervous and reduced grip strength and in those 80+ years a history of dizziness and of falling. Predictors for falls and dizziness differed according to age. Specific factors were identified in those under aged 80. In those 80+ years more general factors were identified implying the need for a comprehensive investigation to prevent falls. This longitudinal study also showed that falling and dizziness in many older people are persistent and therefore should be treated as chronic conditions.

1. Introduction

One third of older people fall each year and the number of falls increase with age and frailty level (WHO, 2007). Of all falls in older adults 10–20% results in injury, hospitalisation and/or death (Rubenstein, 2006). Many studies have investigated risk factors for falls in older people and as many as 400 have been revealed (NICE, 2004). Longitudinal studies investigating predictors for falls also showed the importance of a variety of factors including a history of falling, gait problems, vertigo and drug use (Deandrea et al., 2010). The large number of risk factors indicates the complexity of the problem and that the risk factors identified differ depending on study design and study population. Common risk factors for falls are more frequent at higher ages and the risk of falling rises with the number of risk factors for falls present. This may imply that the predictors for falls differ in different age cohorts.

In a recent meta-analysis of risk factors for falls in community-dwelling older people, the strongest predictors for falls were found to be a history of falls, gait problems, use of a walking aid, vertigo, Parkinson disease and antiepileptic drug use (Deandrea et al., 2010). Most studies that investigate risk factors for falls include people 65+ years but a few studies have investigated associated factors and predictors for falls in people 80+ years (Iinattiniemi, Jokelainen, & Luukinen, 2009; Grundstrom, Guse, & Layde, 2012). A study in 555 people 85+ years showed history of recurrent falls, poor vision, antipsychotic drugs and feelings of anxiety, nervousness or fear to be independent risk factors for falls (Iinattiniemi et al., 2009). Another study comparing risk factors for falls in people younger and older than 85+ years revealed that even though many risk factors for falls were similar between the groups, higher age as well as male gender and general health status were more strongly associated with an increased fall risk in those 85 years and older (Grundstrom et al., 2012). Those differences might indicate that predictors of falls differ according to age but, to our knowledge, no study has investigated predictors for falls in

* Corresponding author at: Center for Primary Health Care Research, Faculty of Medicine, Lund University, SE-205 02 Malmö, Sweden. Tel.: +46 46 222 1833; fax: +46 46 222 1934.
E-mail address: ulrika.olsson_moller@med.lu.se (U. Olsson Möller).

0167-4943/$ – see front matter © 2012 Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.archger.2012.08.013

different age cohorts. This knowledge might reveal specific age-related predictors, which could be useful when screening for people at risk for subsequent falls and when designing fall preventive interventions for people of various ages.

The strategy for preventing falls is elimination of the risk factors for falls. Dizziness is a known risk factor for falls (Deandrea et al., 2010) and predictors for dizziness are indirect predictors for falls. Various studies report the prevalence of dizziness in older people as being between 11 and 31% with an increase with age (Gassman & Rupprecht, 2009; Stevens, Lang, Guralnik, & Melzer, 2008; Tinetti, Speechley, & Ginter, 2000a). The most common major contributory causes of dizziness in elderly (65+ years) patients were cardiovascular disease, peripheral vestibular disease and psychiatric illness (Maarsingh et al., 2010) and although falls may be the most disabling consequence of dizziness (Mendel, Bergenius, & Langius-Eklöf, 2010) it is also associated with poor self-related health (Gassman & Rupprecht, 2009) and reduced quality of life (Ekwall, Lindberg, & Magnusson, 2009), indicating the importance of prevention. A prospective cohort study in 620 people 65+ years showed higher age, female gender, comorbidity, polypharmacy, poor subjective health status, falls and mobility problems to be predictors of dizziness (Gassman & Rupprecht, 2009). To our knowledge no study has investigated predictors for dizziness stratified by age and this knowledge may identify age-specific factors that ought to be eliminated to prevent dizziness and thereby falls. The objectives of this study were to investigate the prevalence and predictors for falls and dizziness among people younger and older than 80 years of age in a longitudinal cohort study with 3- and 6-year follow-ups.

2. Methods

2.1. Sample

The sample was drawn from the SNAC, a national, longitudinal, multidisciplinary study involving four research centers (Lagergren et al., 2004). The present study used data from the sub-study of the County of Blekinge (SNAC-B) with baseline data collection in 2001–2003 on 1402 people 60–96 years of age. SNAC-B focused on one municipality with approximately 60 000 inhabitants, located in the south-eastern part of Sweden including both urban and rural areas. The four youngest age cohorts (60, 66, 72 and 78 years old), i.e. those under aged 80 were selected, using computer-based randomization, monthly from the Swedish Population database (Statistics Sweden). The older age cohorts (81, 84, 87, 90, 93 and 96 years old), i.e. those 80+ years, included the entire population (Halling & Berglund, 2006). At baseline 973 subjects were interviewed by means of self-reported falls in the past year and 1273 subjects by means of self-reported dizziness in the past three months and where included in the present study. These samples were then divided in subjects under age 80 and 80+ years (Fig. 1).

There were two follow-ups, the first after three years on subjects aged 80+ years at baseline. This sample included 237 and 224 subjects with valid data at baseline on falls and dizziness respectively (Fig. 1). The subjects who dropped out before the first follow-up interview were significantly older in both groups ($p < 0.001$) and significantly more of female gender in the dizziness group ($p = 0.009$). The second follow-up after six years included subjects included all at baseline and comprised 616 subjects with valid baseline data on falls; 441 subjects under aged 80 and 175 subjects 80+ years, and 677 subjects with valid baseline data on dizziness; 531 subjects under aged 80 and 146 subjects 80+ years (Fig. 1). The subjects who dropped out before the second follow-up interview were significantly older in both groups ($p < 0.001$) but with no gender differences.

2.2. Data collection

At baseline the selected subjects were invited by mail to take part in the study. If there was no response, they were given one more invitation by telephone and if participation was refused the reason was registered. The enrolled subjects who were unable to come to the research center were offered an examination in their homes. The subjects included were examined medically and cognitively, and were asked survey questions by the research team (physicians and nurses) in two sessions each lasting about 3 h. After the first session, a new visit to the research center was booked and a questionnaire was filled in by the subjects during the time period between the two sessions. The subjects were offered help filling in the questionnaires if needed, and the research team was accessible during office hours. The same procedure was used at both follow-ups, where the enrolled subjects were contacted 3

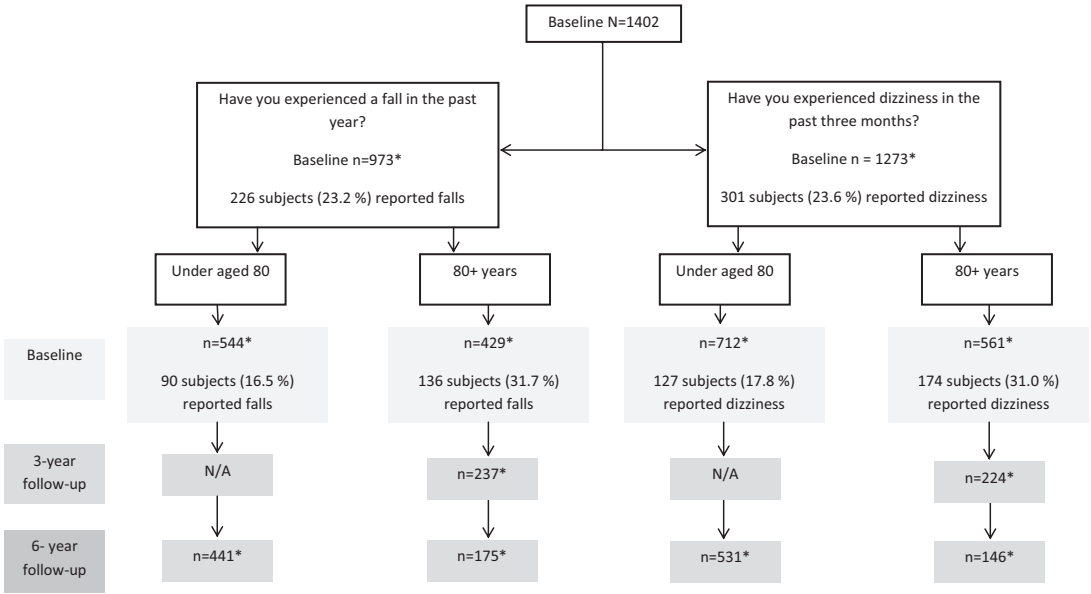

Fig. 1. Flowchart with falls and dizziness prevalence rates at baseline. *Item response rate.

and 6 years (±three months) after inclusion in the study. The Regional Ethics Review Board in Lund approved the study (LU 605-00, LU 744-00) and written consent was obtained from all enrolled subjects.

2.3. Questionnaires and measures

Known risk factors and potential predictors for falls and dizziness (Deandrea et al., 2010; Gassman & Rupprecht, 2009; Gassmann, Rupprecht, & Freiberger, 2009; NICE, 2004; Rubenstein, 2006; Tinetti, Speechley, et al., 2000) that were available in the original SNAC-B study at baseline were used in the present study. This study included data on socio-demographic variables, physical function, self-reported health complaints, cognition, health-related quality of life (HRQoL) and medication.

2.3.1. Socio-demographic variables

Demographic data included age, sex and living conditions, with subjects divided into those who lived in ordinary housing (community-dwelling) and those who lived in special accommodation (nursing homes, modified facilities with staff on call or around the clock).

2.3.2. Physical function

Activities of daily living (ADL) were assessed using questions that directly corresponded to the ADL staircase (Sonn & Åsberg, 1991). The item on continence was excluded in this study (Sonn & Åsberg, 1991). The ADL staircase assesses dependence/independence in daily living and comprises five PADL: bathing; dressing; going to the toilet; transfer; feeding and four IADL: cleaning; shopping; transportation and cooking. The response alternatives were dichotomized (*can* or *cannot*) according to Sonn & Åsberg (1991). Subjects with a score of 0 were defined as independent. The maximum total score was 0–9, with 0–5 in the PADL subscale and 0–4 in the IADL subscale used in the analyses.

The Romberg test was performed by standing with feet together and arms along the side of the body with eyes open (EO) and eyes closed (EC) (*can* or *cannot*). Grip strength was measured using Grippit ® (Nordenskiöld & Grimby, 1993), where the force in newton (N) from 0 to 999 N is registered. In the present study the maximum strength in the right hand was used.

2.3.3. Self-reported health complaints

In this study the number of falls was measured by means of self-reported falls in the past year (0, 1, 2, 3, 4, >4 falls) and the subjects were divided in two groups; no falls (0) or falls (≥1). Dizziness was reported through a single-item question; "Have you experienced dizziness in the last three months?" (*yes* or *no*). Dizziness in this study is used as an umbrella term and may also include other sensations such as vertigo, disequilibrium, or presyncope. The sample was divided into two groups based on whether or not dizziness occurred. Health status included the self-reported presence of balance impairment, fatigue, sleeping problems, poor appetite or feeling nervous in the last three months (*yes* or *no*). Fear

Table 1
Baseline characteristics of subjects older than 80 years of age with falls (F) or no falls (NF) at the 3-year follow-up.

	80+ years (n = 237)		
	F n = 88	NF n = 149	p-Value
Socio-demographic variables			
Age, mean (SD)	85.7 (3.9)	83.8 (3.1)	**<0.001**[a]
Gender, female, n (%)	52 (59.1)	87 (58.4)	0.916[b]
Community-dwelling, n (%)	83 (96.5)[c]	140 (94.6)[c]	0.750[b]
Functional capacity			
PADL dependency, n (%)	9 (10.2)	11 (7.4)	0.447[b]
IADL dependency, n (%)	46 (52.3)	41 (27.7)[c]	**<0.001**[b]
Romberg test (EO), pos, n (%)	11 (15.1)[e]	11 (7.8)[c]	0.097[b]
Romberg test (EC), pos, n (%)	32 (44.4)[e]	40 (28.8)[c]	**0.023**[b]
Grip strength, right, mean (SD)	191 (97)[e]	210 (100)[d]	0.183[a]
Self-reported health problems			
History of fall, n (%)	32 (36.4)	32 (21.5)	**0.013**[b]
Dizziness, n (%)	25 (29.4)[c]	32 (21.6)[c]	0.183[b]
Fear of falling, n (%)	36 (42.9)[c]	37 (25.2)[c]	**0.005**[b]
Self-reported balance impairment, n (%)	39 (47.0)[c]	46 (31.7)[c]	**0.022**[b]
Fatigue, n (%)	58 (67.4)[c]	70 (47.6)[c]	**0.003**[b]
Sleeping problems, n (%)	39 (45.9)[c]	51 (34.5)[c]	0.085[b]
Poor appetite, n (%)	15 (18.1)[c]	18 (12.2)[c]	0.226[b]
Feeling nervous, n (%)	20 (24.4)[c]	29 (19.7)[c]	0.409[b]
Hearing impairment, n (%)	51 (58.0)	63 (42.3)	**0.020**[b]
Vision impairment, n (%)	50 (56.8)	55 (36.9)	**0.003**[b]
Cognition and HRQoL			
MMSE ≤24, n (%) 1.1	27 (31.0)[c]	31 (20.8)	0.078[b]
SF 12 (PCS), mean (SD)	34.9 (10.6)[d]	42.9 (11.4)[d]	**<0.001**[a]
SF 12 (MCS), mean (SD)	51.1 (9.5)[d]	54.9 (7.5)[d]	**0.004**[a]
Medications			
Neuroleptics, n (%)	4 (4.5)	1 (0.7)	0.065[b]
Sedatives, n (%)	9 (10.2)	16 (10.7)	0.902[b]
Hypnotics, n (%)	26 (29.5)	22 (14.8)	**0.006**[b]
Benzodiazepines, n (%)	21 (23.9)	19 (12.8)	**0.027**[b]
Medium- and long-acting benzodiazepines, n (%)	19 (21.6)	11 (7.4)	**0.001**[b]
SSRI, n (%)	4 (4.5)	6 (4.0)	1.000[b]

Bold values indicates statically significant p-value ≤ 0.05.
SD = standard deviation.
[a] Student's t-test.
[b] Chi^2-test.
[c] Missing value: 0.7–6.8%.
[d] Missing value: 9.4–12.5%.
[e] Missing value: 17.0–21.6%.

of falling was measured using a single-item questions; "Are you afraid of falling when outdoors?" (*yes* or *no*). Hearing and vision was self-rated with a single item; "Do you have problems with your hearing/vision?" (*yes* or *no).*

2.3.4. Cognition and HRQoL

Cognitive impairment was measured using the Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975). The maximum total score is 30 points. The sample in the present study was divided into two groups with ≤24 as the limit. HRQoL was assessed using the 12-item Short-form Health Survey (SF 12) (Ware, Kosinski, & Keller, 1996). The questionnaire consists of two sub-scores; a Physical Component Summary Scale (PCS) and a Mental Component Summary Scale (MCS) and were scored and transformed according to the Swedish manual (Sullivan, Karlsson, & Taft, 1997), where a higher score indicates a higher level of HRQoL.

2.3.5. Medication

The subjects were asked to bring their medication and/or a prescription list to the medical examination. Medication use was classified according to the Anatomical Therapeutic Chemical (ATC) classification system (WHO, 2000). The medication groups included in this study are medications known to increase the risk factor for falls and dizziness (Leipzig, Cumming, & Tinetti, 1999; Tinetti, Speechley, et al., 2000), i.e. neuroleptics (N05A), sedatives (N05B), hypnotics (N05C), and selective serotonin reuptake inhibitor (SSRI) (N06AB). Benzodiazepine included both N05BA and N05CD with a subgroup of medium- and long-acting benzodiazepines. The medium-acting benzodiazepines prescribed in Sweden are nitrazepam (N05CD02) and flunitrazepam (N05CD03) whereas diazepam (N05BA01) is the only long-acting benzodiazepine. The data were dichotomized as *yes, taking the medication* or *no, not taking the medication.*

2.4. Statistical analysis

Prevalence rates of the total sample at baseline as well as in different age groups were calculated. Bivariate analyses with independent variables at baseline and data on the occurrence of falls and dizziness at the two follow-ups as dependent variables were made to explore differences between fallers and non-fallers and dizzy and non-dizzy subjects. The Pearson chi-square test for nominal data and Student's *t*-test for interval data were used for group comparisons. A *p*-value ≤0.05 was considered statistically significant. To identify predictors for falls and dizziness the significant variables from the bivariate analyses at baseline were included as independent variables in multiple logistic regression analyses (manual backward), with data on the occurrence of falls and dizziness at the two follow-ups as dependent variables. Crude odds ratios (ORs) were calculated for the identified predictors. Analyses for multicollinearity were tested with Variance inflation factor and tolerance. The Hosmer and Lemeshow goodness-of-fit test and Nagelkerke R^2 test were used as measures of the quality of

Table 2
Baseline characteristics of subjects younger and older than 80 years of age with F or NF at the 6-years follow-up.

	Under aged 80 (*n* = 441)			80+ years (*n* = 175)		
	F *n* = 81	NF *n* = 360	*p*-Value	F *n* = 75	NF *n* = 100	*p*-Value
Socio-demographic variables						
Age, mean (SD)	69.8 (6.1)	67.3 (6.4)	**<0.001**[a]	84.4 (3.3)	84.0 (3.4)	0.395[a]
Gender, female, *n* (%)	47 (58.0)	187 (51.9)	0.310[b]	51 (68.0)	57 (57.0)	0.160[b]
Community-dwelling, *n* (%)	81 (100.0)	358 (100.0)[c]	N/A[b]	73 (98.6)[c]	98 (98.)0	1.000[b]
Functional capacity						
PADL dependency, *n* (%)	4 (5.0)[c]	2 (0.6)[c]	**0.012**[b]	6 (8.1)[d]	3 (3.0)	0.174[b]
IADL dependency, *n* (%)	10 (12.5)[c]	14 (3.9)	**0.005**[b]	35 (46.7)	20 (20.0)	**<0.001**[b]
Romberg test (EO), pos, *n* (%)	1 (1.3)[c]	2 (0.6)[c]	0.458[b]	5 (7.1)[d]	9 (9.7)[d]	0.554[b]
Romberg test (EC), pos, *n* (%)	5 (6.3)[c]	18 (5.1)[c]	0.591[b]	24 (36.4)[e]	24 (26.4)[d]	0.195[b]
Grip strength, right, mean (SD)	255(112)[c]	299 (120)[c]	**0.003**[a]	194 (89)[e]	215 (102)[d]	0.166[a]
Self-reported health problems						
History of fall, *n* (%)	23 (28.4)	41 (11.4)	**<0.001**[b]	30 (40.0)	14 (14.0)	**<0.001**[b]
Dizziness, *n* (%)	21 (25.9)	47 (13.2)[c]	**0.004**[b]	19 (26.0)[c]	18 (18.2)[c]	0.229[b]
Fear of falling, *n* (%)	17 (21.0)	36 (10.1)[c]	**0.006**[b]	23 (31.5)[c]	27 (27.0)	0.546[b]
Self-reported balance impairment, *n* (%)	17 (21.0)	33 (9.2)[c]	**0.003**[b]	35 (47.9)[c]	23 (24.2)[c]	**0.002**[b]
Fatigue, *n* (%)	38 (46.9)	153 (43.2)[c]	0.532[b]	49 (66.2)[c]	43 (43.4)[c]	**0.004**[b]
Sleeping problems, *n* (%)	29 (35.8)	100 (28.1)[c]	0.165[b]	35 (47.3)[c]	35 (35.0)	0.113[b]
Poor appetite, *n* (%)	5 (6.2)	15 (4.2)[c]	0.392[b]	7 (9.7)[c]	14 (14.1)[c]	0.372[b]
Feeling nervous, *n* (%)	15 (18.5)	54 (15.3)[c]	0.468[b]	21 (29.2)[c]	18 (18.4)[c]	0.105[b]
Hearing impairment, *n* (%)	32 (40.0)[c]	97 (27.1)	**0.023**[b]	39 (52.0)	45 (45.0)	0.323[b]
Vision impairment, *n* (%)	28 (35.0)[c]	57 (15.8)	**<0.001**[b]	36 (48.0)	39 (39.0)	0.256[b]
Cognition and HRQoL						
MMSE ≤24, *n* (%)	5 (6.2)	21 (5.8)	0.799[b]	17 (22.7)	27 (27.0)	0.489[b]
SF 12 (PCS), mean (SD)	43.8 (11.4)[d]	47.0 (9.4)[c]	**0.022**[a]	37.7 (12.0)[e]	42.4 (11.4)[e]	**0.015**[a]
SF 12 (MCS), mean (SD)	54.1 (9.8)[d]	55.9 (7.2)[c]	0.141[a]	52.5 (9.0)[e]	54.4 (8.3)[e]	0.166[a]
Medications						
Neuroleptics, *n* (%)	3 (3.7)	2 (0.6)	**0.045**[b]	2 (2.7)	1 (1.0)	0.578[b]
Sedatives, *n* (%)	8 (9.9)	9 (2.5)	**0.005**[b]	8 (10.7)	6 (6.0)	0.269[b]
Hypnotics, *n* (%)	9 (11.1)	24 (6.7)	0.167[b]	14 (18.7)	15 (15.0)	0.538[b]
Benzodiazepines, *n* (%)	9 (11.1)	18 (5.0)	0.067[b]	13 (17.3)	13 (13.0)	0.441[b]
Medium- and long-acting benzodiazepines, *n* (%)	6 (7.4)	15 (4.2)	0.244[b]	7 (9.3)	10 (10.0)	0.866[b]
SSRI, *n* (%)	4 (4.9)	11 (3.1)	0.493[b]	4 (5.3)	2 (2.0)	0.405[b]

Bold values indicates statically significant *p*-value ≤ 0.05.
[a] Student's *t*-test.
[b] Chi^2-test.
[c] Missing value: 0.5–1.9 (0.5-5%).
[d] Missing value: 6.7–9.3%.
[e] Missing value: 12.0–14.0%.

the regression models. The statistical analyses were performed using SPSS 17.0 (Chicago, IL, USA).

3. Results

3.1. Prevalence of falls and associated factors

At baseline a total of 23.2% of subjects reported falls, those under aged 80 reported a prevalence of 16.5% and those 80+ years 31.7% (Fig. 1). Many of the baseline variables were significantly associated in the expected direction and with higher prevalence rates in those 80+ years except dizziness that showed the same prevalence rate in younger and older fallers, i.e. 26% (Table 2).

In those under aged 80 a fall was significantly associated with higher age, ADL dependency, reduced grip strength, a history of falling and dizziness, fear of falling, balance, hearing and vision impairment and reduced physical HRQoL in the expected direction (Table 2). Significant differences between the groups regarding medication were seen in neuroleptics and sedatives (Table 2).

In those 80+ years a fall was at the 3-year follow-up significantly associated with higher age, IADL dependency, Romberg test EC, a history of falling, fear of falling, balance impairment, fatigue, hearing and vision impairment and reduced HRQoL (Table 1). A statistically significant difference was also seen in hypnotics, all benzodiazepines and medium- and long acting benzodiazepines (Table 1). At the 6-year follow-up (Table 2) IADL dependency, a history of falling, balance impairment, fatigue and reduced physical HRQoL was associated with a higher risk for falling.

3.2. Prevalence of dizziness and associated factors

At baseline 23.6% of subjects reported dizziness, 17.8% in those under aged 80 and 31.0% in those 80+ years (Fig. 1). The independent factors showed a higher prevalence rate in the older age group except sleeping problems with 47% in the younger age group compared with 41% in the older (Table 4). Variables significantly associated with dizziness in those under aged 80 were higher age, female gender, reduced grip strength, a history of falling or dizziness, fear of falling, balance impairment, fatigue, sleeping problems, poor appetite, feeling nervous, vision impairment, reduced HRQoL, hypnotics, all benzodiazepines and medium- and long acting benzodiazepines (Table 4). In those 80+ years significant associations in the expected direction at the 3-year follow-up were seen in gender, IADL dependency, reduced grip strength, a history of falling or dizziness, fear of falling, balance impairment, fatigue and reduced physical HRQoL (Table 3). At the 6-year follow-up IADL dependency, a history of falling or dizziness, balance impairment, fatigue, feeling nervous and reduced HRQoL

Table 3
Baseline characteristics of subjects older than 80 years of age with and without dizziness at the 3-year follow-up.

	80+ years ($n=224$)		
	Yes $n=80$	No $n=144$	p-Value
Socio-demographic variables			
Age, mean (SD)	84.3 (2.5)	83.7 (3.2)	0.126[a]
Gender, female, *n* (%)	52 (65.0)	74 (51.4)	**0.049**[b]
Community-dwelling, *n* (%)	78 (100.0)[c]	144 (100.0)	N/A[b]
Functional capacity			
PADL dependency, *n* (%)	5 (6.3)	3 (2.1)[c]	0.139[b]
IADL dependency, *n* (%)	31 (38.8)	30 (20.8)	**0.004**[b]
Romberg test (EO), pos, *n* (%)	5 (7.2)[e]	9 (7.0)[d]	1.000[b]
Romberg test (EC), pos, *n* (%)	22 (32.4)[e]	40 (31.5)[d]	0.903[b]
Grip strength, right, mean (SD)	191 (78)[e]	222 (101)[d]	**0.018**[a]
Self-reported health problems			
History of fall, *n* (%)	22 (41.5)[g]	18 (16.2)[f]	**<0.001**[b]
Dizziness, *n* (%)	45 (56.3)	12 (8.3)	**<0.001**[b]
Fear of falling, *n* (%)	34 (43.0)[c]	32 (22.9)[c]	**0.002**[b]
Self-reported balance impairment, *n* (%)	48 (61.5)[c]	34 (24.6)[c]	**<0.001**[b]
Fatigue, *n* (%)	54 (67.5)	72 (50.0)	**0.011**[b]
Sleeping problems, *n* (%)	37 (47.4)[c]	52 (36.1)	0.100[b]
Poor appetite, *n* (%)	10 (12.8)[c]	15 (10.4)	0.589[b]
Feeling nervous, *n* (%)	22 (27.8)[c]	24 (16.8)[c]	0.051[b]
Hearing impairment, *n* (%)	43 (53.8)	65 (45.1)	0.217[b]
Vision impairment, *n* (%)	41 (51.3)	55 (38.2)	0.059[b]
Cognition and HRQoL			
MMSE ≤24, *n* (%)	13 (16.3)	20 (13.9)	0.633[b]
SF 12 (PCS), mean (SD)	38.3 (10.9)[e]	42.0 (10.8)[d]	**0.023**[a]
SF 12 (MCS), mean (SD)	53.0 (10.1)[e]	54.5 (8.1)[d]	0.264[a]
Medications			
Neuroleptics, *n* (%)	2 (2.5)	1 (0.7)	0.291[b]
Sedatives, *n* (%)	5 (6.3)	11 (7.6)	0.699[b]
Hypnotics, *n* (%)	16 (20.0)	22 (15.3)	0.367[b]
Benzodiazepines, *n* (%)	10 (12.5)	20 (13.9)	0.770[b]
Medium- and long-acting Benzodiazepines, *n* (%)	9 (11.3)	14 (9.7)	0.718[b]
SSRI, *n* (%)	2 (2.5)	4 (2.8)	1.000[b]

Bold values indicates statically significant p-value ≤ 0.05.
[a] Student's t-test.
[b] Chi^2-test.
[c] Missing value: 0.7–4.2%.
[d] Missing value: 6.9–11.8%.
[e] Missing value:13.8–17.5%.
[f] Missing value: 22.9%.
[g] Missing value: 33.8%.

Table 4
Baseline characteristics of subjects younger and older than 80 years of age with or without dizziness at the 6-year follow-up.

	Under aged 80 ($n=531$)			80+ years ($n=146$)		
	Yes $n=114$	No $n=417$	p-Value	Yes $n=58$	No $n=88$	p-Value
Socio-demographic variables						
Age, mean (SD)	69.4 (6.3)	67.0 (6.2)	**<0.001**[a]	83.2 (2.5)	83.2 (2.6)	0.985[a]
Gender, female, *n* (%)	84 (73.7)	213 (51.1)	**<0.001**[b]	40 (69.0)	48 (54.5)	0.081[b]
Community-dwelling, *n* (%)	112 (100.0)[c]	415 (100.0)[c]	N/A[b]	57 (98.3)	87 (100.0)[c]	0.400[b]
Functional capacity						
PADL dependency, *n* (%)	3 (2.7)[c]	4 (1.0)[c]	0.172[b]	2 (3.4)	1 (1.1)	0.563[b]
IADL dependency, *n* (%)	4 (3.5)	18 (4.3)	1.000[b]	15 (25.9)	10 (11.4)	**0.023**[b]
Romberg test (EO), pos, *n* (%)	0 (0.0)	4 (1.0)[c]	0.587[b]	4 (7.8)[d]	4 (5.1)[d]	0.711[b]
Romberg test (EC), pos, *n* (%)	8 (8.0)[d]	29 (7.4)[c]	0.839[b]	13 (26.5)[d]	19 (24.1)[d]	0.753[b]
Grip strength, right, mean (SD)	224 (97)[c]	303 (116)[c]	**<0.001**[a]	201 (89)[c]	223 (103)[c]	0.200[a]
Self-reported health problems						
History of fall, *n* (%)	19 (23.5)[f]	38 (11.5)[e]	**0.005**[b]	13 (32.5)[f]	7 (10.4)[e]	**0.005**[b]
Dizziness, *n* (%)	46 (40.4)	40 (9.6)	**<0.001**[b]	25 (43.1)	10 (11.4)	**<0.001**[b]
Fear of falling, *n* (%)	29 (25.4)	37 (8.9)[c]	**<0.001**[b]	20 (35.1)[c]	20 (22.7)	0.104[b]
Self-reported balance impairment, *n* (%)	32 (29.1)[c]	34 (8.3)[c]	**<0.001**[b]	24 (42.9)[c]	21 (24.7)[c]	**0.024**[b]
Fatigue, *n* (%)	69 (61.1)[c]	158 (38.1)[c]	**<0.001**[b]	37 (63.8)	37 (42.0)	**0.010**[b]
Sleeping problems, *n* (%)	53 (46.9)[c]	100 (24.0)	**<0.001**[b]	24 (41.4)	31 (35.2)	0.453[b]
Poor appetite, *n* (%)	14 (12.4)[c]	15 (3.6)	**<0.001**[b]	10 (17.5)[c]	9 (10.2)	0.202[b]
Feeling nervous, *n* (%)	31 (27.9)[c]	48 (11.6)[c]	**<0.001**[b]	19 (32.8)	11 (12.5)	**0.003**[b]
Hearing impairment, *n* (%)	41 (36.0)	123 (29.6)[c]	0.190[b]	30 (51.7)	36 (40.9)	0.199[b]
Vision impairment, *n* (%)	35 (30.7)	87 (20.9)[c]	**0.028**[b]	28 (48.3)	37 (42.0)	0.459[b]
Cognition and HRQoL						
MMSE ≤24, *n* (%)	5 (4.4)	20 (4.8)	0.855[b]	7 (12.1)	10 (11.4)	0.897[b]
SF 12 (PCS), mean (SD)	42.0 (10.4)[c]	47.9 (9.1)[c]	**<0.001**[a]	38.1 (12.2)[d]	43.7 (10.3)[d]	**0.005**[a]
SF 12 (MCS), mean (SD)	53.8 (9.5)[c]	56.5 (6.8)[c]	**0.005**[a]	52.4 (10.2)[d]	55.7 (7.9)[d]	**0.035**[a]
Medications						
Neuroleptics, *n* (%)	2 (1.8)	3 (0.7)	0.293[b]	1 (1.7)	1 (1.1)	1.000[b]
Sedatives, *n* (%)	8 (7.0)	14 (3.4)	0.108[b]	3 (5.2)	4 (4.5)	1.000[b]
Hypnotics, *n* (%)	15 (13.2)	19 (4.6)	**0.001**[b]	9 (15.5)	14 (15.9)	0.949[b]
Benzodiazepines, *n* (%)	13 (11.4)	17 (4.1)	**0.003**[b]	6 (10.3)	11 (12.5)	0.691[b]
Medium- and long-acting benzodiazepines, *n* (%)	11 (9.6)	12 (2.9)	**0.004**[b]	4 (6.9)	8 (9.1)	0.764[b]
SSRI, *n* (%)	7 (6.1)	10 (2.4)	0.066[b]	3 (5.2)	3 (3.4)	0.682[b]

Bold values indicates statically significant p-value ≤ 0.05.
[a] Student's t-test.
[b] Chi^2-test.
[c] Missing value: 0.2–6.0%.
[d] Missing value: 7.9–15.5%.
[e] Missing value: 20.6–23.9%.
[f] Missing value: 28.9–31.0%.

were associated with a higher risk of falling (Table 4). There was no significant difference in the older age group between those with and without dizziness regarding any of the medications used (Tables 3 and 4).

3.3. Predictors of falls

The predictors of falls are shown in Table 5. The multivariate logistic regression showed significant ORs with regard to the

Table 5
Predictors of falls in subjects younger and older than 80 years of age in the 3 and 6-year follow-ups.

Final model	OR[a,b,c]	95% CI for OR	p-Value	Crude OR	95% CI for crude OR	p-Value for crude OR
Under aged 80						
6-year follow-up ($n=438$)						
Neuroleptics	10.82	1.62–72.15	**0.014**	6.88	1.13–41.90	**0.036**
PADL dependency	6.58	1.00–43.18	**0.050**	9.37	1.68–52.08	**0.011**
History of falling	2.63	1.42–4.89	**0.002**	3.08	1.72–5.52	**<0.001**
Vision impairment	2.29	1.28–4.09	**0.005**	2.86	1.67–4.91	**<0.001**
Higher age	1.05	1.01–1.09	**0.022**	1.07	1.03–1.11	**<0.001**
80+years						
3-year follow-up ($n=233$)						
History of falling	2.05	1.10–3.82	**0.024**	2.09	1.16–3.75	**0.013**
Fatigue	2.00	1.12–3.58	**0.019**	0.44	0.25–0.26	**0.004**
Higher age	1.16	1.07–1.26	**<0.001**	0.00	1.07–1.26	**<0.001**
6-year follow-up ($n=174$)						
History of falling	3.18	1.49–6.80	**0.003**	4.10	1.97–8.50	**<0.001**
IADL dependency	2.72	1.35–5.47	**0.005**	3.50	1.80–6.82	**<0.001**

Bold values indicates statically significant p-value ≤ 0.05.
Dependent variable (falls) coded as: 0 = no falls, 1 = falls.
[a] Hosmer and Lemeshow goodness-of-fit test: under aged 80 $p=0.886$, 80+ years 3-years $p=0.420$ 6-years $p=0.406$.
[b] Nagelkerke R^2: under aged 80 0.138, 80+ years 3-years 0.153 6-years 0.167.
[c] Variables at baseline entered into the regression analysis (manual backward): 3-year: age, IADL, Romberg EC, history of fall, fear of falling, self-reported balance impairment, fatigue, hearing, vision, hypnotics. 6-year: under aged 80: age, IADL, grip strength, history of fall, dizziness, fear of falling, self-reported balance impairment, hearing, vision, neuroleptics, sedatives. 80+ years: IADL, history of fall, self-reported balance impairment, fatigue.

Table 6
Predictors of dizziness in subjects younger and older than 80 years of age in the 3- and 6-year follow-ups.

Final model	OR[a,b,c]	95% CI for OR	*p*-Value	Crude OR	95% CI for crude OR	*p*-Value for crude OR
Under aged 80						
6-year follow-up ($n = 513$)						
History of dizziness	4.74	2.76–8.14	**<0.001**	6.38	3.88–10.47	**<0.001**
Feeling nervous	2.41	1.37–4.25	**0.002**	2.96	1.77–4.93	**<0.001**
Reduced grip strength	0.99	0.99–1.00	**<0.001**	0.99	0.99–1.00	**<0.001**
80+ years						
3-year follow-up ($n = 164$)						
History of dizziness	18.15	6.88–47.90	**<0.001**	14.14	6.76–29.58	**<0.001**
History of falling	3.74	1.55–9.03	**0.003**	3.67	1.74–7–71	**0.001**
6-year follow-up ($n = 107$)						
History of dizziness	5.42	1.90–15.47	**0.002**	5.91	2.55–13.67	**<0.001**
History of falling	4.40	1.50–12.92	**0.007**	4.13	1.48–11.50	**0.007**

Bold values indicates statically significant p-value ≤ 0.05.
Dependent variable (dizziness) coded as: no = 0, yes = 1.
[a] Hosmer and Lemeshow goodness-of-fit test: 3-year 0.414, 6-year; under aged 80, $p = 0.927$; 80+ years, $p = 0.814$.
[b] Nagelkerke R^2; 3-year 0.404, 6-year; under aged 80 0.231, 80+ years 0.217.
[c] Variables at baseline for subjects younger and older than 80 years entered into the regression analysis (manual backward): 3-year: gender, IADL, grip strength, history of fall, dizziness, fear of falling, self-reported balance impairment, fatigue. 6-year; under aged 80: age, gender, grip strength, history of fall, dizziness, fear of falling, self-reported balance impairment, fatigue, sleeping problems, poor appetite, feeling nervous, vision, hypnotics, 80+ years: IADL, history of fall, dizziness, self-reported balance impairment, fatigue, feeling nervous.

following variables for those under aged 80: neuroleptics (OR = 10.82, 95% confidence interval (CI) = 1.62–72.15), PADL dependency (OR = 6.58, 95% CI = 1.00–43.18), a history of falling (OR = 2.63, 95% CI = 1.42–4.89), vision impairment (OR = 2.29, 95% CI = 1.28–4.09) and higher age (OR = 1.05, 95% CI = 1.01–1.09). For those 80+ years the strongest predictors at the 3-year follow-up were a history of falling (OR = 2.05, 95% CI = 1.10–3.82), fatigue (OR = 2.00, 95% CI = 1.12–3.58) and higher age (1.16, 95% CI = 1.07–1.26) and at the 6-year follow-up a history of falling (OR = 3.18, 95% CI = 1.49–6.80) and IADL dependency (OR = 2.72, 95% CI = 1.35–5.47) (Table 5).

3.4. Predictors of dizziness

The predictors of dizziness are shown in Table 6. The variables predicting dizziness with significant ORs in those under aged 80 were a history of dizziness (OR = 4.74, 95% CI = 2.76–8.14), feeling nervous (OR = 2.41, 95% CI = 1.37–4.25) and reduced grip strength (OR = 0.99, 95% CI = 0.99–1.00) (Table 6). In those 80+ years at the 3-year follow-up a history of dizziness (OR = 18.15, 95% CI = 6.88–47.90) and falling (OR = 3.74, 95% CI = 1.55–9.03) were able to predict dizziness and the same predictors were shown at the 6-year follow-up; a history of dizziness (OR = 5.42, 95% CI = 1.90–15.47) and falling (OR = 4.40, 95% CI = 1.50–12.92) (Table 6).

4. Discussion

Approximately 23% of subjects experienced falls or dizziness with an almost doubled prevalence rate the older age cohort compared to the younger (Fig. 1). The high prevalence of associated factors showed that people that fall or have dizziness are strongly affected, signifying the importance of preventive interventions. A history of falling and dizziness were predictors in people with falls and dizziness respectively, in both those under and above 80 years of age, indicating that these conditions may be persistent and difficult to treat.

The prevalence of falls (Fig. 1) was slightly lower than the expected one-third of older people yearly experiencing a fall (WHO, 2007) but clearly showed an increase with age. The present study was in line with a study by Gassman and Rupprecht (2009) that showed a prevalence of about 15% in those under aged 80, 23% in 80–89 year olds and 45% in those 90+ years. The prevalence of dizziness (Fig. 1) was within the span of previously reported prevalence rates (Gassman & Rupprecht, 2009; Stevens et al., 2008; Tinetti, Speechley, et al., 2000). This study clearly showed that the prevalence increased with age and with one third of those 80+ years being affected the importance of early identification and intervention for older people with falls and dizziness is evident.

As in other studies (Deandrea et al., 2010; Ekwall et al., 2009; Gassman & Rupprecht, 2009; Gassmann et al., 2009; Maarsingh et al., 2010; Tinetti, Speechley, et al., 2000) falls and dizziness were significantly associated with a variety of factors, some of which might be seen as risk factors, such as reduced functional capacity, while others may be seen as consequences such as fear of falling and lower HRQoL (Tables 1–4). As expected, those affected and those 80+ years had a higher prevalence in associated factors. Fatigue showed the highest prevalence rate (47–67%) in people with falls or dizziness and differed significantly from those not affected in all age groups except in fallers under aged 80. In a study in people aged 65+ years (Vestergaard et al., 2009) fatigue was associated with poorer physical function and disability and fatigue, and the present study indicates that fatigue is closely connected to both falls and dizziness.

Different predictors for falls in people younger and older than 80 years of age were revealed in this study. In those under aged 80 neuroleptics, PADL dependency, a history of falling and impaired vision were the strongest predictors for falls (Table 5). Psychotropic medications are known to increase the risk of falling (Hartikainen, Lönnroos, & Louhivuori, 2007; Leipzig et al., 1999), and the 10-fold increase in risk of future falls, albeit with great variation, in this study implies that this disadvantage should be taken in consideration when prescribing this medication. Impaired ADL is a known risk factor for falls (NICE, 2004) as it represents a number of risk factors such as gait and balance deficits. This study adds that PADL dependency in people under aged 80 is a strong predictor for future falls which means that this group will benefit from fall preventive interventions. Impaired vision as a risk factor for falls was described by Lord (2006) who recommended regular eye examinations and use of appropriate prescription spectacles to eliminate or reduce the risk and the present study adds that in those under aged 80 regular eye examinations might prevent future falls.

In those 80+ years a history of falling was also a strong predictor, together with fatigue and IADL dependency. The association between fatigue and poorer physical function and disability (Vestergaard et al., 2009) and the fact that physical fatigue affects gait control (Helbostad, Leirfall, Moe-Nilssen, & Sletvold, 2007) could probably explain why fatigue increase the

risk for future falls. Even though self-reported fatigue is a broad term that might include both physical and psychological aspects, the high prevalence rate in the present study (47–67%) and also being a predictor for future falls implies that this health complaint needs to be addressed. IADL dependency as a risk factor for falls (NICE, 2004) may be seen as the initial phase of a functional decline where the older person is in transition from being independent to being dependent. This emphasizes the need to detect older people in this phase and initiate a fall-preventive intervention in order to improve IADL, i.e. physical function, to prevent future falls.

The strongest predictors of dizziness in those under aged 80 were a history of dizziness and feeling nervous (Table 6). That a history of dizziness was the strongest predictor shows that dizziness is probably a chronic condition, even though this study does not show whether dizziness is continuous or periodic. Earlier studies have shown the relationship between dizziness and psychological distress (Maarsingh et al., 2010; Nagaratnam, Ip, & Bou-Haidar, 2005; Tinetti, Speechley, et al., 2000), however, in the present study the reasons for feeling nervous are not known and the underlying cause might be the reason for the dizziness. Other studies showed that psychological disorders are uncommon as causes of dizziness in older, at least compared to younger age groups (Lawson, Fitzgerald, Birchall, Aldren, & Kenny, 1999) and, although not the primary cause, they are contributing or modulating factors in older people with dizziness (Sloane, Hartman, & Mitchell, 1994). This study indicates that feelings of nervousness ought to be addressed and the underlying cause explored in those with dizziness under aged 80s.

In those 80+ years a history of dizziness or falls was the strongest predictors (Table 6). In the 3-year follow-up the subjects were 18 times more likely to have dizziness, indicating the presence of a persistent condition, however with large variations. At the 6-year follow-up there was five times the likelihood of having dizziness for both those younger and older than 80 years (Table 6). In a study (Tinetti, Speechley, et al., 2000) in older people with dizziness, 63–69% reported having it for at least one year. The present study confirmed that dizziness in older people might be a chronic condition that needs to be recognized, investigated and treated at an early stage, to avoid such negative consequences as poor self-rated health and reduced quality of life (Ekwall et al., 2009; Gassman & Rupprecht, 2009).

A history of falls as a predictor for dizziness was also described by Gassman and Rupprecht (2009) who concluded that there is a close causal relationship between dizziness and falls regarding gait disturbances and balance, showing on the one hand that dizziness is a risk factor for falls, and on the other that motor disabilities can be described by older people as a sensation of dizziness. They also argued that the consequences of a fall, i.e. feeling insecure and frightened of walking, may lead to the development of a feeling of dizziness or that dizziness and falls are caused by identical multiple risk factors such as comorbidity, poor self-rated health status and gait disturbances (Gassman & Rupprecht, 2009). The present study confirms that falls and dizziness are closely connected.

It has been suggested that both falls and dizziness should be treated as geriatric syndromes, i.e. conditions caused by concomitant impairment in multiple bodily systems (Tinetti, Williams, & Gill, 2000). The difficulty in finding specific predictors in people aged 80+ years in this study might support this view, as in Grundstrom et al. (2012) where a deterioration of overall health status with age increased the risk of falling in people 85+ years. This would imply that the underlying cause could perhaps not be detected or eliminated. When a person has multiple risk factors for falls that cannot be eliminated, they should be informed and helped to find a way to cope with living with a greater risk of falling. Suffering from a geriatric syndrome also means being vulnerable to situational challenges (Tinetti, Williams, et al., 2000) and it is important for health care providers working with older people suffering from falls and dizziness to be aware of this vulnerability.

4.1. Limitations

This was a large population-based study with a long follow-up of a representative sample, allowing the detection of statistically significant differences. However, this study has certain limitations. First, although there was an oversampling of the oldest age group, the drop-out seen in the oldest group might threaten the external validity, and reduce overall generalizability to the oldest. Second, the highest internal drop-outs were seen in the Romberg test, SF 12 and grip strength (20–39%) indicating that the results from these measurements should be interpreted with caution. This might also be the case for those medications where the prevalence was sometimes low. Third, we used dizziness as an umbrella term and all the four most common dizziness symptom categories in older adults (e.g. vertigo, presyncope, disequilibrium, non-specific dizziness) are probably included. In addition, the reason behind the sensation of dizziness and other self-reported health complaints experienced is not known. The data in this study are derived from a large population-based study where no attempt was made to investigate dizziness and self-reported health complaints in depth but rather to give a broad view of its prevalence and predictors. Finally, data were collected before using the following definition of a fall; "an unexpected event in which the participant comes to rest on the ground, floor or lower level" which is recommended in order to make comparisons between studies possible (Lamb, Jorstad-Stein, Hauer, & Becker, 2005). Reporting falls in the previous year may also have lower validity due to the high risk of recall bias. This means that the number of falls may be slightly biased (probably underestimated). Despite its limitations above this study is important because to our knowledge it is the first to investigate predictors of falls and dizziness in people younger and older than 80 years of age in a large, longitudinal cohort study.

5. Conclusions

This study showed that younger and older age cohorts reveal similar patterns concerning associated factors. Nevertheless, the predictors for the age cohorts differ and it is therefore important to develop strategies differentiated according to age to prevent falls and dizziness. In those under aged 80 specific factors such as neuroleptics, PADL dependency, visual acuity and feelings of nervousness are important factors in predicting falls and dizziness. The results in those 80+ years show that these conditions are persistent and should be comprehensively investigated. If the underlying cause cannot be eliminated, people with falls and dizziness should be helped to cope with living with a greater risk of falling.

Conflict of interest statement

None.

Acknowledgements

The SNAC (http://www.snac.org) is supported financially by the Swedish Ministry of Health and Social Affairs, and by the participating county councils, municipalities and university departments. We are grateful to the subjects and staff of SNAC-Blekinge for their engagement in the study. We also wish to thank Pat Shrimpton for revising the English.

References

Deandrea, S., Lucenteforte, E., Bravi, F., Foschi, R., La Vecchia, C., & Negri, E. (2010). Risk factors for falls in community-dwelling older people. A systematic review and meta-analysis. *Epidemiology, 21*, 658–668.

Ekwall, A., Lindberg, Å., & Magnusson, M. (2009). Dizzy – Why not take a walk? Low level physical activity improves quality of life among elderly with dizziness. *Gerontology, 55*, 652–659.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*, 189–198.

Gassman, K. G., & Rupprecht, R. (2009). Dizziness in an older community-dwelling population: A multifactorial syndrome. *Journal of Nutrition, Health and Aging, 13*, 278–282.

Gassmann, K. G., Rupprecht, R., & Freiberger, E. (2009). Predictors for occasional and recurrent falls in community-dwelling older people. *Zeitschrift fur Gerontologie und Geriatrie, 42*, 3–10.

Grundstrom, A. C., Guse, C. E., & Layde, P. M. (2012). Risk factors for falls and fall-related injuries in adults 85 years of age and older. *Archives of Gerontology and Geriatrics, 54*, 421–428.

Halling, A., & Berglund, J. (2006). Concordance between elderly patients' understanding of and their primary healthcare physician's diagnosis of heart failure. *Scandinavian Journal of Primary Health Care, 24*, 110–114.

Hartikainen, S., Lönnroos, E., & Louhivuori, K. (2007). Medication as a risk factor for falls: Critical systematic review. *Journal of Gerontology, 10*, 1172–1181.

Helbostad, J. L., Leirfall, S., Moe-Nilssen, R., & Sletvold, O. (2007). Physical fatigue affects gait characteristics in older persons. *Journal of Gerontology, 9*, 1010–1015.

Iinattiniemi, S., Jokelainen, J., & Luukinen, H. (2009). Fall risk among a very old home-dwelling population. *Scandinavian Journal of Primary Health Care, 27*, 23–30.

Lagergren, M., Fratiglioni, L., Hallberg, I. R., Berglund, J., Elmstahl, S., Hagberg, B., et al. (2004). A longitudinal study integrating population, care, and social sevices data. The Swedish National Study on Aging and Care (SNAC). *Aging Clinical and Experimental Research, 16*, 158–168.

Lamb, S. E., Jorstad-Stein, E. C., Hauer, K., & Becker, C. (2005). Development of a common outcome data set for fall injury prevention trials: The prevention of falls net-work Europé consensus. *JAGS, 53*, 1618–1622.

Lawson, J., Fitzgerald, J., Birchall, J., Aldren, C. P., & Kenny, R. A. (1999). Diagnosis of geriatric patients with severe dizziness. *JAGS, 47*, 12–17.

Leipzig, M. R., Cumming, R. G., & Tinetti, M. E. (1999). Drugs and falls in older people: a systematic review and meta-analysis: I. Psychotropic drugs. *JAGS, 47*, 30–39.

Lord, S. R. (2006). Visual risk factors for falls in older people. *Age and Ageing, 35*, 42–45.

Maarsingh, O. R., Dros, J., Schellevis, F. G., van Weert, H. C., Bindels, P. J., & van der Horst, H. E. (2010). Dizziness reported by elderly patients in family practice: Prevalence, incidence, and clinical characteristics. *BMC Family Practice11(2) (open access)*.

Mendel, B., Bergenius, J., & Langius-Eklöf, A. (2010). Dizziness: A common, troublesome symptom but often treatable. *Journal of Vestibular Research, 20*, 391–398.

Nagaratnam, N., Ip, J., & Bou-Haidar, P. (2005). The vestibular dysfunction and anxiety disorder interface: A descriptive study with special reference to the elderly. *Archives of Gerontology and Geriatrics, 40*, 253–264.

National Institute for Health and Clinical Excellence (NICE). (2004). *Clinical practice guidelines for the assessment and prevention of falls in older people*http://www.nice.org.uk/nicemedia/live/10956/29585/29585.pdf Accessed 18.05.12.

Nordenskiöld, U. M., & Grimby, G. (1993). Grip force in patients with rheumatoid arthritis and fibromyalgia and in healthy subjects. A study with the Grippit instrument. *Scandinavian Journal of Rheumatology, 22*, 14–19.

Rubenstein, L. Z. (2006). Falls in older people: Epidemiology, risk factors and strategies for prevention. *Age and Ageing, 35*, 37–41.

Sloane, P. D., Hartman, M., & Mitchell, C. M. (1994). Psychological factors associated with chronic dizziness in patients aged 60 years and older. *JAGS, 42*, 847–852.

Sonn, U., & Åsberg, K. H. (1991). Assessment of activities of daily living in the elderly. A study of a population of 76-year-olds in Gothenburg, Sweden. *Scandinavian Journal of Rehabilitation Medicine, 23*, 193–202.

Stevens, K. N., Lang, I., Guralnik, J. M., & Melzer, D. (2008). Epidemiology of balance and dizziness in a national population: Findings from the English Longitudinal Study of Ageing. *Age and Ageing, 37*, 300–305.

Sullivan, M., Karlsson, J., & Taft, C. (1997). *SF 12 Hälsoenkät. Svensk manual*. [SF 12 health survey. Swedish manual]. Gothenburg: Gothenburg University and Sahlgrenska University Hospital.

Tinetti, M. E., Speechley, M., & Ginter, S. F. (2000). Health, functional and psychological outcomes among older persons with chronic dizziness. *JAGS, 48*, 417–421.

Tinetti, M. E., Williams, C. S., & Gill, T. M. (2000). Dizziness among older adults: A possible geriatric syndrome. *Annals of Internal Medicine, 132*, 337–344.

Vestergaard, S., Nayfield, S. G., Patel, K. V., Eldadah, B., Cesari, M., Ferrucci, L., et al. (2009). Fatigue in a representative population in older persons and its association with functional impairment, functional limitation, and disability. *Journal of Gerontology, 64*, 76–82.

Ware, J., Kosinski, M., & Keller, S. D. (1996). A 12-item short-form health survey: Construction of scales and preliminary tests for reliability and validity. *Medical Care, 34*, 220–233.

World Health Organization (WHO). (2000). *Collaborating Centre for Drug Statistics Methodology, Anatomical Therapeutic Chemical (ATC) classification*http://www.whocc.no/atcddd Accessed 28.05.12..

World Health Organization (WHO). (2007). *Global report on falls prevention in older age*http://www.who.int/ageing/publications/Falls_prevention7March.pdf Accessed 18.05.12..