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Epidemiology of balance and dizziness in a national population: findings from the English Longitudinal Study of Ageing

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Abstract

Objective: to identify socio-economic, behavioural and disease status risks for impaired balance or self-reported dizziness in older people from a large population-based study.

Methods: data were from the English Longitudinal Study of Ageing (ELSA), for 2,925 participants, aged 65+. Multivariate models were used to assess the associations between balance and dizziness and disease status, health behaviours, grip strength and socio-economic markers.

Results: there were 21.5% ($n = 619$) participants with impaired balance and 11.1% ($n = 375$) reported dizziness. Impaired balance was statistically significantly associated with age, diabetes (OR = 1.53), arthritis (OR = 1.33), eyesight (OR = 1.94) and grip strength. The wealthiest 20% of participants were less likely to have impaired balance than the poorest 20% (OR = 0.46). Dizziness problems were not associated with age, gender or wealth, but were significantly associated with an abnormal heart rhythm (OR = 1.85), hearing (OR = 1.81), eyesight (OR = 1.72) and grip strength.

Conclusion: the epidemiology of impaired balance differs from that of dizziness, and risk assessment approaches to prevent falls may need to elicit information on different problem-specific factors. Impaired balance test performance in older people may be added to the many outcomes showing strong socio-economic gradients.

Keywords: *balance, dizziness, socio-economic status, elderly*

Introduction

Impaired balance and problems of dizziness are common in older people [1–5], are risk factors for serious falls and fractures [6–8], and may be a more significant direct cause of falls-related injuries than environmental factors [9]. Poor balance is also an important cause of loss of independent mobility [1].

In previous studies, associations have been reported between B&D and impaired sensory function, depression, medication, weight, muscle strength and vascular disease [2–5, 10–15]. The majority of those with dizziness problems tend to have more then one risk factor, suggesting that dizziness is a multi-factorial geriatric syndrome [16, 17]. However, previous studies of balance and dizziness have mainly focussed on relationships between morbidity and balance and dizziness, and studies assessing the effects of socio-economic status and health behaviours have relied on self-reported balance [18].

Our aim here was to identify factors specifically associated with poor performance in well-validated balance tests, or with self-reported problems with dizziness, in disability-free older people. To avoid non-specific associations with general functional impairment or frailty we restricted the study to participants free of Activity of Daily Living disabilities (ADLs). We examined risk factors including socio-economic status, health behaviour risks and disease status in a large nationally representative older population sample from the English Longitudinal Study of Ageing (ELSA). To our knowledge, no previous study has assessed these risk factors for balance impairment or self-reported dizziness in a large and representative sample.

Methods

Sample

The data we used are from ELSA, a national panel study established to enable the study of the dynamic relationships between health, functioning and socio-economic factors in

people aged 50 and over. The ELSA sample was drawn from households with one or more residents aged 50 or older that were part of the Health Survey for England (HSE), an annual government-funded study of households in England, in years 1998, 1999 and 2001. About 19,924 individuals living in eligible households were aged 50 or older in 2002, when the ELSA sample was taken. Of these older individuals, 2,596 died or were ineligible for follow-up; of the remainder, 11,392 (65.7%) became ELSA participants. Analyses of socio-demographic characteristics against census results indicated that the ELSA sample remained population representative [19].

In 2004, when balance tests were conducted, 9,324 participants were still alive, of whom 4,636 were aged 65 and over. To ensure that we were not capturing associations with generally poor function or frailty, we excluded participants who reported difficulties with one or more ADL [dressing; walking across a room; bathing or showering; getting in or out of bed; using the toilet; eating ($n = 1304$)]. We also excluded participants who were blind ($n = 29$) or had Parkinson's disease ($n = 44$). A total of 2,925 participants had complete socio-economic data available and were included in our analyses.

Balance

Static balance was evaluated in three separate and progressively more difficult tests which formed part of the Short Physical Performance Battery [20]. Participants were ineligible for the tests if they were chair-bound or wheelchair-based; if it became clear after discussion that they were too unsteady on their feet; if they found it painful to stand; or if either the nurse or the participant considered the test unsafe ($n = 187$). The tests were demonstrated once and walking aids could not be used. Participants were asked to wear appropriate (flat) shoes. The nurse who conducted the test was permitted to help the participants get into position and then stood by in case they began to fall or lose their balance. We used three components of the balance test (an additional two components were performed by younger participants only): side-by-side, semi-tandem, and full tandem.

Side-by-side stand

Participants were asked to stand with feet together, side-by-side, for at least 10 seconds, using their arms, bending their knees or moving their body to maintain balance, but not moving their feet. If the participant was unable to hold the position for 10 s, a score of zero was recorded and no further tests attempted. Those able to hold the position for 10 s moved on to the semi-tandem stand.

Semi-tandem stand

Participants had to stand with the side of the heel of one foot touching the big toe of the other foot for at least 10 s. Participants unable to hold the position for 10 s scored one and no further tests were attempted. Those able to hold the position for 10 s moved on to the full-tandem stand.

Full-tandem stand

For this test, participants had to stand with the heel of one foot in front of and touching the toes of the other foot. Those unable to hold this position for at least 3 s scored no additional points; those able to hold the position for at least 3 but less than 10 s scored one point for this test; and those able to hold the position 10 s or longer scored two points for this test.

The maximum possible score from all three tests was four points: one point each from the side-by-side and semi-tandem tests, and two points from the full-tandem test. The final score was dichotomised into those with 0 to 3 (impaired balance) and those who scored 4 (good balance).

Dizziness

Participants were asked 'how often do you have problems with dizziness when you are walking on a level surface?' Possible responses were always, very often, often, sometimes, or never. Those who reported never walking ($n = 2$) or that they could not walk ($n = 25$) were excluded. Results were dichotomised into those reporting dizziness problems and those reporting no problems.

Exposures

In line with the previous studies described above, we included in our models self-reported diagnosed prevalence of the following conditions: high blood pressure, cardiovascular disease (CVD), abnormal heart rhythm (AHR), stroke, diabetes, lung disease, asthma, arthritis, osteoporosis and cancer. Participants were asked to rate their sight and hearing as very good, good, fair or poor, and we classified those with fair or poor sight or hearing as having an impairment. Depressive symptoms were identified using the 8-item CES-D (Centre for Epidemiologic Studies Depression Scale) which was developed for the Established Populations for Epidemiologic Study of the Elderly (EPESE) [21]. A cut-off point of four on the 8-item CES-D is comparable to the 16-symptom cut-off for the 20-item scale [22].

Health behaviour variables included smoking status and alcohol consumption. Alcohol consumption was assessed at baseline, when participants were asked, 'Do you ever drink alcohol nowadays, including drinks you brew or make at home?' Drinkers were asked how many days per week they had drunk and on average how much they consumed on days they drank over the previous 12 months. Mean weekly consumption was calculated in standard UK units, where 1 unit of alcohol = 7.9 g of alcohol, and participants categorised as non-drinkers (<1 unit/week), moderate drinkers (1 to 14 units/week for women, 1 to 21 units for men, in line with UK recommendations) and heavier drinkers. Smoking was measured in pack-years.

Height, weight and grip strength were measured by a research nurse. Body mass index (BMI) was categorised as underweight (<18.5), normal (18.5–24.9), overweight (25–29.9), obese (30–39.9) and morbidly obese (>40). Grip strength was measured in kilograms using a grip gauge and

the scores divided by sex-specific quintiles. Participants were asked about medications taken and divided into those taking one or more prescription medication and those taking none.

To assess socio-economic status information on educational level and total wealth was used. Educational level was categorised as degree or higher education, intermediate qualification or no qualifications. Total wealth was derived from a series of questions regarding all financial assets (including savings, investments and property, and pension wealth) and was divided by quintiles.

We also assessed the relationship between balance and dizziness and having fallen. Participants were asked whether they had fallen down, for any reason, in the previous 2 years. Those who said that they had were asked how many times they had fallen in the previous 2 years, and whether any of those falls had resulted in injury serious enough to need medical treatment.

Statistical analysis

Analyses were performed in Stata/SE 9.2 and accounted for clustering and non-response in the ELSA 2004 study [19]. We conducted analyses separately for balance and dizziness, and used logistic regression to assess the association between the exposures described and the outcome. Variables were included in the final model if they had a P-value ≤ 0.05 in unadjusted analysis. Analyses were repeated without non-response weights but no substantial changes in estimates were obtained and results reported are for weighted analyses.

Results

A total of 619 participants (21.5%) had poor balance (a static balance test score of three or less) and 375 (11.1%) reported dizziness problems. The correlation between balance and dizziness had a Pearson coefficient of 0.196 ($P<0.001$). Dizziness problems were strongly associated with having had a fall (age sex adjusted OR = 2.11 95% CI: 1.69–2.64), as was impaired balance performance (OR = 1.27: 95% CI: 1.04–1.56). The prevalence of both outcomes was higher in women than men (Figure 1), but prevalence rates rose with age only for balance impairment. Table 1 shows the prevalence, in relation to each outcome, of the variables that were statistically significant in our models.

Table 2 shows outcomes for the multivariate balance model. There was a strong association between increasing age and poor balance: those in the 80+ age group had an odds ratio (OR) of poor balance of 6.99 (95% CI: 4.96–9.84) compared to those aged 65 to 69. The association between gender and poor balance was not statistically significant. Having diabetes was associated with an OR of poor balance

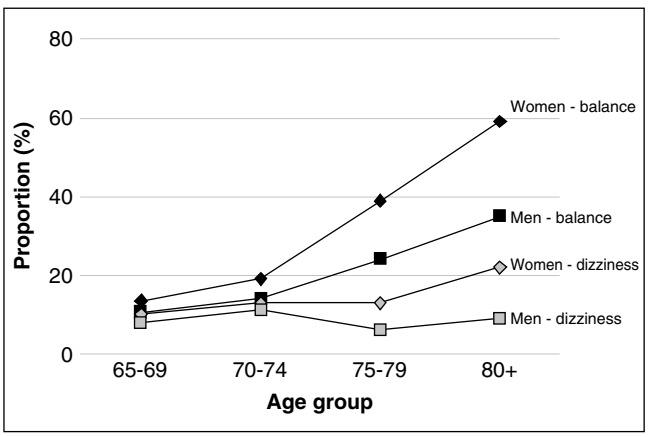

Figure 1. Proportion of participants with impaired tested balance and reported problems with dizziness, by sex and age group.

Table 1. Baseline characteristics of those with impaired balance and dizziness

	n (% within outcome)	
Variable	Poor balance *n* = 623	Dizziness problems *n* = 375
Diabetic		
Yes	38 (16.4)	52 (28.4)
No	335 (10.7)	567 (21.1)
Arthritis		
Yes	175(14.7)	283 (27.8)
No	200 (9.2)	336 (18.1)
Cardiovascular disease (CVD)		
Yes	65 (18.5)	83 (28.0)
No	308 (10.2)	536 (20.8)
Abnormal heart rhythm (AHR)		
Yes	45 (20.0)	43 (22.3)
No	328 (10.5)	576 (21.5)
Self-rated vision		
Good	278 (9.5)	480 (19.0)
Poor	94 (21.2)	138 (39.9)
Self-rated hearing		
Good	236 (9.1)	439 (19.9)
Poor	139 (17.4)	180 (26.9)
Grip strength		
1 (weakest)	123 (15.9)	271 (37.2)
2	78 (12.6)	134 (22.2)
3	43 (7.7)	103 (18.7)
4	49 (7.4)	84 (12.8)
5 (strongest)	16 (5.1)	17 (5.5)
Wealth split by quintiles		
1 (lowest)	105 (16.8)	193 (39.2)
2	74 (10.6)	155 (27.9)
3	83 (11.0)	141 (21.0)
4	66 (9.7)	78 (12.5)
5 (highest)	44 (7.5)	50 (9.7)
Weekly alcohol consumption		
Less then 1 unit a week	138 (15.8)	220 (30.5)
Within recommended levels	159 (10.0)	267 (19.2)
Above recommended levels	63 (8.2)	106 (15.9)
Taking prescription medication		
Yes	239 (13.5)	386 (24.6)
No	62 (7.1)	119 (15.0)
CES-D (Depression)		
0–3	280 (9.4)	529 (20.7)
4–8	95 (23.9)	90 (28.9)

Table 2. Factors associated with impaired tested balance or dizziness problems in the multivariate logistic regression models including survey weighting

		Multivariate OR (95% CI)	
Variable		Impaired balance	Dizziness problems
Gender	Female	1.71 (1.34–2.18)	1.81 (1.38–2.38)
Age group	65–69	—	—
	70–74	2 (1.43–2.79)	1.14 (0.8–1.63)
	75–79	3.37 (2.4–4.74)	0.91 (0.61–1.35)
	80+	6.99 (4.96–9.84)	1.19 (0.82–1.73)
CVD		—	1.34 (0.91–1.96)
AHR		—	1.85 (1.23–2.77)
Diabetic		1.53 (1.01–2.31)	1.24 (0.95–1.61)
Arthritis		1.33 (1.07–1.65)	—
Poor vision		1.94 (1.44–2.61)	1.72 (1.23–2.39)
Poor hearing		—	1.81 (1.35–2.43)
Grip strength quintile	1	—	—
	2	0.65 (0.49–0.86)	0.9 (0.65–1.23)
	3	0.55 (0.41–0.74)	0.67 (0.46–0.98)
	4	0.55 (0.38–0.79)	0.41 (0.25–0.68)
	5	0.46 (0.27–0.79)	0.58 (0.32–1.03)
Wealth quintile	1	—	—
	2	0.77 (0.57–1.05)	—
	3	0.77 (0.57–1.04)	—
	4	0.49 (0.35–0.69)	—
	5	0.46 (0.32–0.68)	—
Weekly alcohol consumption	<1	—	—
	Moderate	0.75 (0.59–0.96)	—
	Higher	0.76 (0.55–1.06)	—
Depression		—	2.17 (1.56–3.01)

Depression = score of 4 or above on the CESD-8 instrument.

of 1.53 (95% CI: 1.01–2.31), the OR for arthritis was 1.33 (95% CI: 1.07–1.65) and the OR for poor vision was 1.94 (95% CI: 1.44–2.61). Grip strength was associated with poor balance, and compared to those in the bottom fifth, those in the top fifth had an OR of poor balance of 0.46 (95% CI: 0.27–0.79). Compared to those who drank less than 1 unit/week, those drinking alcohol within recommended limits had an OR of poor balance of 0.75 (95% CI: 0.59–0.96) and those drinking above recommended limits had an OR of 0.76 (95% CI: 0.55–1.06). Poor balance was associated with wealth and those in the wealthiest 20% had an OR of poor balance of 0.46 (95% CI: 0.32–0.68) compared to those in the poorest 20%.

Outcomes for the self-reported dizziness model are shown in Table 2. Gender but not age was statistically significantly associated with self-reported dizziness problems. There were associations (at $P<0.05$) between dizziness and AHR (OR = 1.85, 95% CI: 1.23–2.77), poor hearing (OR = 1. 81, 95% CI: 1.35–2.43), poor vision (OR = 1.72, 95% CI: 1.23–2.39) and depression (OR = 2.17, 95% CI: 1.56–3.01). Compared to the 20% with the lowest grip strength, the 20% of participants with the highest grip strength had an OR of dizziness of 0.58 (95% CI: 0.32–1.03). For both outcomes there was no significant association with smoking status.

Discussion

We examined a comprehensive set of potential risk factors for impaired balance and dizziness in non-frail older people in the general population. Our findings indicate a number of associations in line with previous findings and some which are novel. We found the risk factors for these two conditions have limited overlap, with some striking differences. For poor balance, heightened risk was associated with increasing age, with having diabetes, arthritis and poor vision, and in those with low grip strength, low socio-economic status (measured by wealth), and those who drank little or no alcohol. For self-reported dizziness there was no increase associated with being older or less wealthy. There were associations with poor hearing and vision and poor grip strength, but also with AHR and depression. Unlike previous studies, we found no statistically significant association between poor balance or dizziness and receipt of prescription medication.

To our knowledge, this is the first large-scale population-based study to examine the association between health behaviours, socio-economic status and balance and dizziness in non-disabled older people. Previous studies have relied on self-reported balance but we used an objective balance test. Dizziness must inevitably be studied as a self-reported problem as objective measures are not available. We were also able to include measured grip strength and measured height and weight (as BMI) in our models. The study also deals with many potential confounders related to general impairment of frailty by excluding people with ADL disabilities. Our study has thus identified the specific factors associated with balance and dizziness, and not general factors for severely impaired ageing outcomes.

There were several differences between the associations we found with poor balance and with dizziness, but the most striking related to changes with age. Poor balance showed an upward trend with increasing age, but dizziness did not. The reason for this difference is not clear and it is possible that it relates to the objective and subjective format of each outcome here. However, the association with age was also present on self-reported problems with balance, suggesting that the difference in age associations may be real.

A novel finding of the analysis is the evidence of an association between poor balance and socio-economic status. A previous study on a related topic found an association between educational level and self-reported vertigo or dizziness in univariate but not in adjusted analysis. [18] The association between poor balance and wealth is in line with findings showing a decline in disability as the socio-economic status increases [23] and is likely to be associated with similar mechanisms.

Our findings are based on cross-sectional data and must be interpreted with caution. We cannot make inferences about causality based on these findings and, for example, it is unclear whether depression is a cause or a result of

dizziness. For some of the other associations, we found it is tempting to infer the likely direction of causality. Diabetic neuropathy has been linked to postural impaired balance and postural instability [24, 25], and although there have been few studies on diabetes and balance, diabetes has been linked to an increased fall-risk [26]. Associations between dizziness and impaired sensory function have been reported [16, 17, 27], and it seems plausible that sensory impairment should precede balance and dizziness problems.

For some of the other associations observed the likely direction of causality is less clear. Those who drink more alcohol seem to be at lower risk of balance problems, which supports findings about alcohol consumption and disability in older people [28, 29], but it is possible that those who experience balance problems reduce their alcohol consumption because they find, or at least fear, that it will exacerbate those problems.

Our results suggest a need to assess and treat problems of balance and dizziness separately. Poor balance and poor dizziness share some associations, and both are more common in women, in those with poor vision, and in those with poor grip strength. However, the differences in associations suggest interventions to improve balance and dizziness and reduce the risk of falls which may need to address different sets of factors. The association of balance with socio-economic status and with levels of alcohol consumption suggests interventions in these areas might be worthwhile, but the marked increase in poor balance with age suggests connections with underlying age-related physiological changes. For dizziness, the most interesting association is with depression but, as we have suggested, it is unclear in which direction the causal pathway runs here. Future work using longitudinal data could clarify the direction of causality of some of these associations, especially for factors that may be the result rather than cause of the problems, such as depression and reduced alcohol consumption.

Conclusion

The epidemiology of impaired balance is different from dizziness in the disability-free older population. Risk-reduction approaches to prevent falls may need to address different sets of problem-specific factors. Impaired balance performance in older people can be added to the many outcomes showing strong socio-economic gradients.

Key points

- Impaired balance and dizziness are common in older people but their association with socio-economic and behavioural factors has not been established.
- Previous studies on this topic have often relied on self-reported balance.
- Using data on balance and self-reported dizziness from a large-scale population-based study, we find a marked socio-economic gradient in the prevalence of these problems.
- Differences in the epidemiologies of balance and of dizziness may necessitate different approaches to intervention and to falls prevention.

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