Age and sex differences in prevalence and clinical correlates of depression: first results from the Irish Longitudinal Study on Ageing

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Abstract

OBJECTIVE:

The risk of depression is increased by physical illness; however, the nature of this relationship is complex and unclear. Here, we explore the prevalence and clinical correlates of depression, with particular emphasis on factors representing consequences or physical manifestations of disease and identify age and gender differences in their effects.

METHODS:

A population-representative sample of 8175 community-dwelling adults aged 50 years and over participated in the first wave of The Irish Longitudinal Study on Ageing. The primary outcome measure was clinically significant depressive symptoms defined by a score of 16 or greater on the 20-item Centre for Epidemiologic Studies Depression scale.

RESULTS:

Overall, 10% (95% CI: 9-11%) of adults reported clinically significant depressive symptoms. Physical illness is associated with depressive symptoms only in adults 65 years and older; in adults aged 50-64 years, the association is mediated by medication use, and this age difference is statistically significant ($p < 0.00$). Irrespective of age, chronic pain and incontinence were stronger predictors of depression in men (interaction effects $p < 0.00$) CONCLUSIONS: Our findings identify age-specific and gender-specific clinical markers for depression risk among the older population, which may identify those more likely to present with depression in community settings.

Introduction

Depression is the leading cause of morbidity and mortality worldwide (Murray and Lopez, 1997), but knowledge about prevention is lacking, especially among older people for whom underdiagnosis and undertreatment is a significant issue (Licht-Strunk *et al.*, 2005). In older adults, physical illness has been well established as one of the most important risk factors for depression, and its dominant role may be one of the most significant differences between late-life depression and depression in younger adults (Beekman *et al.*, 1995c, Beekman *et al.*, 1995a). A number of diseases have been shown to have direct aetiological links with depression, for example, vascular disease (Alexopoulos *et al.*, 1997) and Parkinson's disease (Cummings, 1992); however, findings from community-based studies suggest that general aspects of physical health, such as the level of functional impairment and perceived health, are more important correlates of depression than specific diagnoses (Kennedy *et al.*, 1989, Prince *et al.*, 1997).

The prevalence of major depressive disorder ranges from 1% to 5% among community-dwelling older adults (Hasin *et al.*, 2005), and approximately 15% experience clinically significant depressive symptoms (Blazer, 2003). The prevalence of major depressive illness appears to diminish as people become older;

however, the incidence of clinically significant nonmajor forms of depression increases with advancing age (Park and Unützer, 2011). At least half of all older adults with major depression are experiencing a new condition arising for the first time in old age (Brodaty *et al.*, 2001, Bruce *et al.*, 2002). It is therefore important to identify factors that lead to depression in older adults so that prevention can be targeted at high risk groups. Previous studies have focused on risk factors for depression in all adults 55 years and older or 65 years and older (Beekman *et al.*, 1995b, Schoevers *et al.*, 2000) or explored risk factors in the 'oldest old', that is, adults who are 75 or 80 years and older (van't Veer-Tazelaar *et al.*, 2008). Although not directly comparing young-old and old-old cohorts, these studies suggest that long-standing vulnerability factors, such as family and personal histories of depression, are less important in older adults, whereas risk factors such as physical illness, cognitive decline and a diminishing social network become more significant with increasing age (Fiske *et al.*, 2009).

Although it is well recognised that women are more likely to suffer from depression than men (Djernes, 2006), gender differences in risk factors for depression are not well studied in older people. Rates of depression appear to be higher in older women than older men but with a smaller gender gap than among younger people (Djernes, 2006). Many social and health-related aspects of ageing differ between men and women; therefore, identifying variables that indicate greater risk of depression in different genders and investigating whether risk factors associated with depression differ by gender are important tasks.

The present study sought to determine the prevalence of depressive symptoms in a large population-representative sample of community-dwelling older adults. We explore clinical correlates of depression with particular emphasis on factors representing consequences or physical manifestations of disease. Older adults are not a homogenous group; therefore, we hypothesised that clinical correlates of depression would show age-specific and gender-specific patterns of distribution.

Methods

Study design

We analysed data from the first wave of The Irish Longitudinal Study on Ageing (TILDA) collected between October 2009 and February 2011. Full details of the sampling procedure and response have been described elsewhere (Kearney *et al.*, 2011). In short, TILDA is a study of people who are 50 years and older (and their spouses or partners of any age) and resident in Ireland. A nationally representative sample was drawn from the Irish Geodirectory. Participants completed a computer-assisted personal interview in their own homes, which included detailed questions on their social, economic and health situations. At baseline, 8504 participants were recruited to the study including 8175 respondents aged ≥50 years and 329 younger partners of eligible individuals. The response rate to the study was 62%. The study was approved by the Faculty of Health Sciences Research Ethics Committee, and subjects were required to provide written informed consent prior to participation in the study.

Measurements

The primary outcome measure for this analysis was case-level depressive symptoms defined by a score of 16 or greater on the 20-item Centre for Epidemiologic Studies Depression scale (CES-D). The CES-D generates a total score with a range between 0 and 60 with higher scores indicating greater depressive symptoms. A cut-off score of 16 has been shown to have a sensitivity of 100% and specificity of 88% for major depressive disorder in an older population (Beekman *et al.*, 1997)

In the present study, we considered sociodemographic and clinical correlates depression. Sociodemographic factors included age, gender, education and marital status. Clinical factors included chronic diseases, cognitive impairment, functional limitations, pain, sensory impairment, medication use and lifestyle characteristics (alcohol and substance abuse, smoking). Participants were asked whether a doctor ever told them they had any of the following diseases: heart attack, heart failure, angina, cataracts, hypertension, high cholesterol stroke, diabetes, lung disease, asthma, arthritis, osteoporosis, cancer, Parkinson's disease, peptic ulcer or hip fracture. The number of chronic diseases was calculated by summing up all specific diseases reported to be presented by a participant. Participants also reported whether a doctor had ever told them they suffered from alcohol or substance abuse or whether they had suffered from urinary incontinence in the previous year.

Measures of cognitive function included immediate and delayed recall of 10 words to assess memory and semantic verbal fluency (number of animal names generated in 1 min), which is both a measure of executive function and language. These measures of

cognitive function have been utilised in other large ageing studies, for example, the English Longitudinal Study on Ageing (Steptoe *et al.*, 2012) and the Health and Retirement study in America (Ofstedal *et al.*, 2005) . Low verbal fluency was defined as 1.5 SD below the weighted mean. This equated to ≤10 words in adults aged 50–64 years (mean 21, SD = 7) and ≤9 words in adults 65 years and older (mean 18, SD = 6). Disability was examined by asking participants whether they had any long-standing illness, disability or infirmity that had troubled them or was likely to affect them over a period. If the answer was yes, they were then asked whether the illness limited their activities in any way. From the answers to these questions, a variable was derived to indicate the presence of a limiting long-standing illness (LLI). Participants were asked to list all medications (prescription and nonprescription) that they took on a regular basis, and the total number of medications was summed (excluding antidepressants). Chronic pain was assessed by asking participant if they often suffered from pain. If the answer was yes, they were asked whether most of the time the pain was mild, moderate or severe. Participants who reported moderate or severe pain were classified as suffering from chronic pain. Sensory impairment was examined by asking participants to rate their vision and hearing using a 5-point Likert scale ranging from excellent to poor. Adults who rated their vision/hearing as fair or poor were classified as having visual impairment.

Statistical analysis

Univariate logistic regression was used to identify correlates of depressive symptoms. These factors were then added into a multivariate model in three blocks to assess possible mediating relationships between factors. The first block included sociodemographic factors. The second included chronic disease, cognitive impairment and lifestyle factors, and the third block included factors representing consequences or physical manifestations of disease.

To examine how correlates of depressive symptoms varied by age and sex, multivariate models were estimated separately in four groups defined by gender and age (50–64 vs. 65+). To test whether factors were significantly different between age and gender groups, a final model was then estimated on the basis of all participants including the interaction terms.

Sample weights were applied and calculated by comparing the TILDA sample with the Irish population with respect to age, sex and educational attainment (Kearney *et al.*, 2011). All analyses include an adjustment for clustering of responses at the household and geographical primary cluster levels.

Results

Sample characteristics

The sample consisted of 8175 older adults (mean age 64 years, SD 9.7 years, range 50–99 years, 52% women). A total of 8032 participants successfully completed the CES-D (98% of sample). People with known or suspected dementias were specifically not recruited by interviewers to the TILDA study at baseline, so few people are classified as having moderate or severe cognitive impairment in our study. Over a third (38%) of participants had only primary education (8 years or less of formal schooling), and over two thirds (68%) of the sample were currently married (Table 1).

Prevalence of depressive symptoms by age and sex

The overall prevalence of clinically significant depressive symptoms in our sample was 10%. The highest prevalence 10.7% (95% CI: 10–12%) was found among adults aged 50–64 years, declining to 9.1% (95% CI: 8–11%) for adults aged 65–74 years and 8.7% (95% CI: 7-11%) in those 75 years and older. Overall, women report more depression than men (12.5%, 95% CI: 11–14% vs. 7.2%, 95% CI: 6–8%).

Correlates of depressive symptoms

There were significant differences in sociodemographic factors between participants with and without depressive symptoms (Table 1). Women had greater odds of being depressed than men (OR = 1.85, 95% CI: 1.58, 2.16). Older participants were less likely than younger participants to have depressive symptoms (OR = 0.84, 95% CI: 0.71, 1.00, for the category 65–74 years; and OR = 0.79, 95% CI: 0.64, 0.98, for the category 75+, when compared with adults aged 50–64 years). Participants who had only completed primary level education were more likely than those with secondary or tertiary level to suffer with depressive symptoms (OR = 1.62, 95% CI: 1.39, 1.89 for primary when compared with adults with tertiary education). Never having married or been widowed separated or divorced were associated with increased odds of being depressed (OR = 1.44, 95%

Table 1 Sociodemographic characteristics of older adults with and without depressive symptoms and univariate logistic regression analyses

				Nondepressed		Depressed			
		All sample		CES-D ≤ 15		CES-D ≥ 16			
		n[a]	%[b]	*n*[a]	%[b]	*n*[a]	%[b]	OR	95%CI
Age (years)	Mean(SD)	64 (10)		64(10)		63(10)			
	50–64	4606	58.4	4118	58.1	488	63.1		
	65+	3426	41.6	3141	41.9	285	36.9	0.76	(0.65–0.89)
Sex	Male	3688	48.0	3435	49.6	253	34.8		
	Female	4344	52.0	3824	50.4	520	65.2	1.85**	(1.58–2.16)
Education	Primary	2444	38.3	2133	36.9	311	47.9	1.62**	(1.39–1.89)
	Secondary	3222	43.2	2941	44.0	281	38.0	0.84	(0.72–0.98)
	Tertiary	2363	18.5	2182	19.1	181	14.2		
Marital status	Married	5560	67.8	5143	69.8	417	53.1		
	Never married	766	9.7	677	9.3	99	12.8	1.44	(1.14–1.79)
	Widowed/separated/divorced	1696	22.5	1439	20.9	257	34.2	2.00	(1.71–2.35)
Medical card		3948	52.4	3442	50.3	506	68.4		
Private medical insurance		3246	36.6	3060	38.7	186	21.0		

[a]Unweighted counts.
[b]Weighted percentages.
*$p \leq 0.05$, **$p \leq 0.001$.

CI: 1.14, 1.79 for never married; and OR = 2.0, 95% CI: 1.71, 2.35, for been widowed separated or divorced when compared with been married).

Univariate logistic regression analyses of clinical characteristics on depressive symptoms can be seen in Table 2. The odds of depressive symptoms increased as the number of chronic diseases increased (OR = 1.31, 95% CI: 1.25, 1.37) and in the presence of an LLI (OR = 4.18, 95% CI: 3.58, 4.86). Other health-related (smoking, number of medications, pain, urinary incontinence and sensory impairment) and cognitive (poor recall and poor verbal fluency) factors were also significantly related to increased odds of being depressed.

Table 2 Clinical characteristics of older adults with and without depressive symptoms and univariate logistic regression analyses

	Nondepressed		Depressed			
	CES-D ≤ 15		CES-D ≥ 16			
	Mean	SE	Mean	SE	OR	95% CI
Number of medications	2.4	0.03	3.9	0.12	1.17*	(1.15–1.20)
Immediate recall	5.7	0.02	5.3	0.06	0.88	(0.84–0.92)
Delayed recall	5.9	0.03	5.3	0.08	0.89	(0.87–0.92)
Number of chronic diseases	1.6	0.02	2.3	0.06	1.31**	(1.25–1.37)
	n[a]	%[b]	*n*[a]	%[b]	OR	95% CI
Low verbal fluency	393	6.2	75	10.6	1.92**	(1.48–2.47)
Limiting long illness	1442	20.0	395	49.7	4.18**	(3.59–4.86)
Chronic pain	1610	22.2	396	51.3	3.69**	(3.17–4.30)
Incontinence	582	8.0	161	20.8	3.02**	(2.49–3.66)
Smokes	1208	16.6	248	31.9	2.35**	(2.00–2.77)
Poor vision	2939	40.4	426	54.8	3.02**	(2.50–3.65)
Poor hearing	2832	39.0	359	46.2	1.51**	(1.24–1.82)

[a]Unweighted counts.
[b]Weighted percentages.
*$p \leq 0.05$, **$p \leq 0.001$.

Multivariate analysis

The factors that attained statistical significance in the univariate analyses were then included in a series of multivariate logistic regression models for men and women separately and stratified by age group (Tables 3 and 4). Table 5 shows the p-values for tests of the interactions between each factor and age and sex when the final model was estimated across all participants.

In the first step of each regression analysis, significant demographic variables were entered as predictors (age, having only primary education and marital status). In the second step, health-related factors including verbal fluency, immediate recall, number of chronic conditions, alcohol/substance abuse and smoking were added to the model. In the presence of these additional factors, education remained significantly associated with depressive symptoms only in adult women aged 50–64 years, whereas all other associations remained stable. Step 3 involved adding factors associated with chronic conditions such as number of medications, presence of an LLI, chronic pain, incontinence and sensory impairment. Some associations seen in the fully adjusted models differed significantly by sex and age category.

Age and sex differences in clinical factors

Cognitive function. Verbal fluency was associated with depression only in men and women who are 65 years and older. Immediate recall was associated with depression in women of all ages, but no association was observed in men.

Physical illness and medication use. Physical illness was associated with depression in the partially adjusted model (model 2) for both men and women of all ages. However, in the fully adjusted model, physical illness was associated with depression only in men and women who are 65 years and older. The inclusion of medications in the full model caused the association between physical illness and depression to lose significance for younger adults aged 50–64 years.

Differences in the effects of physical illness and of medication use were significantly different by age group ($p < 0.001$). The effects of pain and incontinence, although statistically significant in both sexes, were significantly stronger predictors of depressive symptoms in men than women ($p < 0.001$ for interaction terms). Smoking was associated with depressive symptoms only in women, and this sex difference was significant (Table 5).

Discussion

Overall in this population-based study of older Irish adults, we found that 10% of adults 50 years and older reported clinically significant depressive symptoms with a higher prevalence of depressive symptoms observed amongst women in all age groups.

Regardless of age and gender, chronic pain, disability, visual impairment and urinary incontinence are the most consistent correlates of depressive symptoms found in this study. Substantial evidence already exists in the literature linking pain and functional disability with depressive symptoms (Geerlings *et al.*, 2002, Yang and George, 2005); however, the association between incontinence and depressive symptoms is not well documented, particularly in men. Urinary incontinence is a significant health problem for older adults, and the prevalence increases significantly with age (Roberts *et al.*, 1998). It is also a common reason for admission to residential care where the prevalence of depressive symptoms is known to be much higher. Some studies (Sims *et al.*, 2011) suggest that incontinence is only associated with depressive symptoms in older women; however, our findings suggest that incontinence is strongly associated with depressive symptoms in both men and women, and this finding is strengthened by the fact that the analysis controlled for limitations to physical mobility. Moreover, we found that among both age groups, incontinence was more strongly associated with depressive symptoms among men than women. Depression was seen in 20% of those reporting incontinence, suggesting that adults presenting for treatment of urinary incontinence should be screened for depression and greater awareness and treatment of incontinence in older adults could potentially reduce the prevalence of depression.

In our study, visual impairment was associated with depressive symptoms in all adults, whereas hearing impairment was not associated with depressive symptoms after adjusting for all other factors. We might have expected visual impairment to be associated with depressive symptoms only in those aged 50–64 years, given the literature (Rees *et al.*, 2010) suggesting it is the age at which individuals are dealing with loss that is critical to the development of depression. However, our results suggest that vision-specific distress is associated with depressive symptoms in all older adults regardless of age. Identifying older adults with high levels of distress from visual impairment could be a way to determine those at risk of depression and in need of early intervention. Older adults may benefit from early interventions focused on coping and dealing with the practical and social burden associated

Table 3 Multivariate logistic regression analysis of depressive symptoms for male adults who are 50–64 years and 65 years and older

	50–64						≥65					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	0.965	(0.93–1.01)	0.96	(0.92–1.00)	0.95*	(0.90–0.94)	0.97	(0.93–1.00)	0.96*	(0.92–0.99)	0.94*	(0.90–0.98)
Primary education	1.47*	(1.00–2.16)	1.31	(0.88–1.95)	1.13	(0.73–1.73)	1.55*	(1.01–2.37)	1.28	(0.81–2.02)	1.07	(0.66–1.75)
Never married	3.19**	(2.11–4.83)	2.87**	(1.87–4.40)	2.69**	(1.69–4.27)	2.07*	(1.21–3.55)	1.86*	(1.02–3.39)	2.23*	(1.17–4.25)
Widowed/separated/divorced	2.86**	(1.82–4.48)	2.06*	(1.27–3.32)	1.92*	(1.14–3.22)	1.52	(0.90–2.58)	1.38	(0.80–2.40)	1.38	(0.77–2.47)
Low verbal fluency			0.70	(0.25–1.92)	0.80	(0.26–2.40)			2.37*	(1.11–5.05)	2.64*	(1.14–6.08)
Immediate recall			0.94	(0.84–1.04)	0.98	(0.87–1.11)			0.90	(0.78–1.04)	0.94	(0.80–1.09)
No chronic conditions			1.25*	(1.09–1.41)	0.85	(0.72–1.01)			1.53**	(1.34–1.75)	1.24*	(1.05–1.47)
Alcohol or substance abuse			5.28**	(2.89–9.63)	4.24**	(2.17–8.28)			2.94*	(1.35–6.37)	2.29	(0.98–5.37)
Smokes			1.62**	(1.11–2.36)	1.34	(0.89–2.02)			1.12	(0.64–1.99)	1.01	(0.55–1.87)
Number of medications					1.18*	(1.07–1.29)					1.04	(0.95–1.14)
Limiting long illness					1.98*	(1.28–3.06)					1.38	(0.80–2.37)
Pain					2.67**	(1.79–3.97)					3.42**	(2.06–5.68)
Incontinence					3.15*	(1.54–6.42)					3.12**	(1.65–5.89)
Poor vision					2.10*	(1.29–3.42)					1.92*	(1.07–3.45)
Poor hearing					1.00	(0.58–1.24)					0.94	(0.56–1.58)

*$p \leq 0.05$, **$p \leq 0.001$.

Table 4 Multivariate logistic regression analysis of depressive symptoms for female adults who are ≤64 years and 65 years and older

	50–64						≥65					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	0.96*	(0.93–0.99)	0.95*	(0.93–0.98)	0.96*	(0.92–0.99)	0.963	(0.94–0.99)	0.94	(0.91–0.96)	0.90*	(0.90–0.96)
Primary education	2.41**	(1.85–3.14)	1.65**	(1.23–2.20)	1.35	(0.98–1.84)	1.74*	(1.27–2.38)	1.30	(0.93–1.84)	1.14	(0.80–1.63)
Never married	1.23	(0.78–1.92)	1.21	(0.76–1.92)	1.19	(0.74–1.93)	1.83*	(1.00–3.33)	1.63	(0.88–3.04)	1.42	(0.75–2.72)
Widowed/separated/divorced	2.36**	(1.80–3.09)	1.97**	(1.48–2.62)	1.83**	(1.35–2.48)	2.42**	(1.71–3.42)	2.13**	(1.48–3.07)	2.09**	(1.44–3.04)
Low verbal fluency			1.45	(0.85–2.49)	1.50	(0.86–2.64)			1.91*	(1.14–3.24)	1.88*	(1.08–3.26)
Immediate recall			0.87*	(0.80–0.95)	0.91*	(0.84–0.98)			0.83**	(0.70–0.92)	0.85*	(0.76–0.95)
No chronic conditions			1.33**	(1.21–1.45)	0.95	(0.85–1.07)			1.39**	(1.26–1.54)	1.22*	(1.08–1.38)
Alcohol or substance abuse			3.02*	(1.15–7.93)	3.20*	(1.15–8.92)			5.85*	(1.10–30.9)	11.2*	(1.76–71.4)
Smokes			2.13**	(1.64–2.76)	2.06**	(1.56–2.71)			1.85*	(1.24–2.75)	1.74*	(1.15–2.65)
Number of medications					1.13**	(1.06–1.20)					0.97	(0.90–1.04)
Limiting long illness					2.44**	(1.79–3.32)					1.70*	(1.16–2.50)
Pain					1.54*	(1.16–2.06)					1.80*	(1.26–2.58)
Incontinence					1.51*	(1.07–2.12)					1.70*	(1.14–2.51)
Poor vision					1.57*	(1.05–2.33)					1.71*	(1.12–2.60)
Poor hearing					1.54	(0.99–2.39)					1.21	(0.81–1.82)

*$p \leq 0.05$, **$p \leq 0.001$.

Table 5 The *p*-values for interactions terms in the final model

	Age group	Sex
	p-value	*p*-value
Age	0.40	0.76
Education	0.57	0.67
Never married	0.98	**0.01**
Widowed/separated/divorced	0.87	0.66
Low fluency	0.19	0.53
Immediate recall	0.28	0.18
Chronic disease	**0.00**	0.56
Substance abuse	0.71	0.63
Smoker	0.28	**0.03**
Medications	**0.00**	0.59
Limiting illness	0.13	0.43
Pain	0.42	**0.00**
Incontinence	0.63	**0.00**
Poor vision	0.92	0.25
Poor hearing	0.83	0.22

with visual or hearing impairment rather than being treated for depression.

In building our model of depression, we developed three steps that represented sociodemographic variables, chronic disease factors and conditions or factors that may mediate the effect of chronic disease on depression. This procedure generated some statistically significant differences in the association between physical illness and medications across age groups. Among those aged 50–64 years, the relationship between physical illness and depressive symptoms appears to be accounted for by medication use. This is in direct contrast to what is observed in adults 65 years and older where physical illness remains significantly associated with depression despite the inclusion of medications in the model. These results might suggest that in adults aged 50–64 years, it is the medications taken for chronic diseases that account for some of the increased risk for depression associated with comorbid physical illness. Future work will focus on whether this association is related to polypharmacy or the nature and dosage of specific medications.

Low verbal fluency was associated with depressive symptoms only in adults 65 years and older, although this age difference was not statistically significant (interaction effect $p = 0.19$). These results are in keeping with previous findings of a strong association between depression and executive dysfunction in older adults (Alexopoulos *et al.*, 2002). Interestingly, memory (measured by immediate recall) was associated with depressive symptoms only in women. It is possible that women may be more susceptible to the psychological and emotional impact of memory impairment although again the gender difference was not statistically significant. The causal and temporal relationship between depressive symptoms and cognitive function is currently of great research interest, and results thus far yield mixed findings. Future waves of TILDA will add to the evidence base in this area.

Depression is associated with cerebrovascular disease, and as a result, there is increasing interest in the potential role that risk factors for cerebrovascular disease might play in facilitating the clinical expression of depression (Thomas *et al.*, 2004). Cigarette smoking is an important, but potentially reversible, risk factor for cardiovascular diseases. The link between smoking and depression has been well documented in young people; however, smoking research and intervention efforts have largely neglected older adults, with older women particularly underserved (Brown *et al.*, 2004, Donze *et al.*, 2007). Our results extend the evidence base by showing that current smoking is much more strongly associated with depressive symptoms in women than men (*p*-value for gender difference, 0.03). Throughout adulthood, women show higher levels of depressive disorders than men and women are more prone to engage in negative affect-related smoking and to show stronger relations of life stressors to smoking maintenance or relapse (Livson and Leino, 1988, McKee *et al.*, 2003). For these reasons, the most plausible interpretation of our results is that in older adult women, it is depressed mood that increases smoking risk rather than smoking behaviour leading to depression and that treatment of low mood may be a target for smoking cessation among older women.

Strengths of the present study are the very large nationally representative sample with a high response rate and the comprehensive assessment of health-related and sociodemographic factors. A response rate of 60% is used as the threshold of acceptability for most journals; therefore, our response rate of 62% is robust for a study of older adults, given that survey response rates have been in steep decline for several years (Johnson and Wislar, 2012). Limitations are that the data were analysed cross-sectionally, and although we have used modification of regression effects to attempt to identify mediating relationships, we cannot make any direct inferences about causality. Depression was not formally diagnosed in our study; however, the CES-D instrument has been shown to have good validity with respect to depression in the older population, and CES-D is a well-validated measure of depressive symptomatology. Additionally, findings from a recent review of risk factors for depression (Vink *et al.*, 2008) showed no clear differences between risk factors for depressive symptoms and disorders, suggesting that these risk

factors are significant for the whole continuum of severity of depression.

In summary, we have identified age-specific and gender-specific clinical correlates of depressive symptoms among the older population, which may identify those most likely to present with depression in community settings. Some of the factors found to be associated with depression are potentially modifiable, in particular visual impairment and incontinence. Given the rapidly expanding population of older adults and the burden of morbidity represented by depression, more research is needed to fully understand the effects of these potentially modifiable factors and how they can be targeted to alleviate depression in the older population.

Key points

- In older adults, the risk of depression is increased by physical illness; however, the nature of this relationship is complex and unclear.
- Older adults are not a homogenous group, and some clinical correlates of depressive symptoms show specific age and gender distribution patterns.
- Physical illness is associated with depressive symptoms only in older adults (65+)—the association is mediated by medication use in adults aged 50–64 years.
- Pain and incontinence are stronger predictors of depressive symptoms in men compared with women.

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Conflicts of interest

There are no conflicts of interests to report.

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