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Exploring smoking, mental health and smoking-related disease in a nationally representative sample of older adults in Ireland – A retrospective secondary analysis

Annette Burns[a,*], Judith D. Strawbridge[b], Luke Clancy[c], Frank Doyle[a]

[a] Department of Psychology, Royal College of Surgeons in Ireland, Ireland
[b] School of Pharmacy, Royal College of Surgeons in Ireland, Ireland
[c] TobaccoFree Research Institute, DIT Kevin Street, Dublin 8, Ireland

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ABSTRACT

Objective: Smoking is the leading preventable cause of death among individuals with mental health difficulties (MHD). The aim of the current study was to determine the impact of smoking on the physical health of older adults with MHD in Ireland and to explore the extent to which smoking mediated or moderated associations between MHD and smoking-related diseases.

Methods: Cross-sectional analysis of a nationally representative sample of 8175 community-dwelling adults aged 50 and over from The Irish Longitudinal Study on Ageing (TILDA) was undertaken. Multivariate adjusted logistic regression models were used to assess the association between MHD, smoking (current/past/never) and smoking-related diseases (respiratory disease, cardiovascular disease, smoking-related cancers). A number of variables were employed to identify individuals with MHD, including prescribed medication, self-reported diagnoses and self-report scales.

Results: MHD was associated with current (RRRs ranging from 1.84 [1.50 to 2.26] to 4.31 [2.47 to 7.53]) and former (RRRs ranging from 1.26 [1.05 to 1.52] to 1.99 [1.19 to 3.33]) smoking and also associated with the presence of smoking-related disease (ORs ranging from 1.24 [1.01 to 1.51] to 1.62 [1.00 to 2.62]). Smoking did not mediate and rarely moderated associations between MHD and smoking-related disease.

Conclusions: Older adults in Ireland with MHD are more likely to smoke than those without such difficulties. They also experience higher rates of smoking-related disease, although smoking had no mediating and no consistent moderating role in these analyses. Findings underscore the need for attention to the physical health of those with MHD including support in smoking cessation.

1. Introduction

1.1. Background

General population smoking prevalence has reached an all-time low of 19% in the UK and 19.5% in Ireland [1,2]. Mental health difficulties (MHD) as identified via various indicators including diagnostic or clinical interview, medical records, current psychiatric treatment, reported doctor diagnosed conditions or medication use, are consistently associated with higher smoking prevalences with rates cited ranging from 25.5 to 59% [3–9]. These increased smoking rates are most pronounced in those with substance use disorders and more severe mental illness (SMI) diagnoses such as bipolar disorder, schizophrenia or psychosis [6,7,10–13]. In general, those with MHD tend to smoke more heavily than other smokers [7] and also appear to be less likely to quit smoking [7]. While those with schizophrenia appear to be less likely to quit smoking [14], common mental illnesses such as anxiety or depression also seem to affect quitting behaviour [15]. For instance, meta-analyses have shown that in patients with chronic respiratory conditions or coronary heart disease patients with depressive symptoms are less likely to quit smoking than those without such depressive symptoms [16,17].

This higher prevalence of smoking has been associated with significant health consequences in those with MHD. People with mental health conditions die on average 10 to 20 years younger than the general population [18–22] and smoking has been reported as the largest contributor to this premature mortality [23,24]. In the US, Callaghan et al. found significantly heightened patterns of tobacco-

* Corresponding author at: Department of Psychology, Beaux Lane House, Mercer Street Lwr, Royal College of Surgeons in Ireland, Dublin 2, Ireland.
E-mail address: annetteburns@rcsi.ie (A. Burns).

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related mortality in terms of respiratory disease, smoking-related cancers and cardiovascular disease in patients with schizophrenia (standardised mortality ratio [SMR] 2.45 95% CI 2.41–2.48), bipolar disorder (SMR 1.57 95% CI 1.53–1.62) and depression (SMR 1.95 95% CI 1.93–1.98) [25]. Earlier studies have also shown increased risk of death from cardiovascular disease [4,22,26,27] and cancer [22,26]. Morbidity studies have also shown those with SMI have a significantly higher prevalence of pulmonary illness [3,28–33], cancer [28] and cardiovascular diseases (including stroke, congestive heart failure, angina and myocardial infarction) [28–30] compared to matched samples or general population counterparts [28–32]. While smoking is thought to account for the majority of morbidity and mortality in these populations, studies have also found associations between mental illness and respiratory disease, cardiovascular disease and risk of death from cardiovascular disease which seems to persist after adjustment for smoking [4,28,34]. However, the literature is limited by the range of conditions investigated, and the samples used are not always generalisable. For example, many of these studies focus on schizophrenia-related disorders and psychosis, though some have also included affective disorder diagnoses [28,32]. Partti et al.'s study of respiratory disease was population-based but only explored psychosis [3], while other studies were based on clinical populations with some reliant on small samples ranging from 80 to 100 [28,30,32]. The last study to address the impact of smoking on the physical health of those with MHD in Ireland is now over 30 years old, was specific to schizophrenia and was not population-based [35]. More generally, morbidity and mortality studies have tended to rely upon one or two indicators, such as structured clinical interviews, medical records, medical service claims or scale scores, but never more than two indicators when identifying those with MHD [3,4,25,27,29,34]. The use of a number of different methods is preferable to enhance the reliability of the findings.

In addition, chronic diseases such as cardiovascular disease and cancers usually occur later in life. Most cancer diagnoses occur in individuals older than 65 years [36] and CHD risk increases in both men and women after age 55 [37]. In spite of this, some studies of smoking prevalence in those with MHD have been limited to younger samples with age ceilings of 54 and 64 [7,10] and there are almost no studies of smoking or smoking-related morbidity or mortality specific to older populations. To our knowledge only one study exploring excess mortality in those with MHD concerns those aged 65 and older [27]. The impact of smoking on the physical health of older adults with MHD therefore remains unclear.

In summary, few population studies have explored smoking-related morbidity in older individuals with MHD and there are no recent studies addressing the health impacts of smoking in those with MHD in Ireland. This study had two aims. Firstly, to determine whether there is a higher prevalence of smoking and of smoking-related disease in older adults with mental health problems. Secondly, to assess whether smoking mediates or moderates the relationship between mental health difficulties and smoking-related disease at a population level. Given the absence of diagnostic interviews, several indicators were used both individually and in combination to reliably identify those with MHD. We hypothesized that persons with MHD would be more likely to have higher levels of smoking-related diseases, which would be explained by a higher rate of smoking.

2. Methods

2.1. The Irish Longitudinal Study on Ageing (TILDA)

TILDA provides a stratified clustered nationally representative sample of community dwelling adults aged 50 and over living in Ireland [38]. Private residential dwellings were assigned to clusters stratified by geography and socioeconomic group to produce a population representative sample. Across households where it was possible to make contact to confirm eligibility a response rate of 62% was achieved [39]. Population weighting was employed to counteract bias introduced by differential nonresponse [39]. The main sample was compared to Quarterly National Household Survey respondents on age, sex and educational attainment and consequent weights assigned [38]. A more detailed description of the study sample and response rates has been described elsewhere [40]. The current analysis involves the first wave which was collected between 2009 and 2011. Data collection involved an extensive face-to- face computer assisted home interview, a self-completion questionnaire for data deemed more sensitive and a health assessment. Health assessments were conducted at TILDA Assessment Centres in Dublin and Cork, or for those not willing to travel to TILDA Assessment Centres a shorter assessment carried out in their home by a qualified, trained nurse was offered. At wave one 5894 (72.1%) of the 8175 participants aged 50 and over completed a health assessment. All variables included in the current analysis were collected at both health centre and home assessments.

2.2. Outcomes

2.2.1. Smoking status

Self-reported current smoking status.

Those who reported ever smoking ‘cigarettes, cigars, cigarillos or a pipe daily for a period of at least one year’ and answered ‘Yes’ when asked if they smoked at the present time (including if smoked in past 3 months) were categorised as current smokers. In the initial part of this paper lifetime smoking prevalence (current/former/never) is the outcome, later it was explored as a potential mediator/effect modifier (to achieve the second aim). Smoking status data was available for 8174 respondents due to the refusal of one participant to answer this question.

2.2.2. Smoking-related disease

The presence of any one or more self-reported doctor diagnosed smoking-related diseases i.e. respiratory disease, cardiovascular disease or smoking-related cancers.

For the purposes of this analysis smoking-related cancer was defined as answering ‘Yes’ when asked if they were ever told by a doctor that they had cancer in any of the following sites: lung; colon or rectum; stomach; oesophagus; bladder; liver; cervix; kidney; pancreas; oral cavity; larynx; other pharynx (including nasopharynx, oropharynx, laryngopharynx or hypopharynx). These sites were identified based on the 2014 Surgeon General's report [41]. Cancer of the lip, the renal pelvis and acute myeloid leukaemia were not included as these were not specified in the TILDA study.

Respiratory disease was defined as answering ‘Yes’ when asked if they were ever told by a doctor that they had ‘chronic lung disease such as chronic bronchitis or emphysema’.

Cardiovascular disease was defined as answering ‘Yes’ when asked if they were ever told by a doctor that they had ‘angina’, ‘a heart attack (including myocardial infarction or coronary thrombosis)’, ‘congestive heart failure’, ‘high cholesterol’, ‘a stroke (cerebral vascular disease)’ or ‘Ministroke or TIA’.

Due to low numbers in two categories (respiratory disease (n = 330); smoking-related cancers (n = 135)) all three disease groups were combined to indicate having a chronic smoking-related disease (score = 1) or not (score = 0) for the purposes of this analysis.

2.3. Exposure variables

MHD: A number of variables were taken as indicators of evidence of MHD and used individually and in combination to model the association between MHD and smoking and between MHD and smoking-related disease.

An emotional, nervous or psychiatric problem was defined as answering ‘Yes’ when asked if they were ever told by a doctor that

they had 'any emotional, nervous or psychiatric problems, such as depression or anxiety'.

Alcohol or substance abuse was defined as answering 'Yes' when asked if they were ever told by a doctor that they had an 'alcohol or substance abuse' condition.

Psychiatric medication use: Participants were asked to bring medications to interviewer during the face-to-face home interview and all anxiolytics, antipsychotics and anti-depressants were included (ATC codes: N05B; N05A; N06A). Any participant who was taking one of these medications was considered to have MHD.

Psychometric scales:

- CES-D: The Center for Epidemiologic Studies Depression Scale (CES-D) is a 20-item self-report depression scale designed for epidemiological studies of depression [42]. Each item is measured on a 4-point Likert scale reflecting frequency of occurrence. A cutoff score of ≥ 16 is said to indicate clinically significant or severe depressive symptoms while a score of 8–15 is defined as moderate depressive symptoms [43–45]. This measure was administered during the face-to-face computer assisted home interview [39] and 8044 (98.4%) responded to all 20-items.
- HADS-A: The HADS-A is the 7-item anxiety subscale of the Hospital Anxiety and Depression Scale [46]. This self-report measure with a four option Likert-type response format was included in the self-completion questionnaire and returned by 6637 of the 8175 (81.2%) TILDA participants aged 50 and over. Zigmond and Snaith recommended cutoffs of > 8 and > 11 to detect possible and probable anxiety caseness [46].

For categorical scale variables, the 'probable anxiety' and 'severe depressive symptoms' categories were assessed as indicators of MHD.

2.4. Covariates

We adjusted for demographic variables (age, sex, education and marital status) when modelling smoking status. In modelling smoking-related disease other known confounders (physical activity, waist circumference, alcohol use and diabetes (self-reported doctor diagnosed)) were also included. Age and waist circumference were continuous, while all other covariates were ordinal/categorical. Physical activity was assessed using the short form 8-item version of The International Physical Activity Questionnaire (IPAQ) [47], which estimates time spent performing physical activities (moderate to vigorous) as well as inactivity (time spent sitting) [48]. Alcohol problems were identified using the CAGE questionnaire, a widely used and extensively validated screening tool for alcoholism, which was included in the self-completion questionnaire. A CAGE test score of 2 or more is said to identify problem drinkers [48,49]. Waist circumference was measured at the health assessment during wave one and so was only available for participants completing that component.

2.5. Statistical analyses

Key variables and demographic characteristics of the sample were compared according to smoking status using analysis of variance models and chi-square statistics as appropriate.

Multinomial regression analysis was performed to investigate the association between MHD and smoking. The models were weighted and adjusted for age, sex, education and marital status as these were all significantly associated with the outcome smoking status. The *margins* command in Stata provided adjusted prevalence estimates.

Multivariate logistic regression models were then employed to explore the association between MHD and smoking-related disease. These models were weighted and adjusted for potential confounders including socio-demographic characteristics (age, sex, education) and additional known risk factors (physical activity, waist circumference, alcohol use and diabetes (self-reported doctor diagnosed)). These covariates were identified based on the literature.

Baron and Kenny's four step approach was employed to test for mediation [50]. Firstly, as above, we tested to see if the independent variable, MHD, predicted the dependent variable smoking-related disease. Secondly, and also already encompassed in aim one, we tested to see if MHD predicted smoking. Thirdly, it was assessed whether the mediator, smoking status, predicted smoking-related disease even while adjusting for MHD. Finally, smoking status was added to models predicting smoking-related disease and changes in the association between MHD and smoking-related disease were observed for mediation effects.

Then, to test for any moderating role of smoking, interaction terms were also built and added to models.

Data analysis was performed using Stata 13.0 [51].

3. Results

3.1. Sample description

This analysis of TILDA included 8175 participants aged 50 years and over. As described above, due to missing values related to issues such as health assessment attendance and completion of the HADS-A the analytic sample ranged from 5024 to 8158. Sample sizes for each model are included below (Tables 2–4).

Overall 18.24% of respondents were current smokers and 38.1% were former smokers. The prevalence of MHD ranged from 1.60% (self-reported alcohol or substance use problem) to 9.49% (severe depressive symptoms as per CES-D) based on the various indicator variables. Almost half of respondents (45.9%) had at least one smoking-related disease at baseline. Cardiovascular disease was most prevalent (43.1%), followed by respiratory diseases (4.04%) and finally smoking-related cancers (1.65%).

Table 1 illustrates the main characteristics of the sample broken down by current smoking status. Age, sex, education and marital status were all significantly related to current smoking status. Current smokers were younger and more women had never smoked. Overall just 17.3% of those with a smoking-related disease were current smokers. Over half of those reporting a diagnosed smoking-related cancer were former smokers and almost a third of those reporting diagnosed respiratory conditions were current smokers.

As shown in Table 2, MHD was significantly associated with smoking status with relative risk ratios for former and current smoking ranging from 1.26 to 1.99 and 1.84 to 4.31 respectively when adjusting for potential confounders. Never smoker was taken as the base category. The adjusted current smoking prevalence ranged from 25 to 39% and was highest in the alcohol or substance abuse group. This compares to the crude smoking prevalence of 18.24% in the sample overall. Adjusted former smoking prevalence ranged from 38 to 41% which compares to 38% in the overall sample. The never smoking prevalence was particularly low in the self-reported doctor diagnosed alcohol/substance abuse group (Model 5) at 22%, albeit from the initially low absolute prevalence of 1.6%.

3.2. Smoking-related diseases among individuals with MHD

MHD was also significantly associated with smoking-related disease with odds ratios ranging from 1.24 to 1.62 (Table 3). The adjusted prevalence of smoking-related disease ranged from 53 to 60% and was highest in the alcohol or substance abuse group. This compares to a crude prevalence of 46% in the overall sample. As per Baron and Kenny's four steps for mediation, the independent variable, MHD, therefore predicted the dependent variable smoking-related disease (Table 3, middle columns) fulfilling the first step in Baron and Kenny's approach [50]. As per Table 2, the independent variable, MHD, also predicted smoking status thus fulfilling the second step. Further

Table 1
Demographics, physical and mental health and health behaviour characteristics of TILDA cohort (8174).

	Current smoker (n = 1491) 18.2%		Former smoker (n = 3117) 38.1%		Never smoker (n = 3566) 43.6%			
Continuous	Mean	SD	Mean	SD	Mean	SD	F	P Value
Age	61.3	8.87	64.9	9.82	64.0	9.93	69.7	< 0.001**
Categorical	N	%	N	%	N	%	χ^2	P Value
Women	811	18.3%	1387	31.3%	2233	50.4%	220.0	< 0.001**
Men	680	18.2%	1730	46.2%	1333	35.6%		
Education								
Primary/none	571	22.8%	990	39.5%	942	37.6%	113.2	< 0.001**
Secondary	619	19.0%	1165	35.7%	1479	45.3%		
Third/higher	300	12.5%	960	39.9%	1144	47.6%		
Marital status								
Married	920	16.3%	2179	38.7%	2538	45.0%	110.8	< 0.001**
Never married	162	20.5%	311	39.3%	318	40.2%		
Separated/divorced	186	33.8%	186	33.8%	179	32.5%		
Widowed	223	18.7%	441	36.9%	531	44.4%		
MHD indicator variables (exposure variables)								
Emotional, nervous or psychiatric problem (self-reported doctor diagnosed) ***Lifetime prevalence***	190	27.4%	254	36.6%	249	35.9%	45.7	< 0.001**
Self-reported psychiatric medication use(antidepressant, antipsychotic or anxiolytic) (**self-reported) *Current prevalence***	200	27.2%	269	36.6%	266	36.2%	46.4	< 0.001**
Antidepressant	148	26.4%	206	36.8%	206	36.8%	28.8	< 0.001**
Antipsychotic	40	36.0%	32	28.8%	39	35.1%	23.9	< 0.001**
Anxiolytic	49	28.6%	65	38.0%	57	33.3%	14.6	0.001*
Alcohol/substance abuse (self-reported doctor diagnosed) ***Lifetime prevalence***	57	43.5%	50	38.2%	24	18.3%	66.2	< 0.001**
Depression (CES-D) (n = 8044) ***Current prevalence***								
None/mild (7 or less)	737	**15.2%**	1873	**38.7%**	2230	**46.1%**	129.4	< 0.001**
Moderate (8–15)	422	**19.0%**	856	**38.5%**	944	**42.5%**		
Severe (16 +)	296	**30.2%**	342	**34.9%**	343	**35.0%**		
Anxiety (HADS-A) (n = 6637) ***Current prevalence***								
Normal (7 or less)	756	**15.1%**	1978	**39.4%**	2286	**45.5%**	78.6	< 0.001**
Possible (8–10)	199	**19.4%**	381	**37.2%**	444	**43.4%**		
Probable (11 +)	172	**29.0%**	201	**33.9%**	220	**37.1%**		
Any smoking-related disease (outcomes) ***Lifetime prevalence (self-reported doctor diagnosed)***	648	17.3%	1573	42.0%	1526	40.7%	44.0	< 0.001**
Respiratory	107	32.4%	143	43.3%	80	24.2%	70.0	< 0.001**
Smoker-related cancers	26	19.3%	69	51.1%	40	29.6%	12.3	0.002*
CVD	583	16.5%	1479	42.0%	1463	41.5%	40.0	< 0.001**
Other covariates								
IPAQ (physical activity) (n = 8096) ***Current***								
Low	517	19.9%	955	36.8%	1120	43.2%	11.5	0.022*
Moderate	459	16.5%	1087	39.0%	1241	44.5%		
High	500	18.4%	1044	38.4%	1173	43.2%		
Alcohol problem (CAGE score of 2 or more) (n = 6758) ***Lifetime prevalence***	215	26.4%	390	47.8%	210	25.8%	142.9	< 0.001**
Diabetes (self-reported doctor diagnosed) ***Lifetime prevalence***	110	17.3%	293	46.2%	231	36.4%	20.2	< 0.001**
Waist cm (mean and (SD)) (n = 5863) ***Current***	93.77	(13.9)	97.79	(14.0)	93.95	(13.5)	F = 55.9	< 0.001**

Smoking among individuals with MHD.

regression analyses confirmed that smoking status predicted smoking-related disease, with significant associations for former smoking (step 3). Finally in relation to step four, the addition of smoking status to models had virtually no impact indicating that smoking status was not a mediator of the association between MHD and smoking-related disease (Table 3, right columns) [50].

Table 4 presents results from the moderation analysis (see Appendix B for full models). All smoking and MHD interaction terms were non-significant when main effects were included in the model, except one. Past smoking appeared to have a negative moderating effect on the association between self-reported doctor diagnosed emotional, nervous or psychiatric problems and smoking-related diseases while current smoking had no significant moderating role, although effect sizes were similar. This would suggest that those who self-reported a doctor diagnosed emotional, nervous or psychiatric problem and were former smokers were less likely to have a smoking-related disease, although this result was not replicated in any other model, suggesting it may be spurious.

4. Discussion

We reported a number of important findings in a population-based dataset of older people, using multiple indicators of MHD to ensure robustness of findings. MHD, as evidenced by self-reported doctor diagnosed problems, psychiatric medication use and scores on anxiety and depression scales, was associated with smoking status in community living adults aged 50 and over in Ireland. MHD was also associated with the presence of a smoking-related disease i.e. respiratory disease, cardiovascular disease or a smoking-related cancer in this cohort. Contrary to our hypothesis, respondents' smoking status did not mediate the association between MHD and smoking-related disease. While it was expected that higher rates of smoking would be an important factor in the relationship between MHD and smoking-related disease, smoking did not fully explain the increased disease prevalence

Table 2
Adjusted multinomial regression models of smoking status (current/past/never) according to various indicators of MHD for TILDA cohort.

Model		n	Adjusted prevalence	Adjusted prevalence for no MHD	Adjusted RRR	95% CI	P value
1	Emotional, nervous or psychiatric problem **(self-reported doctor diagnosed)** ***Lifetime prevalence***	8154					
	Never smoker		34%	44%	(Base)		
	Former smoker		39%	37%	1.33	1.10–1.60	0.003*
	Current smoker		26%	19%	1.84	1.50–2.26	< 0.001**
2	Psychiatric medication use (**self-reported**) ***Current prevalence***	8158					
	Never smoker		35%	44%	(Base)		
	Former smoker		38%	38%	1.26	1.05–1.52	0.012*
	Current smoker		27%	19%	1.84	1.51–2.25	< 0.001**
3	Self-reported doctor diagnosed emotional, nervous or psychiatric problem **(*Lifetime*) and** self-reported any psychiatric medication **(*Current*)**	8158					
	Never smoker		33%	43%	(Base)		
	Former smoker		41%	38%	1.44	1.11–1.86	0.006*
	Current smoker		26%	19%	1.90	1.40–2.55	< 0.001**
4	Self-reported doctor diagnosed emotional, nervous or psychiatric problem **(*Lifetime*) or** self-reported any psychiatric medication **(*Current*)**	8158					
	Never smoker		35%	44%	(Base)		
	Former smoker		38%	38%	1.26	1.08–1.46	0.003*
	Current smoker		26%	18%	1.87	1.58–2.21	< 0.001**
5	Alcohol/substance abuse **(self-reported doctor diagnosed)** ***Lifetime prevalence***	8158					
	Never smoker		22%	43%	(Base)		
	Former smoker		38%	38%	1.99	1.19–3.33	0.009*
	Current smoker		39%	19%	4.31	2.47–7.53	< 0.001**
6	Alcohol/substance abuse **or** emotional, nervous or psychiatric problem **(self-reported doctor diagnosed)** ***Lifetime prevalence***	8158					
	Never smoker		34%	44%	(Base)		
	Former smoker		38%	38%	1.33	1.11–1.60	0.002*
	Current smoker		28%	18%	2.04	1.68–2.47	< 0.001**
7	CES-D ***Current prevalence***	8029					
	NONE/MILD	**(Base)**					
	Never smoker		46%		(Base)		
	Former smoker		38%				
	Current smoker		17%				
	MODERATE						
	Never smoker		41%		(Base)		
	Former smoker		38%		1.14	1.01–1.29	0.036*
	Current smoker		21%		1.33	1.15–1.54	< 0.001**
	SEVERE						
	Never smoker		35%		(Base)		
	Former smoker		38%		1.37	1.15–1.63	< 0.001**
	Current smoker		26%		2.27	1.88–2.75	< 0.001**
8	HADS-A ***Current prevalence***	6626					
	NORMAL	**(Base)**					
	Never smoker		45%		(Base)		
	Former smoker		38%				
	Current smoker		17%				
	POSSIBLE ANXIETY						
	Never smoker		41%		(Base)		
	Former smoker		39%		1.12	0.96–1.32	0.141
	Current smoker		21%		1.30	1.06–1.60	0.011*
	PROBABLE ANXIETY						
	Never smoker		36%		(Base)		
	Former smoker		38%		1.27	1.02–1.59	0.034*
	Current smoker		25%		2.02	1.59–2.56	< 0.001**

Weighted and adjusted for age, sex, education and marital status.

in this population. The various indicators of MHD revealed similar results. Associations with both current smoking and with smoking-related disease were strongest for self-reported doctor diagnosed alcohol/substance use. This was the first study to examine the burden of smoking on the physical health of those with MHD in Ireland at a population level.

The first aim of the current study was to establish the prevalence of smoking and the prevalence of smoking-related disease in older adults with MHD in Ireland. The higher rates of smoking among those with MHD compared to the general population have already been established in the UK, the US and Australia [7,9,23]. Between 2009 and 2011 the general population smoking prevalence among those aged 15 and over in Ireland fell from 24.6% to 22.9% [52]. In the current study adjusted current smoking prevalences of 25 to 39% were found among those with MHD while former smoking prevalences were 38 to 41%. This compares to current smoking prevalences of 25.5 to 59% among those with MHD [3–9] found in previous studies and lifetime prevalences between 55.3 and 81% with higher rates observed in those with psychosis [7,10,11].

Increased rates of tobacco-related disease [3,28–33] have also been shown. The adjusted prevalences of smoking-related disease in the current study ranged from 53 to 60%. Previous studies have found

Table 3
Adjusted logistic regression models of any smoking-related disease (respiratory disease, cardiovascular disease or smoking-related cancer) according to various indicators of MHD for TILDA cohort and with mediational analysis adjusting for smoking status (never/past/current).

Model								Mediation analysis		
		n	Adjusted prevalence smoking-related disease	Adjusted prevalence smoking-related disease for no MHD	Adjusted OR	95% CI	P value	Adjusted OR	95% CI	P value
1	Emotional, nervous or psychiatric problem **(self-reported doctor diagnosed)** ***Lifetime prevalence***	5176	53%	48%	1.24	1.01–1.51	0.036*	1.23	1.01–1.51	0.039*
2	Psychiatric medication use **(self-reported)** ***Current prevalence***	5176	55%	48%	1.38	1.12–1.70	0.002*	1.38	1.12–1.70	0.002*
3	Self-reported doctor diagnosed emotional, nervous or psychiatric problem **(*Lifetime*) and** self-reported any psychiatric medication **(*Current*)**	5176	57%	48%	1.46	1.11–1.93	0.007*	1.45	1.10–1.92	0.008*
4	Self-reported doctor diagnosed emotional, nervous or psychiatric problem **(*Lifetime*) or** self-reported any psychiatric medication **(*Current*)**	5176	53%	47%	1.27	1.07–1.50	0.006*	1.27	1.07–1.50	0.006*
5	Alcohol/substance abuse **(self-reported doctor diagnosed)** ***Lifetime prevalence***	5176	60%	48%	1.62	1.00–2.62	0.048	1.63	1.01–2.61	0.044*
6	Alcohol/substance abuse **or** emotional, nervous or psychiatric problem **(self-reported doctor diagnosed)** ***Lifetime prevalence***	5176	54%	48%	1.30	1.07–1.58	0.008*	1.30	1.07–1.58	0.008*
7	CES-D ***Current prevalence***	5114								
	NONE/MILD		46%							
	MODERATE		50%		1.10	0.96–1.26	0.160	1.10	0.96–1.26	0.190
	SEVERE		54%		1.44	1.18–1.75	< 0.001**	1.43	1.18–1.74	< 0.001**
8	HADS-A ***Current prevalence***	5024								
	NORMAL		47%							
	POSSIBLE ANXIETY		51%		1.10	0.93–1.29	0.261	1.10	0.93–1.30	0.256
	PROBABLE ANXIETY		55%		1.50	1.21–1.85	< 0.001**	1.50	1.21–1.85	< 0.001**

Weighted and adjusted for age, sex, education, physical activity (IPAQ), waist circumference, alcohol problem (CAGE) and diabetes.

Table 4
Moderation analysis: Odds ratios for smoking and MHD interaction terms for any smoking-related disease (respiratory disease, cardiovascular disease or smoking-related cancer).

Model		n	Adjusted OR	95% CI	P value
1	Emotional, nervous or psychiatric problem **(self-reported doctor diagnosed)** ***Lifetime prevalence***	5176			
	ˣ *Past smoking*		0.62	0.39–0.98	0.041*
	ˣ *Current smoking*		0.66	0.38–1.15	0.142
2	Psychiatric medication use **(self-reported)** ***Current prevalence***	5176			
	ˣ *Past smoking*		1.10	0.69–1.74	0.699
	ˣ *Current smoking*		1.14	0.68–1.91	0.627
3	Self-reported doctor diagnosed emotional, nervous or psychiatric problem **(*Lifetime*) and** self-reported any psychiatric medication **(*Current*)**	5176			
	ˣ *Past smoking*		1.02	0.53–1.96	0.962
	ˣ *Current smoking*		1.26	0.63–2.55	0.513
4	Self-reported doctor diagnosed emotional, nervous or psychiatric problem **(*Lifetime*) or** self-reported any psychiatric medication **(*Current*)**	5176			
	ˣ *Past smoking*		0.76	0.52–1.11	0.160
	ˣ *Current smoking*		0.77	0.49–1.21	0.257
5	Alcohol/substance abuse **(self-reported doctor diagnosed)** ***Lifetime prevalence***	5176			
	ˣ *Past smoking*		2.08	0.52–8.34	0.301
	ˣ *Current smoking*		0.83	0.22–3.08	0.779
6	Alcohol/substance abuse **or** emotional, nervous or psychiatric problem **(self-reported doctor diagnosed)** ***Lifetime prevalence***	5176			
	ˣ *Past smoking*		0.74	0.47–1.15	0.177
	ˣ *Current smoking*		0.68	0.41–1.13	0.139
7	CES-D ***Current prevalence***	5114			
	MODERATE				
	ˣ *Past smoking*		0.93	0.70–1.24	0.638
	ˣ *Current smoking*		0.84	0.56–1.25	0.389
	SEVERE				
	ˣ *Past smoking*		1.03	0.67–1.57	0.899
	ˣ *Current smoking*		1.14	0.69–1.88	0.605
8	HADS-A ***Current prevalence***	5024			
	POSSIBLE ANXIETY				
	ˣ *Past smoking*		1.23	0.85–1.77	0.270
	ˣ *Current smoking*		1.20	0.76–1.91	0.437
	PROBABLE ANXIETY				
	ˣ *Past smoking*		1.05	0.65–1.70	0.834
	ˣ *Current smoking*		0.86	0.50–1.48	0.588

Weighted and adjusted for age, sex, education, physical activity (IPAQ), waist circumference, alcohol problem (CAGE) and diabetes.

prevalences ranging from 0.9 (peripheral vascular disorder) to 61% (raised cholesterol) for cardiovascular conditions including cardiac disease and stroke. In relation to respiratory conditions, COPD prevalences of 6.8–45.7% [3,29–32] have been reported in previous studies. Cancer morbidity studies reporting prevalence according to MHD appear to be rare though a number of mortality studies have been published.

The second aim of this study was to uncover the impact of smoking on the association between MHD and smoking-related disease. However, although the diseases included were selected by the authors to show the burden of tobacco on the physical health of those with MHD in Ireland, in the current study smoking did not mediate this association. In general, smoking status had no moderating role in the association between MHD and smoking–related diseases either. The only exception was a significant negative moderating effect of past smoking on the association between self-reported doctor diagnosed emotional, nervous or psychiatric problems and smoking-related diseases. However given this was present in just one model and not a pattern seen across exposure variables no strong conclusions can be drawn. Previous studies involving psychiatric populations or those with SMI have found elevated odds of respiratory illness, cardiovascular disease and risk of death from cardiovascular disease which were not fully explained by smoking [4,28,34]. Researchers have suggested antipsychotic medications, diet, exercise [4] smoking intensity (dose-response relationship), inhaling more deeply (as has been indicated in schizophrenia) [53,54] and greater second-hand smoke exposure [28] may form part of the explanation. It should also be noted that in the current study, cardiovascular disease, which is known to have risk factors beyond smoking, accounted for the vast majority of smoking-related disease. High cholesterol was also responsible for a large proportion of this CVD and 66% of the overall smoking-related disease outcome variable was accounted for by those with high cholesterol alone. However, only minor changes were present in a few models when cholesterol was excluded as an outcome, and the overall pattern of results remained (see Appendix C). Respiratory disease and smoking-related cancers accounted for just 4% of the smoking-related disease outcome modelled. Other risk factors for cardiovascular disease such as physical activity were assessed in this study but may not have been accurate enough to account for all excess risk. For instance, while the IPAQ is said to have reasonable measurement properties for 18–65 year olds [47] its reliability with those aged 65 and over has been questioned [55]. It is also possible that other risk factors that were not assessed may be more important.

Overall, individuals with MHD are known to die younger [18–22] and tobacco-related deaths specifically also seem to occur at an earlier age than in the general population [56]. Given that the current study involved those aged 50 and over it is likely that a proportion of those with MHD are missing from the dataset as they have already died or were terminally ill and therefore not participating. Support for this is provided by the fact that for most MHD indicators (with the exception of medications) case respondents were significantly younger compared to the rest of the sample (data not shown). Only one of the studies cited above in describing excess morbidity and mortality was limited to an older population and it concerned those aged 65 and older and hospitalised for acute myocardial infarction [27]. Another study, linking 1213 inpatient records to death index data, found cigarette smoking contributed to an increased risk of death in schizophrenia patients particularly in those aged 35–54 years but that in older ages (55–69 years) mortality risk was actually lower for smokers [57]. Similarly, Bandiera et al. found persons with MHD, including substance

abuse, experience tobacco-related deaths at earlier ages than the general population but that after age 70 this pattern is reversed and tobacco-related deaths occur more often in the general population [56].

Although descriptive data indicated that former smokers had higher estimates of smoking-related disease and only former smoking (and not current) was predictive of smoking-related disease, as stated results from the mediation and moderation analysis show that past smoking did not explain the association between MHD and smoking-related disease. We should note in this older sample 38.1% were former smokers. Furthermore as stated this is a relatively healthy sample, missing those who have already died or were too unwell to participate.

5. Strengths and limitations

Strengths of the current study include the large nationally representative sample of older adults. The TILDA study with its robust methodology provides a detailed and rich population weighted dataset and the necessary power to adjust for many confounders. This large representative sample means results can be generalised to the population [39]. This study also included multiple measures of MHD from self-reported doctor diagnosed conditions to medication use to standardised scales.

This study was limited in that it is representative only of those aged 50 and over who are living in the community. Datasets which do not include younger people or other sectors of society, such as those not living in the community do not provide a full picture and are therefore likely to underestimate disease prevalence, particularly if those excluded tend to experience higher rate of disease and decreased life expectancy as is the case for those with severe mental illness [21]. Osborn et al. accessed the UK General Practitioners Research Database and achieved a large nationally representative community sample of people with SMI which included those in long-term care. However, as they acknowledged, homeless people may not be well-represented and as such the estimated risk of CHD death may still be even greater than it appears [4]. This is again especially relevant in the case of MHD given, as noted in the UK, the striking disparity of prevalence of psychiatric disorders in different subsections of the population [58]. In addition to these challenges in gaining representative samples of those with SMI the exclusion of those in residential care is also an issue as while this covers only around 2% of those aged 50 and over, it represents a greater proportion of those in older age categories and people in residential care tend to have more chronic disease [59]. Future research could look to include surveys of institutions and the homeless in addition to households.

This study also largely relied on self-reported doctor diagnosed conditions and involved an older population introducing issues including under diagnosis of conditions and under-reporting. This older sample in particular may potentially under-report conditions and medications due to memory but also due to stigma and social desirability bias [60], particularly in the case of questions around mental health within the context of a face-to-face interview. A 2007 national survey in Ireland revealed just over half of respondents agreed with the statement 'If I was experiencing mental health problems, I wouldn't want people knowing about it' [61]. Self-report data in relation to smoking has however been shown to be accurate in most studies [62].

In addition to potential underreporting, psychiatric medications such as benzodiazepines can be prescribed for short term conditions such as insomnia or as muscle relaxants for pain and thus would not necessarily indicate MHD. Furthermore the role which psychiatric medications themselves can play in terms of weight gain and metabolic effects is also a factor [63]. Nonetheless the similar pattern of results across models (including those based on self-reported doctor diagnosed MHD and scale scores) provides reassurance that this alone was not responsible for the increased risk of disease in those with indicated MHD after controlling for smoking.

Arguably some models were overfitted due to the inclusion of the CAGE questionnaire (for consistency of models) as a covariate when modelling the presence of smoking-related disease based on self-reported doctor diagnosed alcohol/substance abuse however removal had little impact on results (data not shown).

As with all observational studies we cannot rule out the potential for residual confounding. Finally, the fact that it was not possible to include cancers of the lip, the renal pelvis and acute myeloid leukaemia is a further limitation.

6. Conclusion

Among older community living adults in Ireland indicators of MHD was associated with a higher prevalence of current smoking and self-reported doctor diagnosed cardiovascular disease, respiratory diseases and smoking-related cancers. This increased risk of smoking-related disease remained even after adjusting for smoking status.

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Declaration of interests

The authors declare no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jpsychores.2017.05.005.

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