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Sleep issues and burnout in Irish farmers: A cross sectional survey

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ABSTRACT

Farming can be a demanding, solitary, and unpredictable occupation. As a result, farmers may be more susceptible to sleep issues and burnout than workers in other occupations. However, economic and social pressures that may cause burnout and sleep issues in farmers vary greatly between nationalities. There is a lack of research on sleep and burnout in European, and specifically Irish, farmers using reliable psychometric tests. Therefore, we conducted a cross-sectional prevalence assessment of sleep issues and burnout with a population sample of 351 Irish farmers. Using the Pittsburgh Sleep Quality Index (PSQI), a subscale of the Maslach Burnout Inventory (MBI), and the Short Form Health Survey-12 (SFHS), we identified how farmers' sleep and burnout were correlated with their mental and physical health and identified the role of individual differences such as socioeconomic status, age, and gender. Irish farmers reported frequent burnout (23.6%) and widespread sleep issues (50.1%), with burnt out farmers reporting especially poor sleep. This has serious implications for farmers' health, as burnt out farmers and farmers with poor sleep both reported worse mental and physical health. We identified age and parenthood as risk factors for burnout but identified no gender differences. While these exploratory findings are constrained by our cross-sectional design, they extend literature on occupational health risks in European agriculture to cover poor sleep and burnout. Irish farmers as a population need health intervention targeting sleep and burnout; especially in older and parent populations.

1. Introduction

Burnout and poor sleep have detrimental effects on the working population (Salvagioni et al., 2017; O'Hagan et al., 2017, Orzeł-Gryglewska, 2010). For example, after 20–25 h of sleeplessness, the resultant impaired task performance is equivalent to the effect of having a blood alcohol level of 0.10 % (Orzeł-Gryglewska, 2010). Research shows that burnout and sleep issues among workers results in poor psychological, physical and occupational well-being (Salvagioni et al., 2017; Orzeł-Gryglewska, 2010; O'Hagan et al., 2017; Winwood & Lushington, 2006). Farmers are a culturally unique occupational group because farming is entangled in meaningful ways with their identity, ancestry, and lifestyle (Vanclay, 2004). Because of this, it can be challenging for farmers to manage their work and home life balance (McShane & Quirk, 2009).

For example, farmers rarely take vacation from their work because of challenges with arranging cover while they are away (Irish Farm Accountancy Council, 2021). In addition to this demanding workload, farmers may also experience external pressures relating to the economy, unpredictable weather, or livestock diseases (Brennan et al., 2022; Thelin & Donham, 2016; Glasscock et al., 2006). Farming demands and activities also vary across single working days and according to seasonal requirements (Lilley et al., 2012). Specifically in Ireland and Europe where family farming is the predominant model (see Eurostat, 2020; Central Statistics Office, 2020; Balaine, 2019), a day's work could include both manual labour (e.g. managing livestock and machinery) and business management (e.g. tracking sales, purchasing feed; see Glasscock et al., 2006). Furthermore, many farmers in Ireland are part-time, with 42 % of farm holders working part-time at other occupations to support farm income. As a result of these complex occupational demands and their culturally unique position, Irish farmers as a group may be especially susceptible to sleep issues and burnout.

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High rates of sleep issues may be especially dangerous for farmers, contributing to a cycle of poor mental and physical health. Drowsiness can lead to impaired decision making, attention and reaction time (Flin and O'Connor, 2017) while working. This is concerning considering the hazards associated with farm work, including the operation of heavy machinery, exposure to chemicals and handling of large livestock (Shortall et al., 2018). Research on sleep in farmers has indicated that sleeping less than 7.5 h (Choi et al., 2006; Lilley et al., 2012), using sleep medication, and having sleep apnea symptoms (Spengler et al., 2004; Heaton et al., 2010) are associated with farm-related injuries. These injuries themselves may exacerbate sleep issues which are more prevalent among farmers with musculoskeletal issues (Tangtong et al., 2022) and work-related injuries (Du et al., 2022) compared to those without.

Experiencing sleep issues can also threaten farmers' mental health (see Hamilton et al., 2007) and is positively associated with psychological disorders such as depression (Hawes et al., 2019). Indeed, sleep dysfunction is a qualifying symptom of major depressive disorder according to the DSM-5 TR (American Psychiatric Association, 2013). Furthermore, due to the heavy occupational demands, farmers are vulnerable to the exacerbating role that sleep issues can have on their mental health and may experience work strain and occupational stress as a result (Chengane et al., 2021). The heavy demands of farming also put farmers at risk of experiencing burnout (Jones-Bitton et al., 2019). Burnout refers to exhaustion, a sense of alienation from one's work, or feelings of negativism or cynicism related to one's work; and reduced professional efficacy due to chronic workplace stress (World Health Organization, 2019). According to a recent review, an average of 13.72 %- 25 % of farmers experience burnout (O'Shaughnessy et al., 2022). Burnout is associated with significant economic, psychological, and social costs (Salvagioni et al., 2017; Rosch, 2001) and in the case of farmers, this can affect not only the well-being of individual farmers and their families, but also the agricultural sector and food supply at-large.

Important demographic dimensions of age, gender, and nationality may shape farmer's experiences of sleep issues and burnout. In rural populations, sleep issues including altered sleep patterns, challenges getting to sleep, and reduced sleep time, can occur with increasing age (Habte-Gabr et al., 1991; Ganguli et al., 1996). However, age differences in sleep issues are less examined within the farming population. Similarly, female farmers report higher burnout than male farmers (O'Shaughnessy et al., 2022; Zaharia et al., 2018). This could be for a multitude of socio-cultural reasons and the degree to which female farmers fulfil more traditional gender roles such as bearing a heavy domestic workload in addition to farm-related work (Hagen et al., 2021). Additionally, Irish agricultural policies fundamentally shape the administrative workloads and financial pressures on farmers (Furey et al., 2016), potentially exacerbating burnout. Therefore, Irish farmers' sleep issues and burnout warrant further examination.

However, while the exacerbating relationship between burnout and sleep issues is well established in high-pressure occupational groups such as medical professionals (Sayılan et al., 2021; Vela-Bueno et al., 2008), teachers (Pohl et al., 2021; Souto-Manning & Melvin, 2022), and social and emergency services (Sørengaard & Saksvik-Lehouillier, 2022), similar research in Irish and European farmers is lacking. Most of the current research on farmer's sleep issues is based on North American populations and limited by the absence of standardised measures (O'Shaughnessy et al., 2022). At the time of writing this article, no studies on farmers' sleep issues had been conducted in a European context. Similarly, farmer burnout has been examined in North America, Europe, Oceania and North Africa (O'Shaughnessy et al., 2022), but not in an Irish context. Similar to research on sleep, the burnout literature is limited by a lack of standardised burnout classification methods (O'Shaughnessy et al., 2022; Leiter & Maslach, 2016).

In the present study we aim to examine three connected research questions in Irish farmers: (1) what is the rate of, and the relationship between, farmers' burnout and sleep issues, (2) how are farmers' burnout and sleep issues associated with their mental and physical health, and (3) what are individual differences in farmers' burnout and sleep issues including farm type, size, and income, as well as family, gender, and age.

2. Methods

2.1. Participants

Eligible participants were all adults over the age of 18 who self-identified as farmers. In Ireland where a family farming system is the norm (Eurostat, 2020; Balaine, 2019), a farm may be actively worked and managed by many people who identify as farmers despite being owned by a single designated farm holder. Therefore, our source population included both designated farm holders and farmers otherwise at work on and managing farms. Participants included both full-time farmers and farmers who worked in other occupational roles to supplement farm income. Participants included farmers of any principal farming type (e.g. dairy, beef, sheep, pig, equine, tillage, organic), and any gender. To determine sample size, we used the online calculator provided by openepi.com (Dean et al., 2013) which follows the statistical formula developed by Schaeffer et al. (1990). Based on the total national sample of farm holders (N = 135,037) as well as family members (N = 114,300) actively farming (total N = 249,337; Central Statistics Office, 2020), our use of cross-sectional design, and desired confidence intervals (90 %), we determined that 271 participants would be sufficient.

2.2. Measures/Instrumentation

An 81-item anonymous survey that took approximately 15 to 20 min to complete was employed as part of a larger study on farmers' mental health literacy and help-seeking. This paper focuses only on participant characteristics, (physical and mental health), sleep, and burnout outcomes (see supplementary material). To determine readability and comprehensibility, a paper and online version of the survey was pilot tested with 10 farmers who represented the general farming population in gender and age characteristics.

2.3. Participant demographics and health

We collected participant demographic information relevant to our research questions regarding the rate of burnout and sleep issues in Irish farmers. We recorded participants' age and gender, and did not record sexual orientation, race, ethnicity, or country of birth. We recorded farm information from participants including the primary farm type (e.g. dairy, beef, tillage), whether participants farmed full or part-time or had another job off-farm, farm size, overall net income, and farm-specific net income.

While we did not record participants' ability or diagnostic history, we did enquire about their experience relevant to mental health, physical health, and substance use. A list of 15 common physical issues (e.g. diabetes, arthritis, weight issues, heart disease, bowel problems) was presented and participants selected whether they had none or, one or more of the issues listed. A text box was provided to name other issues that were not listed. A list of 10 common mental health issues (low mood, depression, anxiety, bipolar disorder, etc.) was also presented with an option to include others not listed. To measure substance use issues, participants were required to indicate whether they had no substance use issues, alcohol abuse or dependency disorder, substance abuse or dependency disorder or both a mental health and substance use or alcohol abuse or dependency disorder. A dichotomous variable was created for each of the physical issues, mental health issues and substance use scales. If participants identified as having a physical, mental or substance use issue this was coded as '*yes*' or if they did not have one, '*no*'.

2.4. Sleep issues

We measured sleep issues using items 1–9 of the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). The PSQI measured sleep issues across seven components: sleep quality, latency (or the duration it takes to fall asleep), duration, efficiency, disturbance, use of sleep medication and daytime dysfunction. To maintain clarity throughout, we use 'sleep issues' to describe any or all challenges to good sleep. Specific terms, such as sleep quality, refer only to a specific subscale of the PSQI. Items 1–7 assess sleep issues in the previous month with a 4-point Likert response scale ranging from 0= "*not during the past month*" to 3= "*three or more times a week*". Item 8 refers to enthusiasm to get things done, and respondents rate this on a 4-point Likert scale ranging from 0= "*no problem at all*" to 3 = "*a very big problem*". Item nine refers to sleep quality and respondents rate this on a 4-point Likert ranging from 0 = "*very good*" to 3= "*very bad*". Items corresponding with each of the seven components are scored from 0 to 3 and summed to make a global score (range 0 to 21) where a higher score indicates poorer sleep. It has demonstrated construct validity (Mollayeva et al., 2016) and reliability ($\alpha = 0.73$, Nicassio et al., 2014; Tomfohr et al., 2013). We chose to exclude item ten on having a bed partner/roommate for brevity and because it does not contribute to the overall measure score. The PSQI scale had good internal consistency (Cronbach's $\alpha = 0.74$).

2.5. Burnout

A single-item burnout measure (Freeborn, 2001; Schmoldt et al., 1994; Williams et al., 1999) derived from the Maslach Burnout Inventory emotional exhaustion (EE) subscale was used to measure burnout. Participants were asked to define burnout for themselves and to rate their level of burnout on a 5-point Likert scale from 1= *"I enjoy my work. I have no symptoms of burnout;*" to 5= "*I feel completely burned out and often wonder if I can go on. I am at the point where I may need some changes or may need to seek some sort of help."* A score of ≥ 3 on this item indicates the presence of burnout. The single-item burnout measure has demonstrated construct and discriminant validity (Dolan et al., 2015; Rohland et al., 2004), and is widely used in investigations of burnout and health (Edwards et al., 2018; Abraham et al., 2021; Bui et al., 2022; Rosen et al., 2023).

2.6. Procedure

A cross-sectional study design with convenience sampling was employed. Before data collection, research ethical approval was obtained from the [redacted for review] research ethics committee. The self-report survey was adapted for both online and in-person administration and participants provided informed consent. Data was collected from 12th July to 4th November 2022. Study information was advertised through national farming organisations, who displayed recruitment flyers on their social media pages. The study was advertised widely on relevant social media pages, and via word of mouth. Supplemental recruitment took place at local farming events (e.g. marts, farm walks and national agricultural shows) and at farm safety classes organised by a national farming organisation, where farmers were approached by the researchers and invited to participate.

The online survey was available on Qualtrics (Qualtrics XM, 2022). Digital data was downloaded from Qualtrics and imported to IBM SPSS version 28 (IBM SPSS Statistics for Mac, 2021). We recorded 513 online survey responses and removed 280 due to insufficient response (i.e. solely opening the survey or only completing demographic information). Including an additional 118 hard copy surveys that were completed in-person and entered into Qualtrics, we reached 351 total participants for analysis.

2.7. Statistical analysis

To test whether values were missing at random, we conducted Little's missing completely at random (MCAR) test on all measures (Little, 1988). We estimated missing values using the Expectation–Maximization technique in IBM SPSS (Dempster et al., 1977). Little's MCAR analysis indicated that all data was missing at random, with the exception of net income and farm net income. Predicted values for both variables could therefore not be obtained. Descriptive analysis was conducted to assess participant characteristics. Shapiro–Wilk's tests (Razali & Wah, 2011; Shapiro & Wilk, 1965) indicated that data for MBI single- item scale, PSQI scale and subscales, age, net income, farm net income, and farm size did not follow normal distribution.

An alpha level of 0.05 was used for all tests except our examination of PSQI scores, which used an adjusted alpha of 0.006. For normally distributed data, we employed Pearson's *r* and the Phi coefficient effect sizes with the following effect size classifications: 0.10 = small, 0.30 = medium and 0.50 = large effect size (Cohen, 1988). Global PSQI score and component scores were used for analyses. The Global PSQI score was also used to create a dichotomous variable to establish the rate of 'good' versus 'bad' sleepers (Global PSQI score > 5) (Buysse et al., 1989). Spearman's rank order correlation analyses were used to test the associations between non-normally distributed data: sleep issues and age, farm size, net income, farm net income, and full/part-time farming. Mann Whitney *U*-tests examined associations between burnout and age, farm size, farm net income, and net income; and between sleep issues and gender, children, physical issues, musculoskeletal issues, mental health issues and substance use issues. Kruskal Wallis tests with post hoc analyses examined associations between sleep issues and farm type. Chi-square tests of independence tested associations between burnout and gender, children, full/part-time farming, farm type, physical health issues, musculoskeletal issues, mental health issues and substance use issues.

The data that support the findings of this study are available from the corresponding author upon reasonable request.

3. Results

3.1. Participant characteristics

As more comprehensive demographic data is available on farm holders than other farmers, we used this group as a comparison point for our sample. There are important differences between our sample and farm holders nationally due to our inclusion of other farmers. Our sample was younger (mean age of 36 ± 13.7, range = 18–78 compared to 57), more likely to be female (24 % compared to 13 %), more likely to farm part- time (64.7 % compared to 42 %), reported a smaller net income (€34713.8 ± 126059.0. compared to €45,809), and had a smaller proportion of beef to dairy farmers (33.9 % and 31.9 % respectively compared to 55 % and 11 %) than the national average for farm holders (Central Statistics Office, 2020; Dillon et al., 2021). Many participants were employed in full-time off-farm roles (41.9 %). Over half of farms were < 100 acres (50.4 %, $n = 177$) with a mean of 148.8 ± 240.2. Most participants worked on farms operated by both the farm holder and their family (57.5 %), while many worked on farms operated solely by the farm holder (33.3 %). Most participants had no children (57.3 %). One-fifth did not report their net farm income (19.7 %). Total net income from the farm and off-farm employment was below €40,000 for 41.6 % ($n = 146$) with a mean total net income of €44871.8 ± 44767.3, while 18.8 % did not report their total net income. Table 1 displays demographic and farm-specific information.

3.2. Participant health characteristics

Over half of participants reported no physical health issues (51.6 %) or mental health issues (57.8 %) (Table 2). The vast majority reported no

Table 1
Demographic and Farm-Specific Information of Participants (N = 351).

Variable	Category	% (*n*)	Farm-Specific Variable	Category	% (*n*)
Age	18–25	25.9 % (91)	Farm employment	Part- time	64.7 % (227)
	26–39	39.6 % (139)		Full- time	35.3 % (124)
	40–59	26.8 % (94)	Principal farm type	Dairy/ dairy & dry-stock	34.5 % (121)
	60–69	6.3 % (22)		Livestock & crop	7.7 % (27)
	≥70	1.4 % (5)		Tillage	2.6 % (9)
Gender	Male	76.4 % (268)		Beef	34.2 % (120)
	Female	23.6 % (83)		Sheep	9.4 % (33)
Have children	No	57.3 % (201)		Other	11.6 % (41)
	Yes	42.7 % (150)	Net income (farm) €	<15,000	39.9 % (140)
Overall net income €	<15,000	15.1 % (53)		15,000—40,000	23.4 % (82)
	15,000—40,000	26.5 % (93)		40,000—60,000	7.0 % (24)
	40,000—60,000	21.4 % (75)		60,000—80,000	4.0 % (13)
	60,000—80,000	10.3 % (36)		> 80,000	6.8 % (23)
	> 80,000	10.0 % (35)		Unreported	19.7 % (69)
	Unreported	16.8 % (59)	Farm size (acres)	<50	20.2 % (71)
Off- farm role	None	33.3 % (117)		51–100	30.2 % (106)
	Part-time job	21.4 % (75)		101—150	20.0 % (70)
	Full-time job	41.8 % (147)		151—200	13.1 % (46)
	Part-time education	0.6 % (2)		201—300	10.5 % (37)
	Full-time education	2.8 % (10)		>300	6.8 % (24)
			Main farm staff	Farm holder	33.3 % (117)
				Farmer & family	57.6 % (202)
				Casual labourers	0.3 % (1)
				Permanent staff	2.0 % (7)
				Family & hired staff	9.7 % (34)

*%; Percentage; *n*; Number of participants.

Table 2
Health Issues Reported by Participants (N = 351).

Physical Health Issue	%	(*n*)	Mental health Issue	%	(*n*)
No physical health issues	51.6 %	181	No mental health issues	57.8 %	203
Asthma	10.5 %	37	Low mood	21.1 %	74
Arthritis	4.0 %	14	Depression	11.1 %	39
Heart disease	1.7 %	6	Anxiety	19.7 %	69
Diabetes	2.0 %	7	Social phobia/ anxiety	6.0 %	21
Weight issues	9.4 %	33	Panic disorder	1.2 %	4
High blood pressure	7.7 %	27	Other mental health issues	2.6 %	9
Thyroid issues	2.6 %	9	Addiction or substance use issues		
Bowel problems	3.1 %	11	No addiction or substance use issues	97.2 %	341
Back problems	21.4 %	75	Alcohol abuse or dependency disorder	2.3 %	8
Effects of stroke	0.3 %	1	Substance use dependency or disorder	0.3 %	1
Musculoskeletal issues	22.8 %	80	Both mental health and substance use disorder	0.3 %	1
Other physical health conditions	3.7 %	13			

*%; Percentage; *n*; Number of participants.

addiction or substance use issues (97.2 %).

3.3. Sleep issues

Half of participants (50.1 %, $n = 176$) were identified as "bad sleepers" with a PSQI score of > 5. Almost two thirds of participants reported 7 or below hours of sleep per night in the past month (62.7 %, $n = 220$) (Table 3). The mean PSQI global and component scores for participants are presented in Table 4.

There was a small, negative correlation between age and sleep latency ($r = -0.17$, $p < .001$), meaning older farmers fell asleep faster. However, sleep latency scores of participants with no children were significantly higher than participants with children ($U = 12360.0$, $p = .002$, $r = -0.16$). No other significant individual differences (age, gender, having children, farm size, farm income, principal farm type, farming full/part-time) were observed for global PSQI scores or component scores.

Table 3
Participants' Sleep Duration in Hours per Night in the Past Month (N = 351).

Hours slept	% (*n*)
< 5 h	4.3 % (15)
5–6 h	30.8 % (108)
hours	27.6 % (97)
> 7 h	37.3 % (131)

*%; Percentage, (*n*); Number of participants.

Table 4
Means and Standard Deviations for Pittsburgh Sleep Quality Index- Global and Component Scores.

Variable	*M* ± *SD*	Range
Global PSQI score	6.32 ± 3.47	0–16
1. Subjective sleep quality	1.12 ± 0.72	0–3
2. Sleep latency	1.12 ± 0.96	0–3
3. Sleep duration	1.02 ± 0.92	0–3
4. Habitual sleep efficiency	0.65 ± 0.97	0–3
5. Sleep disturbances	1.15 ± 0.55	0–3
6. Use of sleeping medication	0.11 ± 0.45	0–3
7. Daytime dysfunction	1.09 ± 0.77	0–3

M: Mean; *SD*: Standard deviation.

Participants with physical health issues had significantly higher global PSQI scores than others ($U = 18156.0$, $p = .003$, $r = 0.16$) indicating overall worse sleep. In addition, participants with physical issues had significantly higher sleep disturbances, ($U = 18420.0$, $p < .001$, $r = 0.21$), and daytime dysfunction scores ($U = 18423.0$, $p < .001$, $r = 0.19$) than participants with no physical health issues. Participants with musculoskeletal issues had significantly higher daytime dysfunction scores ($U = 12856.5$, $p = .005$, $r = 0.14$), than participants with no musculoskeletal issues. No other significant differences in physical health were observed for global PSQI scores or component scores.

Participants with mental health issues had significantly higher global PSQI scores than others, indicating more sleep issues ($U = 20364$, $p < .001$, $r = 0.31$). In addition, compared to participants with no reported mental health issues, participants with mental health issues had significantly worse subjective sleep quality ($U = 19125$, $p < .001$, $r = 0.27$), sleep latency ($U = 19332.5$, $p < .001$, $r = 0.26$), sleep disturbances ($U = 19104.5$, $p < .001$, $r = 0.29$), and daytime dysfunction scores ($U = 20856.5$, $p < .001$, $r = 0.37$). Higher scores indicate more sleep issues. No other significant differences in mental health issues were observed for global PSQI scores or component scores ($p > .05$). In addition, no differences for substance use were observed for the global PSQI and component scores.

3.4. Burnout

The rate of burnout among participants was 23.6 % ($n = 83$). A statistically significant difference between age and burnout was observed ($U = 12812.5$, $p = .036$) with a small effect size ($r = 0.11$). Ages of participants that were burnt out ($Mdn = 37$) were higher than those that were not burnt out ($Mdn = 32$). Participants with children reported significantly higher burnout (30.0 %, $n = 45$) than participants with no children (18.9 %, $n = 38$) with a small effect size ($\chi^2 = 5.23$, $p = .022$, $\varphi = 0.13$). While females reported slightly higher levels of burnout (27.7 %, $n = 23$) compared to males (22.4 %, $n = 60$), the difference was not significant ($p > .05$). No other significant differences in burnout were observed for farm size, farm income, farming full/part-time, principal farm type ($p > .05$).

Participants with physical health issues reported higher levels of burnout (30.8 %, $n = 53$) than participants without (16.8 %, $n = 30$) with a small effect size ($\chi^2 = 8.83$, $p = .003$, $\varphi = 0.17$). Participants with musculoskeletal issues reported higher levels of burnout (38.8 %, $n = 31$) than those without (19.2 %, $n = 52$) with a small effect size ($\chi^2 = 12.03$, $p < .001$, $\varphi = 0.19$). Participants with mental health issues reported higher levels of burnout (39.2 %, $n = 58$) than those without (12.3 %, $n = 25$) with a medium effect size ($\chi^2 = 32.77$, $p < .001$, $\varphi = 0.31$). In addition, no differences in burnout were observed for substance use ($p > .05$).

3.5. Association between burnout and Sleep issues

Greater burnout was associated with worse sleep across all measures. Significant associations were observed between burnout and the global PSQI score and for each of the component scores (Table 5).

Table 5
Associations Between Burnout and Sleep.

Variable	Total Mean ± *SD*	Burnout Mean ± *SD*		Burnout Median			
		Yes	No	Yes	No	*p*	*r*
Global PSQI	6.32 ± 3.47	9.07 ± 3.47	5.46 ± 3.00	9.0	4.5	<0.001	0.42
Subjective sleep quality	1.12 ± 0.72	1.54 ± 0.74	0.99 ± 0.67	2.0	1.0	<0.001	0.35
Sleep latency	1.12 ± 0.96	1.59 ± 1.13	1.06 ± 0.87	2.0	1.0	<0.001	0.21
Sleep duration	1.02 ± 0.92	1.59 ± 0.80	0.84 ± 0.89	2.0	1.0	<0.001	0.35
Habitual sleep efficiency	0.65 ± 0.97	0.99 ± 1.12	0.54 ± 0.90	1.0	0.0	<0.001	0.19
Sleep disturbances	1.15 ± 0.55	1.46 ± 0.61	1.05 ± 0.50	1.0	1.0	<0.001	0.31
Sleeping medication use	0.11 ± 0.45	0.25 ± 0.68	0.06 ± 0.34	0.0	0.0	<0.001	0.19
Daytime dysfunction	1.09 ± 0.77	1.65 ± 0.77	0.91 ± 0.68	2.0	1.0	<0.001	0.40

SD; Standard deviation; *p*; p value; *r*; Pearson's correlation effect size.

4. Discussion

In the present study, we examined three central research questions in a sample of the Irish farming community: what is the rate of and the relationship between farmers' burnout and sleep issues, how are farmers' burnout and sleep issues associated with their mental and physical health, and are there individual differences in farmers' burnout and sleep issues including farm characteristics such as farm type, size, and income, as well as gender and age? First, we identified that nearly one in four farmers (23.6 %) reported being burnt out and half of farmers (50.1 %) reported poor sleep. Burnt out farmers specifically reported significantly worse sleep than farmers in general. Second, farmers who reported mental or physical health problems were more likely to experience burnout and sleep issues. Third, we identified that burnout was more common in older farmers, and both burnout and sleep issues were more common in farmers with children. There were no significant gender differences across all measures.

4.1. Burnout and sleep in Irish farmers

We identified that rates of both burnout and sleep issues in our sample of Irish farmers were similar to, or greater than, those reported in other countries using similar assessment tools. Irish farmers reported high (24 %) rates of burnout, matching rates reported by farmers in New Zealand (25 %) and well above the average (13 %) reported across North America, Europe, and Australia (O'Shaughnessy et al., 2022). Internationally, farmers' livelihoods are shaped by socio-economic (O'Shaughnessy et al., 2022) and technological changes (Mc Cullough et al., 2008); in Europe specifically, these social changes have forced many farmers out of their occupation, placing more demands on a smaller number of farmers who are increasingly uncertain about their livelihoods (Eurostat, 2020). The COVID-19 pandemic, which increased social isolation in Ireland and across the world, (O'Sullivan et al., 2021) may have isolated farmers from their family, friends, and others in the industry that can help mitigate farmers' burnout (Jones-Bitton et al., 2019). The connection between these widespread cultural shifts and farmers' burnout (in Ireland and elsewhere) merits further study, with ethnographic methods particularly well-suited.

Our identification that half of Irish farmers in our sample reported poor sleep is concerning and supports findings that at least one fifth of farmers may struggle to sleep (Chengane et al., 2021; Botha & White, 2013; Lilley et al., 2012). While no study has assessed sleep issues in the general Irish population, nor in Irish farmers using the PSQI, rates of 50 % reported by our sample of Irish farmers is well above the 36 % reported in another European population sample from Germany (Hinz et al., 2017). Poor sleep is especially dangerous for farmers, who often operate heavy machinery and handle large livestock (Shortall et al., 2018), and can lead to farm-related injuries (Spengler et al., 2004; Heaton et al., 2010). Our findings indicate that Irish farmers may be at increased risk of farm-related injuries due to their poor sleep, and merit further analysis in a representative population.

Irish farmers who reported burnout also reported especially poor sleep across all dimensions of the PSQI, including quality, duration, efficiency, and daytime disruptions. This indicates the connection between burnout and sleep issues identified in workers across the medical field (Sayılan et al., 2021; Vela-Bueno et al., 2008) is also present in agriculture. Concerningly, sleep issues can cyclically lead to and exacerbate burnout and the depletion of one's mental and physical energy (Shirom, 1989). Therefore, the rate of burnout in our sample has dangerous implications; Irish farmers may be at increased risk of suffering this exacerbating relationship between burnout and sleep issues. As external pressures on farmers such as the economy and weather are highly regional (Thelin & Donham, 2016; Glasscock et al., 2006), future analyses should examine farmers' lived experiences of burnout and sleep issues to identify risk factors specific to Irish and European farmers. As farming often requires an irregular schedule, interventions

designed to improve farmer's sleep hygiene have the potential to improve both their burnout and sleep together (Brubaker et al., 2020).

4.2. Health implications

We identified that both burnt out farmers and those with sleep issues reported higher rates of both physical and mental health issues. Therefore, farming careers may have serious occupational hazards to mental and physical health (e.g. Brew et al., 2016; Shortall et al., 2018). These results highlight the role that sleep and burnout may play in farmers' increased risks of mental health issues when compared to general populations worldwide (Younker & Radunovich, 2021; Hounsome et al., 2012; Judd et al., 2006). Our findings also illustrate the often cyclical relationship between health, poor sleep, and burnout (e.g. Hawes et al., 2019; American Psychiatric Association, 2013; Salvagioni et al., 2017; Rosch, 2001) at work in the Irish farming community. For example, we observed that farmers with musculoskeletal issues reported higher burnout and worse sleep. As farmers usually face a wide variety of tasks from administration to hard labour (Glasscock et al., 2006), health concerns such as musculoskeletal issues may not only hamper sleep but also impact farmers' ability to manage and operate their farm, leading to burnout (Jones-Bitton et al., 2019).

Overall, our results also reflect Chengane and colleague's (2021) findings that farmers' mental health, physical health, and sleep are all intimately connected to their occupational performance and stress. Therefore, intervening at any point in this cycle stands to benefit the Irish farming community; interventions could improve farmers' sleep and burnout by addressing exacerbating musculoskeletal issues. The specific causal relationships between farmers' sleep, burnout, and health therefore have important implications for the development of interventions and merit further investigation.

4.3. Individual differences

Our demographic analysis of Irish farmers' sleep and burnout identified two potential risk factors: age and having children. First, while age usually exacerbates sleep issues in rural populations (Habte-Gabr et al., 1991; Ganguli et al., 1996), we identified that older farmers reported a higher rate of burnout instead. As our sample was younger on average compared to farm holders nationally (36 compared to 57 years), our observed rates of burnout may be an underestimation of those suffered by this group specifically. While the relationship between age and burnout is highly variable in the general population (Brewer & Shapard, 2004), the solitary nature of farming could place additional strain on aging farmers, leading to burnout (Daghagh Yazd et al., 2019). Additionally, farmers with children were significantly more burnt out and suffered greater sleep latency than those without children. Like burnout in other domains, parental burnout results from an increasing gap between perceived demands on parents and the resources they feel that they can offer (Mikolajczak et al., 2021). Both demographic risk factors introduce more complex demands on farmers whose resources may already be stretched thin from their challenging occupation alone and may struggle balancing life outside of work (McShane & Quirk, 2009). Interventions designed to target farmers and their families together are effective at helping farmers manage stress from both their occupational and familial demands (Brumby et al. 2009), and may be particularly well-suited to Irish farmers' familial culture (Balaine, 2019) and therefore effective at addressing burnout in both farming parents and older farmers.

Diverging from other populations of farmers where women faced greater rates of burnout (see O'Shaughnessy et al., 2022; Zaharia et al., 2018), Irish farmers were at high risk of sleep issues and burnout regardless of gender. While gender roles have changed rapidly in European agricultural families (Shortall, 2014; 2017; Balaine, 2019), little work has examined the role of gender in Irish farmers' health. Further work could identify health risks for Irish men and women specific to farming, or differences in qualitative experiences of sleep issues and burnout.

4.4. Limitations

Our findings and their implications should be considered with respect to the limitations of our study. First, our results are not a prevalence assessment but an analysis of the relationship between sleep, burnout, health, and individual differences in the Irish farming community. Therefore, as our sample included any self-identified farmers, our results are not representative of any single occupational group (such as farm holders). Similarly, our sample size of 351 should be understood as statistically representative of the wider farming community at a 5 % margin of error and 90 % confidence interval alone. Participants' low response rate to questions regarding net farm income indicate that future research should include multiple choices of income bands as well as a "prefer not to say" option. Additionally, our measure of burnout simplifies much of the information in the Maslach Burnout Inventory emotional exhaustion (EE) subscale, resulting in multiple varied options within a single item. Future work could capture more nuanced experiences of emotional exhaustion by using the full subscale. Our findings should be interpreted as observational only as we utilised cross-sectional analysis. Therefore, while our results may point towards processes that may worsen farmers' health, future work could investigate causal factors regarding sleep issues and burnout in the Irish farming community.

5. Conclusion

This study identified that farming in Ireland can carry notable occupational mental and physical health hazards. Among our sample of 351 self-identified Irish farmers, burnout is common and sleep issues are widespread, with nearly one quarter experiencing burnout, and one half facing poor sleep. These high rates have serious implications for farmers' health, as both burnt out farmers and farmers with poor sleep reported higher rates of physical and mental health issues. These findings imply that the concerning cycle of poor sleep, burnout, and health issues observed in other high- pressure occupations such as the medical field, is likely at play in the Irish agricultural sector. We identified two especially at-risk groups: burnout was especially common in older farmers and those with children. High rates of sleep issues and burnout in Irish farmers endanger the health and safety of not only farmers themselves, but their families and the entire Irish agriculture industry as well. As a result, we strongly recommend the design, implementation, and evaluation of interventions that target sleep issues and burnout in Irish farmers; especially in aging and parent populations.

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CRediT authorship contribution statement

Siobhan O'Connor: Writing – review & editing, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Anna Donnla O'Hagan:** Resources, Writing – review & editing. **Sandra M. Malone:** Investigation, Data curation, Formal analysis, Writing – review & editing. **Branagh R. O'Shaughnessy:** Writing – review & editing, Writing – original draft. **John McNamara:** Investigation, Resources, Writing – review & editing.

Joseph Firnhaber: Visualization, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssci.2023.106377.

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