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Investigating the Prevalence and Level of Pain Experienced by Australian Farmers

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ABSTRACT

Objectives: This study evaluated the prevalence and level of pain in Australian farmers and how these compare to the general working population. We also explored factors related to the interference of pain on farmers' work.

Design: Logistic regressions were used to examine the prevalence of chronic pain and pain interference with normal work among farmers compared to the general working population, and also to examine the factors associated with pain interference in farmers. A multinomial logistic regression model was used to examine the level of bodily pain among farmers compared to the general working population.

Setting: The nationally representative HILDA (Household, Income, and Labour Dynamics Australia) survey data (wave 21) was used.

Participants: The final sample included 168 (1.6%) farmers and 10 318 (98.4%) people in the general working population.

Results: There was a higher prevalence of chronic pain ($p < 0.001$), higher levels of bodily pain ($p < 0.001$), and pain interference with normal work ($p < 0.001$) in farmers than in the general working population. Age, gender, Body Mass Index (BMI), education level, remoteness, and personal social cohesion were not associated with pain interference with normal work in farmers.

Conclusion: The prevalence of chronic pain, level of bodily pain, and pain interference with normal work in Australian farmers is higher than the general working population. However, information is lacking on the factors that influence pain for this unique group. Further exploration is needed into why factors that are commonly associated with pain are not associated with pain in the farming population.

1 | Introduction

Farming is an important contributor to the Australian economy, producing commodities worth more than $80 billion per year [1], and employing approximately 250 000 people [2]. Farming can be viewed by outsiders as an idyllic way of life, but this has been termed 'the agrarian myth', given the poor physical and mental health outcomes experienced by many farmers [3].

Musculoskeletal disorders are highly prevalent among farmers. Many farmers prefer to self-manage their physical health concerns rather than seek assistance from health professionals, and they report structural, attitudinal and farm-related reasons for

Summary

- What is already known on this subject?
  - In many countries around the world, chronic pain is commonly reported among farmers.
  - The prevalence and the extent to which pain impacts upon the lives of Australian farmers is currently unknown.
- What does this study add?
  - This study reports that Australian farmers have a higher prevalence of chronic pain, higher levels of bodily pain, and higher levels of pain interference with normal work than the general working population in Australia.
  - The reported prevalence of chronic pain among Australian farmers is considerably lower than that of farmers in other countries, which may indicate that Australian farmers may view chronic pain differently and underreported their pain.
  - Common determinants of pain among general populations were not associated with pain interference among Australian farmers. Understanding the drivers that cause pain among Australian farmers is important to help them better manage pain.

this preference [4, 5]. After injury, farmers also tend to return to work without complete recovery and without necessarily being aware of the long-term consequences for their health and wellbeing [6]. Moreover, interviews with relatives of Australian farmers who died by suicide found that physical illness and pain had often been experienced in the lead-up to their deaths [7]. A Canadian study showed that 27% of farmers reported that pain is interfering with their normal activities [8].

However, little is currently known about the extent to which Australian farmers experience, and are impacted by, pain. Pain is known to be influenced by a wide range of contextual and cultural factors. Therefore, Butler and Moseley [9] point to the critical need to undertake local research in this area. Prevalence certainly varies between countries: United States-based studies have reported a prevalence of chronic back pain among farmers between 25% and 33% [10, 11]; a French population study reported 46% [12]; a Norwegian study of long-standing musculoskeletal pain among farmers reported 52% [13]. Australian data are thus far lacking. Our primary aim was to fill this gap by using population-level data to estimate the prevalence of pain and its impact on Australian farmers and how this compares to the general working population in Australia.

There is also a need to understand the factors that may be associated with, or contribute to, the problem of pain in farmers, in order to prevent and address it in at-risk groups. In the general population, common factors associated with more pain are greater age, female sex, and lower education level [12, 14]. Although social determinants have been identified as influencing the experience of many other health conditions, the pain field is lagging in this regard [15]. Therefore, the second aim of this work was to explore the extent to which chronic pain determinants identified in other populations relate to pain interference with normal work among Australian farmers.

2 | Methods

2.1 | Ethical Approval

Ethical approval was obtained from the University of South Australia Human Research Ethics Committee (project number: 205043). The researcher obtained approval from the Government of Australia—Department of Social Services (DSS) to gain access to HILDA data sets via the Australian Data Archive (ADA).

2.2 | Protocol

Our research protocol was lodged prior to undertaking data analysis and locked on Open Science Framework. DOI: doi.org/10.17605/OSF.IO/Q5ZVA. All deviations from that protocol are noted in this manuscript and described in Table S1.

2.3 | Data Source

The HILDA (Household, Income, and Labour Dynamics Australia) survey is a longitudinal, nationally representative, nationwide survey-based study funded by the Australian Government through the DSS. It has collected data annually since 2001 [16]. The current study used wave-21 data (restricted), which were collected in 2021 [17].

HILDA collects data through five questionnaires: the household questionnaire, the household form, the Self-Completion Questionnaire, and the Responding Person Questionnaires, which consist of the Continuing Person Questionnaire and the New Person Questionnaire. For this analysis, we used data from the Continuing Person Questionnaire, the New Person Questionnaire, and the Self-Completion Questionnaire. The Continuing Person Questionnaire and the New Person Questionnaire collect information related to biographical history, family background, employment history, education, relationships, and health. Everyone who completes a Continuing Person Questionnaire or New Person Questionnaire is given the Self-Completion Questionnaire to complete. The Self-Completion Questionnaire collects information related to general health and well-being, lifestyle and living situations, personal and household finances, attitudes and values, job and workplace issues, parenting, sex and age [16].

2.4 | Measures

2.4.1 | Demographic Variables

Age (calculated from date of birth) and gender (assessed by asking participants to identify if they are male, female or 'another term') were recorded.

Level of remoteness was calculated based on postcode using the Australian Statistical Geography Standard (ASGS) 2011 Remoteness Area (RA) with response options: 0) Major Cities, 1) Inner Regional, 2) Outer Regional, 3) Remote, and 4) Very Remote. For analysis purposes, the Outer Regional, Remote, and Very Remote categories were recoded into one category

representing 'Rural Australia' due to small numbers of farmers in the upper categories (Remote $n = 10$, Very Remote $n = 5$).

Education level was measured by asking participants to identify their "highest education level achieved", with response options: 1) Postgraduate – Masters or Doctorate, 2) Graduate Diploma, Graduate Certificate, 3) Bachelor or Honours, 4) Advanced Diploma, Diploma, 5) Certificate III or IV, 8) Year 12, and 9) Year 11 and below. Responses 1 to 3 were recoded to 'University Degree' and responses 4 and 5 were recoded to "Diploma or Certificate" for analysis. This aggregation was a deviation from our original protocol (see Table S1).

2.4.2 | Pain Variables

Three items related to pain: (1) prevalence of chronic pain (from the Responding Person Questionnaire [New Person Questionnaire or Continuing Person Questionnaire]; determined from the list of long-term health conditions, see Figure S1); (2) bodily pain in the last 4 weeks (from the Self-Completion Questionnaire); and (3) pain interference with normal work (from the Self-Completion Questionnaire). Development of these HILDA survey items was followed by extensive fieldwork, and based on items extracted from the standard 36-Item Short-Form Survey (SF-36), the Department of Family and Community Services (FaCS) and the Australian Bureau of Statistics (ABS) Survey of Training and Education. HILDA has consistently used these measures since 2001 [16].

2.4.2.1 | Prevalence of Chronic Pain. To assess the prevalence of chronic pain, participants were first asked whether they had any long-term health conditions that restrict their everyday activities and whether these have lasted or are likely to last for 6 months or more (Yes/No). If Yes, they were then asked to select from a list of health conditions, which included 'chronic or recurring pain'. For the current analysis, participants who responded 'No' to having any long-term health conditions or who identified other long-term health conditions but not 'chronic or recurring pain', were coded as 'No' (see Figure S1).

2.4.2.2 | Bodily Pain in the Past Four Weeks. Participants were asked 'how much bodily pain have you had during the past four weeks?' and to rate its severity on a 6-point Likert scale (1- No Bodily Pain, 2- Very Mild, 3- Mild, 4- Moderate, 5- Severe, and 6- Very Severe). Due to a small number of responses among farmers in the upper categories (Severe = 8, Very Severe = 2) the 'Moderate', 'Severe', and 'Very Severe' categories were combined for analysis. This aggregation was a deviation from our original protocol (see Table S1).

2.4.2.3 | Pain Interference With Normal Work. Participants were asked 'during the past four weeks, how much did pain interfere with your normal work?' and to rate the extent of interference on a 5-point Likert scale (1- Not at All, 2- Slightly, 3- Moderately, 4- Quite a Bit, and 5- Extremely). Due to a small number of responses among farmers in the upper categories (Quite a Bit = 7, Extremely = 2) compared to the lower and middle categories (Not at All = 63, Slightly = 52, Moderately = 22), the 'Not at All', and 'Slightly' categories were recoded into a new 'No Pain Interference' category, and the 'Moderately', 'Quite a Bit', and 'Extremely' categories were recoded into a new category representing 'Any Level of Pain Interference'. This recoding was a deviation from our original protocol (see Table S1).

2.5 | Independent Variables

Farming status was determined by classifying participants' reported occupations as either a Farmer/Farm Worker (ANZSCO 1212, 1213, 1214, 8412, 8415, 8416) or part of the General Working Population using the Australian and New Zealand Standard Classification of Occupations (ANZSCO).

Body mass index (BMI) was calculated using participants' recorded weight (in kilograms) and height (in meters).

Personal social cohesion was used as a measure of social support. The scale comprises three sub-scales representing Sense of Belonging (7 items; e.g., people don't come to visit me as often as I would like), Tangible Support (2 items; e.g., I often need help from other people I can't get), and Enjoyment (1 item; I enjoy the time I spend with people who are important to me). Item responses used Likert scales, with higher scores representing higher levels of each construct. We analysed each subscale separately.

2.6 | Exclusion Criteria

Aquaculture farmers (ANZSCO 1211), farm forestry and garden workers (ANZSCO 8400/8410), and other farm forestry and garden workers (ANZSCO 8419) were excluded from the study ($N = 20$) because they do not clearly fit within either the Farmer or the General Working Population categories. Farmers who resided in a major city ($N = 17$) were also excluded.

2.7 | Data Analysis

Data were analysed using SPSS version 28.0. A logistic regression examined whether the prevalence of chronic pain differed between farmers and the general working population. An ordinal logistic regression was initially planned for the analysis of the level of bodily pain, due to the ordinal nature of Likert scales; however, the proportional odds assumption of ordinal logistic regression was violated. Therefore, a multinomial logistic regression examined whether the level of bodily pain differed between farmers and the general working population. This was a deviation from our original protocol (see Table S1). An ordinal logistic regression was initially planned for the analysis of pain interference with normal work; however, due to small numbers in the different categories of pain interference with normal work, the pain variable was recoded into a binary variable, and a logistic regression examined whether pain interference with normal work differed between farmers and the general working population. This was a deviation from our original protocol (see Table S1). Finally, a logistic regression examined the association between pain interference with normal work andage, gender, BMI, education level, sense of belonging, tangible support, and enjoyment. This final analysis was limited to responses from farmers only.

Age, gender, and remoteness of residence were included as covariates in all analyses, based on previous research that indicates they may be associated with pain: age is positively related to pain [12]; women are more likely than men to live with chronic pain [14]; people living in rural areas report a significantly higher prevalence of chronic pain than people living in urban areas [18] and living in a rural area poses structural barriers to accessing healthcare [4]. Between remoteness of residence and socio-economic indexes for areas (SEIFA), only remoteness was included as a covariate, given the relevance of remoteness of residence to our research question and the need to limit covariates due to small numbers in some of our analyses.

Analysis for prevalence of chronic pain was weighted using the Responding Person Questionnaire weights. Analysis for bodily pain and pain interference with normal work was weighted using Self-Completion Questionnaire weights [16] (non-weighted data are provided in Tables S2–S4). However, we did not weight the last exploratory question examining the factors associated with pain interference with work, because this question was limited to farmers only ($N=137$), and weighting was deemed inappropriate for the small sample size [19]. Statistical significance was determined at the $\alpha=0.05$ level.

2.8 | Missing Data

Data were missing because 1) 820 (7.8%) participants did not return their Self-Completion Questionnaire, and 2) some participants who returned the Self-Completion Questionnaire chose not to answer a question (amount of missing data varies per question). All farmers answered the questions that we used to determine the prevalence of chronic pain in the Responding Person Questionnaire, but eight participants (0.08%) in the general working population did not. Out of 9666 people who returned the Self-Completion Questionnaire, 74 (0.77%) people did not answer the question related to bodily pain in the last 4 weeks, and 76 (0.79%) people did not answer the question related to pain interference with normal work (see Table 1). For bodily pain in the last 4 weeks and pain interference with normal work, age, gender, and remoteness were shown to be associated with the missingness of the data related to the Self-Completion Questionnaire (see Table 1). To address the non-random nature of missing data, and for the reasons outlined in the Data Analysis section above, covariates in each analysis included age, gender, and remoteness.

3 | Results

The total HILDA sample in wave 21 was 22 434 people, out of which 16 549 (73.8%) people were interviewed using the New Person Questionnaire and the Continuing Person Questionnaire. The final sample for the current study was 10 486 people. This included 168 (1.6%) farmers and 10 318 (98.4%) people in the general working population. Out of these 10 486 people, 9666 (92.2%) people returned the Self-Completion Questionnaire containing the assessment of bodily pain and pain interference questions. See Table 2 for sample characteristics.

3.1 | Prevalence of Chronic Pain

The weighted prevalence of chronic pain in the general working population was 4.4% and among farmers was 7.8%; after controlling for age, gender, and remoteness. Weighted prevalence of chronic pain was higher among farmers than it was among the general working population (OR = 1.13, 95% CI [1.11, 1.15], $p<0.001$) (see Table 3).

TABLE 1 | Summary of missing data and the association of completeness/incompleteness with age, gender and level of remoteness.

Pain-related question		General Working Population (n)	Farmers (n)	Age (p)[a]	Gender (p)[b]	Level of remoteness (p)[b]
Prevalence of chronic pain	Complete[c]	10 310	168	0.631	0.990	0.153
	Incomplete[d]	8	0			
Bodily pain in the last 4 weeks	Complete[c]	9446	146	< 0.001	< 0.001	< 0.001
	SCQ not returned[e]	800	20			
	Complete[c]	9446	146	0.117	0.010	0.097
	Incomplete[d]	72	2			
Pain interference with normal work	Complete[c]	9444	146	< 0.001	< 0.001	< 0.001
	SCQ not returned[e]	800	20			
	Complete[c]	9444	146	0.154	0.006	0.180
	Incomplete[d]	74	2			

[a] *T*-test.
[b] Chi square test.
[c] Number of participants in the sample who completed the specific pain-related question(s).
[d] Number of participants in the sample who did not complete the specific pain-related question(s).
[e] Number of participants in the sample who did not return the Self-Completion Questionnaire (SCQ).

TABLE 2 | Comparison of characteristics of the general working population ($n = 10\,318$) and farmers ($n = 168$).

	General working population		Farmers		
	n	**Mean (SD) or %**	***n***	**Mean (SD) or %**	**Sig.**
Age, (years)[a]	10 318	40.2 (14.3)	168	47.6 (17.0)	< 0.001
Gender[b]					
Male	5104	49.5	126	75.0	< 0.001
Female	5214	50.5	42	25.0	
Level of remoteness[c]					
Major City	7099	68.8	0	0.0	< 0.001
Inner Regional	2227	21.6	73	43.5	
Rural Australia	987	9.6	95	56.5	

[a]*T*-test.
[b]Chi square test.
[c]Fisher's test.

TABLE 3 | Odds of the weighted prevalence of chronic pain.

Prevalence of chronic pain	**OR**	**95% CI for OR**		**Sig.**
		Lower	**Upper**	
Farming status[a] (farmer/general working population)				
Farmer	1.13	1.11	1.15	< 0.001
Gender[b] (male/female)				
Male	0.75	0.75	0.75	< 0.001
Age	1.04	1.04	1.04	< 0.001
Remoteness[c] (Major Cities/Inner Regional/Rural Australia)				
Major Cities	0.62	0.61	0.62	< 0.001
Inner Regional	0.78	0.77	0.79	< 0.001

Note: Model: χ^2 (5) = 161036.07, $p < 0.001$, Nagelkerke $R^2 = 0.043$.
[a]The general working population.
[b]Female.
[c]Rural Australia.

3.2 | Bodily Pain in the Last Four Weeks

As shown in Table 4, considering no bodily pain as the reference category, there were greater odds ($p < 0.001$) of farmers reporting moderate to very severe bodily pain (24.8%) than the general working population (14.9%). In contrast, considering no bodily pain as the reference category, there were greater odds ($p < 0.001$) of the general working population reporting very mild (36.8%) and mild bodily pain (20.7%) than farmers (30.9% and 19.4%, respectively).

3.3 | Pain Interference With Normal Work

As shown in Table 5, there were greater odds of farmers reporting pain interfering with their normal work than the general working population; 18.5% of farmers and 11.8% of the general working population reported pain interference with normal work (OR = 1.35, 95% CI [1.33, 1.37], $p < 0.001$).

3.4 | Factors Associated With Pain Interference With Normal Work in Farmers

As shown in Table 6, age ($p = 0.186$), gender ($p = 0.435$), education ($p = 0.186$), BMI ($p = 0.692$), sense of belonging ($p = 0.378$), tangible support ($p = 0.454$), enjoyment ($p = 0.350$), and remoteness of residence ($p = 0.623$) were not related to pain interference with normal work in farmers.

4 | Discussion

The primary aim of this work was to use nationally representative population-level data to estimate the prevalence of pain and its impact on Australian farmers, as well as how this compares to the general working population. The secondary aims were to explore the factors associated with pain interference with normal work among Australian farmers. We found that farmers are more likely than the general working population to report chronic pain, bodily pain in the past 4 weeks, and pain interference with normal work. We found no association between pain and age, gender, BMI, personal social cohesion (sense of belonging, tangible support, enjoyment), highest education level, or remoteness of residence among the farmers in our sample.

A key finding was that pain seems to be experienced more commonly among Australian farmers than it is in the wider Australian population. This result is consistent with data from the United States of America (USA) [11], the United Kingdom (UK) and Europe [12, 20]. It should be noted that the prevalence and impact data obtained through the HILDA data set are substantially lower than other published data from the field. Reports from the USA [21], the UK [22], France [12], and Europe [23], have indicated pain prevalence between 12% and 52% (vs. 4.4% in HILDA). Other reports of the Australian general population have indicated prevalence of 15%–19% [24–27], which contrasts with the current findings.

The current study identified that 15% of the general working population and 25% of farmers had experienced moderate to

TABLE 4 | Odds of the weighted association between farming status and level of bodily pain.

Level of bodily pain	OR	95% confidence interval for OR		Sig.
		Lower	Upper	
Very Mild[a]				
Farming Status[b] (farmer/general working population)				
Farmers	0.64	0.63	0.65	< 0.001
Gender[c] (male/female)				
Male	0.96	0.96	0.97	< 0.001
Age	1.03	1.03	1.03	< 0.001
Remoteness[d] (Major Cities/Inner Regional/Rural Australia)				
Major cities	0.80	0.80	0.80	< 0.001
Inner regional	1.24	1.23	1.25	< 0.001
Mild[a]				
Farming status[b] (farmer/general working population)				
Farmers	0.70	0.69	0.71	< 0.001
Gender[c] (male/female)				
Male	0.76	0.76	0.77	< 0.001
Age	1.03	1.03	1.03	< 0.001
Remoteness[d] (Major Cities/Inner Regional/Rural Australia)				
Major Cities	0.71	0.71	0.71	< 0.001
Inner Regional	1.05	1.04	1.06	< 0.001
Moderate/Severe/Very Severe[a]				
Farming status[b] (farmer/general working population)				
Farmers	1.06	1.04	1.07	< 0.001
Gender[c] (male/female)				
Male	0.68	0.67	0.68	< 0.001
Age	1.05	1.05	1.05	< 0.001
Remoteness[d] (Major Cities/Inner Regional/Rural Australia)				
Major Cities	0.68	0.67	0.68	< 0.001
Inner Regional	1.19	1.18	1.20	< 0.001

Note: Model: χ^2 (15) = 724015.32, $p < 0.001$, Nagelkerke Pseudo $R^2 = 0.060$.
[a]No Bodily Pain.
[b]The general working population.
[c]Female.
[d]Rural Australia.

TABLE 5 | Odds of the weighted association between farming status and level of pain interference with normal work.

Pain interference with normal work	OR	95% CI for OR		Sig.
		Lower	Upper	
Farming status[a] (farmer/general working population)				
Farmer	1.35	1.33	1.37	< 0.001
Gender[b] (male/female)				
Male	0.81	0.80	0.81	< 0.001
Age	1.02	1.02	1.02	< 0.001
Remoteness[c] (Major Cities/Inner Regional/Rural Australia)				
Major Cities	0.87	0.87	0.88	< 0.001
Inner Regional	1.12	1.11	1.12	< 0.001

Note: Model: χ^2 (5) = 147089.63, $p < 0.001$, Nagelkerke $R^2 = 0.023$.
[a]The general working population.
[b]Female.
[c]Rural Australia.

TABLE 6 | Factors associated with pain interference with normal work in farmers ($N = 137$).

	OR	95% CI for OR		Sig.
		Lower	Upper	
Age	1.02	0.99	1.05	0.186
Gender[a] (male/female)				
Male	0.66	0.23	1.88	0.435
Body mass index (BMI)	0.98	0.90	1.07	0.692
Sense of belonging	0.76	0.42	1.39	0.378
Tangible support	0.84	0.53	1.33	0.454
Enjoyment	1.21	0.81	1.80	0.350
Education[b] (University Degree/Diploma or Certificate/Year 12/Year 11 and below)				
Diploma or Certificate	10.90	1.27	93.81	0.030
Year 12	7.24	0.62	84.67	0.115
Year 11 and below	8.50	0.97	74.14	0.053
Remoteness[c] (Inner Regional/Rural Australia)				
Rural Australia	1.27	0.50	3.24	0.623

Note: Model: χ^2 (10) = 14.66, $p = 0.145$, Nagelkerke $R^2 = 0.158$.
[a]Female.
[b]University Degree.
[c]Inner Regional.

very severe bodily pain in the last 4 weeks. Although care must be taken when comparing Australian Bureau of Statistics (ABS) data with HILDA data due to the differences in methodological and point-in-time analysis, this statistic is lower than 2020–2021 data from the ABS, which showed that 24.5% of people in the general population had experienced moderate to very severe bodily pain in the last 4 weeks [28]. Furthermore, in our study, 18.5% of farmers reported that bodily pain was interfering with their normal work; higher than in the general working population

(11.8%). This statistic from the general working population is similar to a 2001 Australian chronic pain study, which found that 11% of males and 13.5% of females in the general population reported any level of pain interference with daily activities [24]. Comparing with international research, a Canadian study showed that 28% of farmers reported pain interference with their normal work [8], which is higher than the current study. These differences in pain prevalence and impact data between studies could be due to differences in the definition of pain, duration of pain, study setting, and the sample characteristics both internationally and locally, and require further exploration using consistent measures in future research.

Why might pain be a bigger problem in farmers than it is in the wider population? One potential reason relates to the demographic characteristics of the sample. The farmers in our study were older on average than the general working population. Farmers have a significantly higher retirement age than other occupations [29] and may have been working for longer and with greater exposure to strenuous physical labour and occupational injury than the general population. Although we controlled for age, doing so does not also control for years of exposure to potential injury. Perhaps this contributes to the difference in bodily pain prevalence between farmers and the general population.

One additional factor we might expect to influence prevalence in the opposite manner is that three quarters of the farming sample was male, a greater proportion than that observed in the general working population. There could be differences in the duration of engagement with farm work and the types of farm activities that men and women traditionally undertake, and some of these could potentially lead to male farmers being more susceptible to occupational injuries and pain, notwithstanding their propensity to underreport such incidents [30]. Chronic pain is reported to be more prevalent in women than it is in men [14], while sex was controlled in our analysis; it is possible that the true disparity in prevalence between farmers and non-farmers is offset by sex-related predisposition, the role of the farm and the types of tasks undertaken, and thus greater than that observed here. It is also possible that the HILDA data missed some women farmers-women's roles on the farm are not always fully acknowledged as an occupation by women farmers themselves [31].

Another potential contributor to the greater prevalence of chronic pain in farmers relates to where people live. The majority of farmers included in this study were living in rural Australia (outer regional, remote, or very remote areas) whereas the general working population resided predominantly in metropolitan areas. Greater rurality is generally associated with greater relative socio-economic disadvantage [32], reduced access to healthcare, and delayed diagnosis and intervention for chronic illnesses [4]. Studies designed to better understand the differential impacts of *being a farmer* and *living rurally* would require direct comparison between farmers and non-farmers from the same location or at least the same level of remoteness, for example via a case–control approach. Studies that have used this approach and have compared health-related attitudes between farmers and other rural people have noted significant differences between the two groups; for example, the need for control and self-reliance has been found to act as significantly greater barriers to accessing professional support in farmers when compared to non-farming rural residents, and farmers are also significantly more likely to report difficulty understanding their health professional [33].

Therefore, it is also possible that higher pain prevalence in farmers reflects their attitudes and behaviours around pain specifically, or health in general. Prioritising the health of their farm over their own health, and perceiving the need to focus on completing routine farm tasks, rather than seeking health-related help [5], may elevate risk for chronic pain. In general, farmers report hesitation to accept that they have a health problem and seek support [34]. That the prevalence of chronic pain was much lower than the reported level of bodily pain and interference of pain with work, may also relate to attitudes. Farmers' perception about health has been shown to align with their capacity to function and complete their farm activities [35]. Furthermore, the HILDA questions about level and interference of pain focus on *any* pain within the last 4 weeks, meaning that reported pain may not have always been chronic. It is possible that farmers may not consider their pain to be a 'long-term health condition', but rather a short-term problem that affects their normal work. This may explain why more targeted questions about the short-term impact of pain gathered a greater response.

A further possible reason for the relatively low reported prevalence of pain in our sample is the wording and structure of the HILDA questionnaire. HILDA defines chronic pain as a condition lasting for 6 months or more (see Figure S1), which differs from the generally accepted definition as pain that lasts beyond normal healing time, often beyond three months [36]. As such, it is possible that some participants with pain lasting longer than 3 months but less than 6 months may not have been identified as 'chronic'. Second, as previously stated, some participants may not have viewed chronic pain as a long-term condition. Previous research evidence suggests that there are inconsistencies when defining chronic pain, which causes difficulties in predicting and monitoring the prevalence of chronic pain [37, 38].

A novel finding from this research is that we found no relationship between the level of pain interference with normal work and age, gender, BMI, sense of belonging, tangible support, enjoyment, highest education level, or remoteness in our sample of Australian farmers. This was a surprising result considering that general population studies have consistently shown an association between levels of pain and greater age, female gender, and lower education level [24, 39]. Importantly, these associations have not been demonstrated in farmers previously, which points to the importance of caution when generalising data from one population to another. A possible explanation for these inconsistencies may lie in the way that pain is conceptualised among farmers as compared to the general population. In general, it is thought that farmers are more likely to push through pain to focus on their work [40]. Further, it is possible that farmers may attribute pain to underlying health conditions rather than viewing pain as an independent problem. Therefore, in order to support farmers who experience pain, we need a greater understanding of what pain means to them and the unique factors that are relevant to their experience.

Despite being a comprehensive survey, HILDA is not primarily focused on health and wellbeing and the questions addressing pain are somewhat limited. Furthermore, the data is also limited in the extent to which farmers in the sample are described. For example, their farm type and primary role within the farming business (e.g., machinery operator, bookwork) are variables that are not captured in the data set but may potentially impact upon the prevalence and level of pain. However, to the best of our knowledge, HILDA is the only national survey in Australia that asks farmers about their experiences of pain and that enables a direct comparison to the general working population of Australia. There was also some missing data, primarily due to participants not returning the Self-Completion Questionnaire. The pattern by which data were missing is unlikely to have systematically affected our results, but we cannot exclude the possibility.

5 | Conclusion

This study suggests that the prevalence of chronic pain is higher among Australian farmers than it is in the general Australian working population. Prevalence across both groups was lower than expected, which may reflect limitations in the data collected, but it does not take away from this important finding regarding the difference between the two groups. Reports of bodily pain and pain interference with normal work were also higher among farmers than among the general working population. Well-known determinants of pain were not found to be significantly associated with pain interference with normal work among Australian farmers. This highlights the need to understand drivers of pain in this unique population as well as strategies to help farmers better manage their pain that are contextually and culturally appropriate for this at-risk group.

Author Contributions

Indika Koralegedera: conceptualisation, methodology, formal analysis, visualisation, writing – original draft, writing – review and editing, project administration. **Gemma Skaczkowski:** conceptualisation, methodology, formal analysis, visualisation, writing – review and editing, supervision. **G. Lorimer Moseley:** conceptualisation, visualisation, writing – review and editing, supervision. **Kate M. Gunn:** conceptualisation, visualisation, writing – review and editing, supervision.

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Ethics Statement

Ethical approval was obtained from the University of South Australia Human Research Ethics Committee (project number: 205043). The researcher obtained approval from the Government of Australia—Department of Social Services (DSS) to gain access to HILDA data sets via the Australian Data Archive (ADA).

Conflicts of Interest

G.L.M. has received support from: Reality Health, ConnectHealth UK, Institutes of Health California, AIA Australia, Workers' Compensation Boards and professional sporting organisations in Australia, Europe, South and North America. Professional and scientific bodies have reimbursed him for travel costs related to the presentation of research on pain and pain education at scientific conferences/symposia. He has received speaker fees for lectures on pain, pain education and rehabilitation. He receives royalties for books on pain and pain education. He is the non-paid CEO of the non-profit Pain Revolution, which delivers pain education and care services in rural and regional areas, and an unpaid Director of Pain Australia. The other authors declare no conflicts of interest.

Data Availability Statement

We used the HILDA (Household, Income, and Labour Dynamics Australia) wave-21 restricted data set [17], which needs approval from the Australian Government—Department of Social Services to gain access to its restricted data. Therefore, raw data would remain confidential and would not be shared.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.