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Chronic low back pain among tobacco farmers in southern Brazil

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Background: Despite tobacco farming involving intensive manual labor, chronic low back pain (CLBP) prevalence and associated factors are unknown among this occupational group.
Methods: This was a cross-sectional study conducted in southern Brazil. A random sample of tobacco farmers was interviewed. Socioeconomic and individual characteristics, occupational tasks, workloads, and comorbidities were investigated. Chronic low back pain prevalence was described in relation to independent variables, and associations were examined with Poisson regression.
Results: Chronic low back pain prevalence was 8.4%. Increasing age, rearing two or more species of livestock (PR 1.65), exposure to tasks that require heavy physical exertion (PR 2.00), working in awkward postures (PR 1.36), green tobacco sickness (GTS) (PR 1.63), pesticide poisoning (PR 2.37), and minor psychiatric disorders (PR 2.55) were associated with CLBP.
Conclusions: This study found that CLBP is a relevant health problem among tobacco farmers and highlights understudied risk factors such as pesticide poisoning and GTS. Policies to minimize exposure to physiological and chemical workloads in tobacco planting to prevent CLBP are needed. Health professionals should be trained to diagnose and prevent acute low back pain episodes and thus prevent/minimize limitations and disabilities due to CLBP.

Keywords: Chronic low back pain, Prevalence, Tobacco farming, Occupational health, Agriculture, Brazil, Musculoskeletal disorders

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Introduction

Low back pain is a highly prevalent disorder worldwide. Most cases are short lived with symptoms relieved within 3 months. However, approximately 10% of cases become chronic and are responsible for more than 80% of costs incurred through sick leave and early retirement.[1–3] Epidemiological data about chronic low back pain (CLBP) has many different case definitions, making it difficult to compare findings. Population-based studies have shown that CLBP prevalence ranges from 1.0 to 25.6%, with some studies suggesting an increasing prevalence in the general adult population.[4,5]

In urban occupations, CLBP prevalence ranges from 1.8% among industry workers in Russia to 19.4% among civil servants in Brazil.[6,7] Only one study from Thailand reported CLBP prevalence of 46.3% among rice farmers.[8] Despite findings that CLBP prevalence is high among farmworkers, it remains an understudied complaint with unknown prevalence for workers of certain crops.

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In many places, tobacco farming is predominantly manual requiring intensive labor. This work is physically demanding, and farmers are exposed to long hours, strenuous working conditions, awkward postures, heavy lifting, heat, nicotine, and pesticides.[9]

Despite Brazil being the second largest producer and largest exporter of tobacco worldwide, CLBP prevalence and associated factors are unknown among Brazilian tobacco farmers. This paper describes CLBP prevalence and associated factors among tobacco farmers in southern Brazil.

Materials and Methods

A large cross-sectional study of tobacco farmers' health was carried out in São Lourenço do Sul (SLS) – RS, in southern Brazil during the harvest season. A total of 2469 individuals aged $\geq$20 years were interviewed (5.9% loss and refusals). Estimating 8% CLBP prevalence with a precision of $\pm$2 percentage points and a 95% confidence interval (CI), prevalence between 6 or 7% among unexposed, an unexposed : exposed ratio varying from 1:1 (lifting) to 1:12 (awkward posture), and a risk ratio of 1.8, the study has statistical power of at least 80% to investigate associated factors for all the independent variables,

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with the exception of bottom leaf harvesting and tying hands of tobacco.

Random sampling was performed on 3852 invoices raised by SLS tobacco farmers in 2009, and 1100 farms were selected for the study. Invoices are the commercial instruments issued by all tobacco farmers when selling tobacco to the industry. This sampling procedure ensured the representativeness of the SLS tobacco growers. Community health workers familiar with the region identified selected farms.

Individuals were considered ineligible if they were not tobacco workers, lived in urban areas, or had moved to other cities. People with farms who were tobacco workers in 2009 but later quit were excluded and replaced by people from the nearest tobacco farm.

Data collection

Workers involved in tobacco production for at least 15 hours a week were eligible. Two questionnaires were administered: one for farms and another for individuals. Trained interviewers administered questionnaires using personal digital assistants (PDAs). The farm questionnaire included socioeconomic variables such as the amount of tobacco produced in the previous year (kilograms or tons), vehicle tax expenses in the last year (in Brazilian real R$), and agricultural diversification measured according to the following variables: milk production (yes/no), honey (number of hives), other crop production (number of species), and livestock production (number of species). The questionnaire for individuals included demographic (gender, age), socioeconomic (educational background), smoking history, occupational (history and tasks performed at work), comorbidities [green tobacco sickness (GTS), pesticide poisoning, and minor psychiatric disorders], and CLBP questions.

We collected information on occupational tasks including sowing, ridge planting, transplanting seedlings, cutting and/or pruning trees, climbing high into the curing barn, topping, bottom and/or top leaf harvesting, tying tobacco, and baling tobacco (no, sometimes, regularly/always). Work experience in tobacco production (years) and hours of work during the agricultural season were also recorded. Participants self-identified work tasks as requiring heavy physical exertion, working in awkward postures, prolonged sitting work, and lifting, and provided the average and maximum weights lifted.[10]

Green tobacco sickness in the last year was defined as the occurrence of dizziness or headache and nausea or vomiting within 2 days after tobacco harvesting.[11] Pesticide poisoning was determined with the question "Have you ever had pesticide poisoning in your life?"[12] Minor psychiatric disorders were measured according to the self-reported questionnaire (SRQ-20), which is a screening test primarily for anxiety and depressive symptoms. Scores ≥ 6 in men and ≥ 8 in women were used to denote a minor psychiatric disorder.[13]

To evaluate CLBP, subjects identified the site and the duration of pain. Low back pain was measured using a modified version of the original drawings from the standardized nordic questionnaire for musculoskeletal symptoms.[14] A drawing of a person in the supine and standing position with the lumbar, thoracic, and cervical regions painted in different colors was shown to the interviewees.[5,15] Respondents reporting pain in the lumbar region were asked the following question: "In the last year, have you continuously felt this pain for 3 months (90 days)?" Subjects answering positively were considered to have CLBP.

Analysis

Crude and adjusted analyses of the association between independent variables and CLBP were carried out using Poisson regression with robust variance and backward selection. The Wald heterogeneity test for dichotomous exposures and the Wald linear trend test for ordinal exposures were used for determination of statistically significant associations. Adjusted analyses followed a hierarchical model with demographic and socioeconomic variables on the first level, occupational (tasks performed in the previous year) and behavioral variables on the second level, workloads on the third level, GTS and pesticide poisoning on the fourth level, and minor psychiatric disorders on the fifth level. Variables with P-value ≤ 0.2 were maintained in the model and those with a P-value < 0.05 were considered to be significantly associated.

The Ethics Research Committee of the Federal University of Pelotas approved this study, and all participants provided informed consent.

Results

Less than 10 farms were not growing tobacco at the time of the fieldwork and were replaced by the next nearest tobacco farm. Approximately three-quarters of the tobacco farmers produced 2501–10 000 kg of tobacco in the last year and three-quarters had no livestock. Chronic low back pain prevalence tended to be higher among individuals who produced less tobacco and in those rearing two or more species of livestock (Table 1).

Most interviewees were men, less than 50 years old, and approximately half had less than 5 years of schooling. Bottom and top leaf harvestings were performed by more than 90% of tobacco farmers (Table 2).

Chronic low back pain prevalence in the sample was 8.4% (95% CI 7.3–9.5) with no significant difference between men (7.8%; 95% CI 6.4–9.2) and women (9.3%; 95% CI 7.5–11.1). Chronic low back

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pain prevalence among individuals aged 40–49 (12.7%; 95% CI 9.9–15.4) and ≥50 (12.2%; 95% CI 9.7–14.8) was five times greater than among those aged 18–29 (2.4%; 95% CI 1.3–3.6). Tobacco farmers with 4 years of schooling or less reported twice the prevalence of CLBP prevalence compared to farmers with over 9 years of schooling (11.7%; 95% CI 9.8–13.6) and (5.1%; 95% CI 1.8–8.3), respectively. There was no statistically significant association between CLBP and smoking history (Table 2).

Exposure to heavy physical exertion and lifting were reported by more than 60% of the interviewees. Tobacco farmers exposed to tasks requiring heavy physical exertion reported more CLBP (10.1%; 95% CI 8.7–11.6) than unexposed farmers (5.3%; 95% CI 3.8–6.7) (Table 2).

Of the sample, approximately 12% reported GTS in the last year and approximately 8% reported pesticide poisoning during their lifetime. Individuals reporting GTS had nearly twice the prevalence of CLBP compared to individuals with no GTS. People reporting pesticide poisoning had three times more CLBP than the reference group and those reporting minor psychiatric disorders had nearly four times more CLBP than those without minor psychiatric disorders (Table 2).

Education and lifting were excluded from the multivariable analysis, since they had inverse collinearity with age and direct collinearity with exposure to heavy physical exertion.

In the adjusted model, gender, smoking, and bottom leaf harvesting were not associated with CLBP. Rearing two or more species of livestock was a risk factor for CLBP (PR 1.65; 95% CI 1.14–2.38), and increasing age had a direct linear association with CLBP (Table 3).

Exposure to heavy physical exertion (PR 2.00; 95% CI 1.43–2.79), working in awkward postures (PR 1.36; 95% CI 1.02–1.82), GTS (PR 1.63; 95% CI 1.18–2.25), pesticide poisoning (PR 2.37; 95% CI 1.70–3.32), and minor psychiatric disorders (PR 2.55; 95% CI 1.88–3.47) were all statistically associated with CLBP in the adjusted model (Table 3).

Discussion

We found that CLBP prevalence among tobacco farmers was 8.4%. Gender, smoking, and bottom leaf harvesting were not associated with CLBP. Older age, rearing two or more species of animals, exposure to heavy physical exertion, awkward postures, GTS, pesticide poisoning, and minor psychiatric disorders were all statistically associated with CLBP.

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Table 1 Chronic low back pain (CLBP) among tobacco farmers in southern Brazil according to socioeconomic variables

			Prevalence	Crude analysis		
Variable	*N*	%	% (95% CI)[§]	PR	% (95% CI)[§]	*P*
Amount of tobacco produced (kg)						
1–2500	160	6.6	8.8(4.3–13.2)	1	–	0.01**
2501–5000	684	27.9	10.7(8.4–13.0)	1.20	0.70–2.07	
5001–10 000	1076	43.8	7.5(5.9–9.1)	0.86	0.50–1.47	
10 001–36 000	532	21.7	6.6(4.5–8.7)	0.74	0.41–1.34	
Vehicle tax expenses in the last year (R$)						
Free	264	11.0	9.8(6.2–13.5)	1	–	0.4**
≤500	955	39.7	8.2(6.4–9.9)	0.83	0.53–1.30	
501–1000	816	33.9	8.0(6.1–9.8)	0.81	0.51–1.28	
≥1001	372	15.4	7.5(4.8–10.2)	0.77	0.45–1.29	
Livestock rearing (species)						
No	1796	73.2	7.9(6.6–9.1)	1	–	0.02*
Up to one	436	17.8	7.1(4.7–9.5)	0.90	0.60–1.37	
Two or more	220	9.0	13.2(8.7–17.7)	1.68	1.14–2.46	
Honey production (hives)						
No	2009	81.8	8.2(7.0–9.4)	1	–	0.6**
1–5	255	10.4	8.2(4.8–11.6)	1.01	0.66–1.54	
≥6	193	7.8	9.4(5.2–13.5)	1.15	0.73–1.81	
Other crops production						
No	1177	48.1	8.0(6.4–9.6)	1	–	0.7**
One crop	664	27.1	8.1(6.0–10.2)	1.02	0.72–1.44	
Two crops	411	16.8	9.2(6.4–12.1)	1.16	0.79–1.68	
Three or more crops	194	8.0	7.7(3.9–11.5)	0.97	0.57–1.63	
Milk production						
No	1802	73.3	8.1(6.8–9.3)	1	–	0.5*
Yes	655	26.7	8.9(6.7–11.0)	1.10	0.82–1.48	

CI: confidence interval.
* Wald test of heterogeneity.
** Wald test for linear trend.
[§] 95% CI.

Table 2 Chronic low back pain (CLBP) among tobacco farmers in southern Brazil according to demographic, schooling, smoking, and occupational variables

			Prevalence	Crude analysis		
Variable	***N***	**%**	**% (95% CI)[§]**	**PR**	**% (95% CI)[§]**	***P***
CLBP	2468		8.4(7.3–9.5)			
Gender						
Male	1464	59.3	7.8(6.4–9.2)	1	–	0.18*
Female	1005	40.7	9.3(7.5–11.1)	1.19	0.93–1.52	
Age						
18–29	699	28.3	2.4(1.3–3.6)	1	–	<0.001**
30–39	571	23.1	7.2(5.1–9.3)	2.95	1.70–5.12	
40–49	562	22.7	12.7(9.9–15.4)	5.20	3.15–8.58	
≥50	639	25.9	12.2(9.7–14.8)	5.02	3.01–8.37	
Schooling						
0–4	1087	44.0	11.7(9.8–13.6)	2.31	1.22–4.39	<0.001**
5–8	1206	48.8	5.9(4.6–7.2)	1.17	0.60–2.27	
≥9	178	7.2	5.1(1.8–8.3)	1	–	
Smoking						
No	1661	67.2	7.7(6.4–9.0)	1	–	0.06*
Former smoker	322	13.0	8.1(5.1–11.1)	1.05	0.71–1.55	
Smoker	488	19.8	10.9(8.1–13.7)	1.41	1.05–1.89	
Time working with tobacco (years)						
≤9	770	31.2	5.7(4.1–7.4)	1	–	<0.001**
10–19	802	32.5	6.4(4.7–8.0)	1.11	0.75–1.63	
≥20	896	36.3	12.5(10.3–14.7)	2.18	1.57–3.04	
Working hours during agricultural season (hours/day)						
≤8	320	13.0	9.4(6.2–12.6)	1	–	0.5**
9–12	1361	55.2	8.4(6.9–9.9)	0.89	0.61–1.31	
13–18	783	31.8	8.0(6.1–10.0)	0.86	0.56–1.31	
Sowing (last year)						
No	196	7.9	8.7(4.7–12.7)	1	–	0.6**
Sometimes	154	6.2	5.2(1.7–8.7)	0.60	0.26–1.34	
Regularly/always	2121	85.9	8.6(7.4–9.8)	0.99	0.61–1.58	
Ridge planting (last year)						
No	517	20.9	8.1(5.8–10.5)	1	–	0.9**
Sometimes	191	7.7	10.5(6.1–14.8)	1.29	0.78–2.14	
Regularly/always	1762	71.4	8.2(7.0–9.5)	1.02	0.73–1.41	
Transplanting seedlings (last year)						
No	69	2.8	11.6(3.8–19.3)	1	–	0.5**
Sometimes	92	3.7	7.6(2.1–13.1)	0.66	0.25–1.72	
Regularly/always	2309	93.5	8.3(7.2–9.4)	0.72	0.37–1.40	
Cutting trees (last year)						
No	1133	45.9	8.7(7.0–13.3)	1	–	0.6**
Sometimes	147	6.0	9.5(4.7–14.3)	1.10	0.64–1.87	
Regularly/always	1188	48.1	8.0(6.5–9.5)	0.92	0.70–1.21	
Pruning trees(last year)						
No	977	39.7	9.1(7.3–10.9)	1	–	0.4**
Sometimes	307	12.5	7.5(4.5–10.4)	0.82	0.53–1.27	
Regularly/always	1177	47.8	8.0(6.4–9.5)	0.88	0.66–1.15	
Climbing high into the curing barn (last year)						
No	1227	49.7	9.7(8.0–11.4)	1	–	0.01**
Sometimes	169	6.8	9.5(5.0–14.0)	0.98	0.60–1.61	
Regularly/always	1074	43.5	6.7(5.2–8.2)	0.69	0.52–0.91	
Topping (last year)						
No	244	9.9	7.4(4.1–10.7)	1	–	0.7*
Sometimes	158	6.4	9.5(4.9–14.1)	1.29	0.67–2.48	
Regularly/always	2069	83.7	8.4(7.2–9.6)	1.14	0.72–1.82	
Bottom leaf harvesting						
No/sometimes	136	5.5	13.2(7.5–19.0)	1	–	0.03*
Regularly/always	2335	94.5	8.1(7.0–9.2)	0.61	0.39–0.96	
Top leaf harvesting						
No/sometimes	123	5.0	11.4(5.7–17.1)	1	–	0.2*
Regularly/always	2344	95.0	8.2(7.1–9.4)	0.72	0.43–1.21	
Holding leaves under the arms						
No	434	17.6	9.7(6.9–12.5)	1.09	0.64–1.86	0.15**
Sometimes	161	6.5	10.6(5.8–15.4)	0.82	0.59–1.13	
Regularly/always	1875	75.9	7.9(6.7–9.1)			
Tying hands of tobacco						
No	122	4.9	6.6(2.1–11.0)	1	–	0.45**
Sometimes	223	9.1	8.1(4.5–11.7)	1.23	0.55–2.75	
Regularly/always	2125	86.0	8.5(7.3–9.7)	1.30	0.66–2.58	
Baling tobacco						

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Table 2 Continued

Variable	*N*	%	Prevalence % (95% CI)[§]	Crude analysis PR	% (95% CI)[§]	*P*
No	225	9.1	10.2(6.2–14.2)	1	–	0.4**
Sometimes	257	10.4	8.2(4.8–11.5)	0.80	0.45–1.40	
Regularly/always	1984	80.5	8.2(7.0–9.4)	0.80	0.53–1.22	
Tasks that require heavy physical exertion						
No	893	36.2	5.3(3.8–6.7)	1	–	<0.001*
Yes	1577	63.8	10.1(8.7–11.6)	1.93	1.39–2.67	
Working in awkward postures						
No	1102	44.6	6.4(4.9–7.8)	1	–	0.002*
Yes	1368	55.4	10.0(8.4–11.6)	1.57	1.18–2.10	
Prolonged sitting work						
No	1257	50.9	8.2(6.7–9.7)	1	–	0.7*
Yes	1213	49.1	8.6(7.0–10.2)	1.05	0.80–1.36	
Lifting						
No	782	31.7	6.1(4.4–7.8)	1	–	0.01*
Yes	1688	68.3	9.4(8.0–10.8)	1.54	1.12–2.10	
Average weight lifting (kg)						
0	782	31.7	6.1(4.4–7.8)	1	–	0.10*
≤20	349	14.1	8.9(5.9–11.9)	1.45	0.92–2.26	
21–30	610	24.7	9.7(7.3–12.1)	1.58	1.09–2.29	
31–40	377	15.3	9.0(6.1–11.9)	1.47	0.97–2.23	
≥41	352	14.2	9.9(6.8–13.1)	1.62	1.07–2.44	
Maximum weight lifting (kg)						
0	782	31.7	6.1(4.4–7.8)	1	–	0.01*
≤45	523	21.2	10.7(8.0–13.4)	1.74	1.20–2.53	
46–60	1060	42.9	8.5(6.8–10.2)	1.39	0.99–1.95	
≥61	105	4.2	12.4(6.0–18.8)	2.02	1.13–3.59	
GTS (year)						
No	2172	87.9	7.6(6.4–8.7)	1	–	<0.001*
Yes	298	12.1	14.4(10.4–18.4)	1.91	1.39–2.63	
Pesticide poisoning (life)						
No	2281	92.4	7.3(6.2–8.3)	1	–	<0.001*
Yes	189	7.6	21.8(15.9–27.8)	3.00	2.20–4.08	
*Minor psychiatric disorders****						
No	2111	88.0	6.4(5.4–7.4)	1	–	<0.001*
Yes	288	12.0	23.6(18.7–28.5)	3.69	2.83–4.82	

CI: confidence interval; GTS: green tobacco sickness.
* Wald test of heterogeneity.
** Wald test for linear trend.
*** 71 observations missing.
[§] 95% CI.

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There are few studies investigating tobacco farmers' health and most of the existent studies assess GTS.[11,16–20] Although agricultural work is physically demanding, we did not identify any previous studies evaluating musculoskeletal problems in tobacco farmers and found only one published paper about CLBP among rice farmers in Thailand (46.3% CLBP prevalence). Methodological differences relating to sample size and sampling procedures, as well as population and working process characteristics, may explain the difference in the prevalence of CLBP.[8] Although age structure and the healthy worker effect prevent a direct comparison with population-based studies, CLBP prevalence in tobacco farmers is similar to that reported among rural inhabitants in Nigeria and urban dwellers in Brazil.[5,21]

Women were not at higher risk of CLBP than men. Despite the lack of information about the association between gender and CLBP among agricultural workers, this finding differs among studies of urban populations.[5,15] Gender division of labor in tobacco cultivation, whereby men and women are exposed to different tasks and workloads, is likely more important than physical and physiological differences between males and females.

Despite being a known risk factor, smoking did not have statistically significant association with CLBP.[5,15,22–24] Tobacco farmers are occupationally exposed to transdermal nicotine absorption.[25] Therefore, even nonsmokers are nicotine exposed, which could have similar effects of smoking on intervertebral disc nutrition and on increasing levels of proinflammatory cytokines. On the other hand, the amount of nicotine in workers' circulatory systems may vary by season, being higher during the harvest and, thus, not following the same pattern of exposure as that of smokers.[15,26,27]

Since 94% of the individuals were exposed to bottom leaf harvesting, lack of statistical power owing to the sample's homogeneity may explain the non-association found with CLBP.

Table 3 Chronic low back pain (CLBP) and associated factors among tobacco farmers in southern Brazil: adjusted analysis

Variable	PR	95% CI[§]	*P*
1st level			
Gender			
Male	1	–	0.13*
Female	1.22	0.94–1.59	
Age (years)			
18–29	1	–	<0.001**
30–39	3.00	1.70–5.28	
40–49	4.99	2.93–8.50	
50 or over	5.14	3.04–8.71	
Amount of tobacco produced (kg)			
1–2500	1	–	0.11**
2501–5000	1.26	0.72–2.20	
5001–10 000	0.94	0.54–1.65	
10 001–36 000	0.88	0.48–1.63	
Livestock rearing (species)			
No	1	–	0.02*
Up to one	0.92	0.63–1.33	
Two or more	1.65	1.14–2.38	
2nd level			
Smoking			
No	1	–	0.24*
Former smoker	1.04	0.67–1.62	
Smoker	1.34	0.93–1.94	
Climbing high into the curing barn (last year)			
No	1	–	0.1*
Sometimes	1.14	0.69–1.87	
Regularly/always	0.77	0.54–1.10	
Bottom leaf harvesting			
No/sometimes	1	–	0.4*
Regularly/Always	0.82	0.51–1.32	
3rd level			
Tasks that require heavy physical exertion			
No	1	–	<0.001*
Yes	2.00	1.43–2.79	
Working in awkward postures			
No	1	–	0.03*
Yes	1.36	1.02–1.82	
4th level			
GTS (year)			
No	1	–	0.003*
Yes	1.63	1.18–2.25	
Pesticide poisoning (life)			
No	1	–	<0.001*
Yes	2.37	1.70–3.32	
5th level			
Minor psychiatric disorders***			
No	1	–	<0.001*
Yes	2.55	1.88–3.47	

First level: variables adjusted between each other; second level: variables adjusted between each other and for the first-level variables; third level: variables adjusted between each other and for the first- and second-level variables; and fourth level: variables adjusted between each other and for previous levels.
GTS: green tobacco sickness; CI: confidence interval.
* Wald test of heterogeneity.
** Wald test for linear trend.
*** 71 observations missing.
[§] 95% CI.

Rearing two or more species of livestock was statistically associated with CLBP. It may be related to additional work intensity resulting from animal handling. The association between age and CLBP may be related to the degenerative processes of the articular structures of the lumbosacral spine.[15,26]

According to the literature, heavy physical exertion and awkward working postures may be related to the increased risk of disc degeneration, osteophytosis, and osteoarthrosis.[10]

The association between GTS, which is a form of acute nicotine poisoning, and CLBP may be partly explained by the mechanisms related to nicotine tolerance.[28] Individuals intolerant to nicotine may also be more susceptible to the physiological consequences of nicotine in the intervertebral joints and, consequently, be more susceptible to CLBP.[27] Otherwise, GTS may be a work intensity marker. Further studies should investigate this association in depth, since GTS is a relatively unknown form of exposure.

Pesticide poisoning was strongly associated with CLBP. Some studies suggest that pesticide poisoning is a marker of various chronic health problems.[29] Neurotoxic effects may represent direct damage to the nervous system, intensifying pain perception.[30] Organophosphate-induced delayed neuropathy (OPIDN) involves the sciatic nerve and other spinal nerves.[29,31] Specific neurotoxic effects of organophosphates on the sciatic nerve have been found in rats and hens.[32] The same effect was found in frogs exposed to pyrethroids.[33] However, the question we used to measure pesticide poisoning was generic and subject to recall bias. Some studies suggest that mental health disorders and poor psychological health status are associated with CLBP.[24,34,35] Depressed or anxious individuals may report or experience more chronic pain as they may somatize emotional symptoms. Another possibility is that chronic pain exerts a sensitizing effect affecting mental health status.[35] Nevertheless, cross-sectional design limits the analysis of temporal relationships.

The main limitation of this study is the lack of adjustment for body mass index (BMI), a known risk factor for CLBP and possible confounding factor in the associations between smoking, exposure to heavy physical exertion, GTS, and CLBP.[5,15,36] Smoking and BMI likely have an inverse association, and BMI may have been a confounding factor on the association between smoking and CLBP. With regard to exposure to tasks requiring heavy physical exertion and exposure to GTS, the associations may have been underestimated, since obese individuals may avoid heavy physical tasks and have fewer GTS symptoms. Future studies should include BMI as part of the analysis to improve the understanding of CLBP and its associated factors among tobacco farmers.

This is the first paper reporting CLBP prevalence and associated factors among tobacco farmers, and one of only a few papers regarding family farming.

We found CLBP to be a problem among tobacco farmers in southern Brazil and highlights pesticide poisoning and GTS as risk factors. Future studies should further evaluate these exposures and

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interventions such as harvesting mechanization, and the reduction of pesticide use should be promoted and evaluated for their benefits on tobacco farmers' health. Health care professionals serving tobacco farmers should be trained to advise workers about CLBP chemical and physiological workloads. Policies related to the agricultural diversification planned in the Framework Convention on Tobacco Control should promote tobacco farmers' health by taking into account the workloads derived from additional work tasks in their labor process. It is not enough to only discuss agricultural diversification. It is necessary to implement a less chemical-dependent model of agricultural production.

Disclaimer Statements

Contributors RDM performed the bibliographic review, coordinated the fieldwork, developed data analyses, and wrote the article. AGF oversaw fieldwork and data analyses and wrote the article. NMXF oversaw fieldwork, provided advice on data analyses, and wrote the article. NSF coordinated the fieldwork and wrote the article. All authors read and approved the final manuscript.

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Ethics approval The Ethics Research Committee of the Federal University of Pelotas approved this study.

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