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The prevalence of low back pain and its associated factors in Thai rubber farmers

Chadayu Udom[1], Prawit Janwantanakul[1] and Rotsalai Kanlayanaphotporn[1]

[1]Department of Physical Therapy, Faculty of Allied Health Sciences, Chulalongkorn University, Bangkok, Thailand

Abstract: Objectives: Low back pain (LBP) is one of the most prevalent musculoskeletal disorders in the general population, especially among manual laborers. Moreover, it often brings about lost wages and additional medical expenses. However, the potential risk factors for LBP are unknown. This study aimed to estimate the prevalence of LBP and to determine the individual, occupational, and psychosocial factors associated with LBP among rubber farmers. **Methods:** A cross-sectional survey was conducted among 450 Thai rubber farmers using cluster random sampling. Data were collected using face-to-face interviews and objective examination and were analyzed using multivariate logistic regression. **Results:** Of the 433 rubber farmers, the point and 12-month prevalence of LBP in rubber farmers was 33% and 55.7%, respectively. BMI, primary school education, exposure to pesticides, and tapping below knee level were statistically associated with LBP after controlling for other variables. **Conclusions:** Low back pain is common among rubber farmers. Only four factors were identified as being associated with the high prevalence of LBP. However, these factors might be altered if more variables are taken into account. Further research investigating the causal relation between these factors and LBP should be conducted.

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Correspondence to: R. Kanlayanaphotporn, Department of Physical Therapy, Faculty of Allied Health Sciences, Chulalongkorn University, Bangkok, 10330, Thailand (e-mail: rotsalai.k@chula.ac.th)

Introduction

Low back pain (LBP) is a health problem that brings about extensive lost wages and additional medical expenses with the total cost ranging from $US 7,000 to $US 16,000 million per year[1,2]. It affects people in various occupations, including agricultural farmers. A high prevalence of LBP over 12-month period among agricultural farmers was reported (ranging from 18.5% to 84%)[3,4] in comparison to the general working population (ranging from 44.4% to 48.2%)[5].

Agriculture work involves several risk factors associated with the development of LBP. These risk factors include exposure to vibrations[6], repetitive trunk flexion and rotation, and lifting or carrying more than 25 pounds with 2 hands or above the shoulder[7], sleep problems[8], mental distress, and interpersonal stress at work[7], low education, low income[9], history of back pain, other current musculoskeletal complaints, low flexibility of the back muscles[10], low physical activity levels[11], and poor lumbo-pelvic stability[12].

Rubber farming, one sector of agricultural farming, is an important occupation in South-east Asia. Increasing demand for rubber products has led to an increase in rubber production. The top three producers of natural rubber in the world are all in South-east Asia, namely, Indonesia, Malaysia, and Thailand. Although Thailand has fewer rubber plantations, in term of area, than Indonesia, Thailand is the world's largest rubber producer[13].

In general, rubber farming comprises three main tasks: tapping, collecting, and sheeting. Rubber tapping is when rubber farmers use knives to cut lines on the bark of rubber trees. Rubber tapping starts when the circumference of the tree trunk reaches 50 centimeters at a height of 150 centimeters above the ground and with the line gradually moving down each time. Normally, the tree trunk is divided circumferentially into three facets with each facet being tapped for about five years before moving on to the next facet. The tapping level therefore changes approximately 30 centimeters per year. Rubber collecting takes place when rubber farmers collect a cup filled with rubber latex that has dripped from the bark line and pour it into a big tub (20 liters). The big tub is carried along until full, and its content is then poured into several bigger tanks placed on a cart ready for being transported. Rubber sheeting involves lifting and transferring rubber latex to a big container for processing into rubber sheets. Finally, the rubber sheets are hung for drying. Thus, the work of rubber farmers involves physical labor tasks such as trunk twisting, bending, and extension as well as lifting heavy buckets repetitively over a prolonged period of time. Therefore, rubber farmers are exposed to several risk factors associated with LBP.

Previous cross-sectional studies showed that LBP was the most common musculoskeletal disorder affecting rubber famers[9,14)]. Approximately 55% of rubber farmers reported LBP at 1 month[14)], 52.9% at 3 months[9)], and 66.2% at 12 months[15)]. To date, only one study has investigated risk factors for LBP in rubber famers. Meksawi et al.[9)] reported that tapping levels and tapping postures, a high frequency of weight lifting, low level of social support, low level of education, and income were associated with LBP.

There is limited evidence of relations among physical capacity and LBP in rubber farmers, although poor physical capacity, such as reduced trunk flexion[16)], decreased trunk muscle endurance[17)], and instability of the spine[12)], have been linked to LBP in general population. Limited knowledge of physical capacity factors affect prevention efforts and the development of optimal treatment programs to minimize the risk of LBP occurrence. The purposes of this study were to examine the prevalence of LBP in rubber farmers and to identify the associations between potential risk factors and 12-month LBP in rubber farmers. Such information will inform stakeholders about the health status and related factors concerning Thai rubber farmers in order to develop effective interventions or preventive measures for LBP.

Method

Study population

A cross-sectional study was conducted during January to March 2015 in Thai rubber farmers in five sub-districts of Thungsong district, Nakhonsrithammarat province, Thailand, using cluster random sampling. Of 13 sub-districts in Thungsong district, 5 were selected using random numbers. In each sub-district, rubber farmers were interviewed until at least 90 were recruited. Thai rubber famers who were employed in a rubber plantation for at least 1 year and were between 18 and 70 years old were included. Participants who had any history of major back trauma such as a motor vehicle injury, fall from height, serious spinal conditions including cancer were excluded. LBP was defined as pain localized between the 12th rib and the inferior gluteal folds, with or without leg pain that lasted for at least 24 hours and had a pain score of 3 out of 10 or higher. This definition of LBP is generally accepted and commonly used for epidemiological study[18,19)]. The pain had to be greater than or equal to 3 out of 10 on the visual analogue scale (VAS) which was considered to be higher than the minimal clinically important change for LBP[20)]. The duration of pain for at least 24 hours would exclude any pain caused by fatigue or discomfort that could be resolved within a few hours[21)]. An explanation of the study was given to all participants and formal informed signed consents were obtained before any data were collected. The sample size used in this study was calculated based on the prevalence of LBP in rubber tappers from prior research[9)]. With an estimated 10% non-response rate, the required sample size was 450. The project was approved by the Ethics Review Committee for Research Involving Human Research Subjects, Health Sciences Group, Chulalongkorn University, Thailand.

Data collection

Research assistants who conducted all assessments were blinded to the participants' condition. The 12-month and point prevalence of LBP among rubber farmers were evaluated. Participants who indicated pain in the low back region of the specifically modified Nordic questionnaire and scored their pain at greater than or equal to 3 out of 10 on the VAS were categorized as having LBP. A preliminary study found this modified questionnaire to be valid (the content validity was 0.81 and Cronbach's alpha was 0.84) and reliable (intraclass correlation coefficient (ICC) was 0.84).

Risk factors for LBP in rubber farmers were examined using a questionnaire and objective measures. The questionnaire consisted of individual, occupational, and psychosocial risk factors. *Individual risk factors* included age, gender, BMI, educational level, underlying disease, smoking and alcohol usage, level of physical activity, and functional disability. The items related to level of physical activity followed those of the Global Physical Activity Questionnaire (GPAQ) which classified individuals as engaging in low, moderate and high levels of physical activity[22)]. Functional disability was assessed using the modified Oswestry low back pain disability questionnaire (Thai version) which grouped individuals as having minimal, moderate, severe, crippled, and bed-bound conditions[23)]. Two additional individual risk factors were investigated by 2 objective measures, namely, flexibility of back and leg muscles and stability of the lumbopelvic region. Flexibility of back and leg muscles was measured with a sit and reach box being placed on the floor. Participants were asked to slowly reach forward with parallel hands as far as possible without bending the knees while sitting on the floor with both legs fully extended and with the soles of the feet against a box. The furthest distance point in inches reached with the fingertips for 3 trials was recorded. With different criteria for males and females, the recorded distance was then classified as very low, low, moderate, good, and very good flexibility according to the Sports Authority of Thailand criteria[24]. For instance, a distance below nine inches for a female and five inches for a male were classified as very low flexibility. A distance of more than 21 inches for a female and 18 inches for a male were classified as very good flexibility. Stability of lumbopelvic region was measured using a pressure biofeedback unit by asking the participants to perform some tasks in progressive fashion while simultaneously maintaining the pressure on the gauge. A deviation of more than 10 mmHg indicates that the stabilization action of the stabilizer muscle has been lost[25]. The stability of the lumbopelvic region was measured and was classified into 6 levels (0-5) according to Sahrmann's core stability test criteria[26]. *Occupational risk factors* comprised working experience, work posture, tapping level, having a secondary job, and duration of work in each task (*i.e.*, tapping, collecting, and sheeting). *Psychosocial risk factors* included sleep hours and stress level which were asked in concordance with the Suanprung stress test that was shown to have an overall Cronbach's alpha greater than 0.7[27]. The Suanprung stress test contains 20 items rated on a 5-point Likert scale with item responses ranging from "1" (no stress) to "5" (extremely high stress). The total scores were classified into four levels: 0 to 23 as mild, 24 to 41 as moderate, 42 to 61 as high, and more than 61 as severe stress.

Statistical analyses

Participant characteristics were described using means and standard deviation or proportions. Chi-square analysis was carried out to determine the association between the 12-month prevalence of LBP with individual, occupational, and psychosocial factors. Chi-square analysis was performed using 2×2 contingency tables. Any factors with a *p*-value ≤0.2 from Chi-square analysis were eligible for addition into the multivariate logistic regression analysis. Other variables that were logically reasonable and were previously found to be related to LBP were also included in the multivariate models. These were gender[7,28] and stress[7,28]. The odds ratios (OR) associated with particular factors were adjusted for the effect of all other factors in the model. The adjusted OR and 95% confidence intervals (CI) were calculated. Statistical significance was set at the 5% level. All statistical analyses were performed using SPSS statistical software, version 17.0 (SPSS Inc, Chicago, IL, USA).

Results

Of the 450 participants, 17 rubber farmers were excluded because they did not meet the inclusion criteria of having at least 1 year of experience in farming and with no history of back trauma. Therefore, 433 were used in the data analysis of this study. Table 1 presents the demographic characteristics of the rubber farmers participating in the study. The 12-month prevalence of LBP in rubber farmers was 55.7% (n=241) with the point prevalence of 33% (n=143). Almost all of the participants who had LBP at the current time (97%) also had a history of LBP within the preceding 12 months. The average (± standard deviation) pain intensity on the visual analog scale was 4.2± 1.7. However, all of the participants who had LBP at the time of the study were found to have minimal to moderate functional disability. The average (± standard deviation) disability score on the modified Oswestry low back pain disability questionnaire (Thai version) was 9.61±7.29. Approximately two-thirds of the participants defined their farm work as involving low to moderate physical activity level. Nearly all of them (96.77%) were involved in at least 2 tasks of rubber farming (rubber tappers and rubber collectors). The majority of rubber farmers had no additional job off the farm and worked solely as rubber farmers.

When multivariable logistic regression was used, the results revealed that BMI (adjusted OR 1.05; 95% CI: 1.00-1.11), primary school education (adjusted OR 2.45 95% CI: 1.13-5.32), exposure to pesticides (adjusted OR 1.63; 95% CI: 1.04-2.55), and tapping level below their knee (adjusted OR 2.64; 95% CI: 1.02-6.85) were associated with LBP in rubber farmers after controlling for other variables as shown in Table 2.

Discussion

This study found that the 12-month prevalence of LBP in this group of rubber farmers was high (55.7%) with the point prevalence at 33%. The factors that showed significant associations with LBP were BMI, primary education, exposure to pesticides, and tapping below knee level. Surprisingly, physical capacity, including flexibility of the back and leg muscles and stability of the lumbopelvic region, was not found to associate with LBP in rubber farmers.

This study investigated the prevalence of LBP during the previous 12 months, therefore seasonal variation should not have any effect on the results. The high 12-month prevalence of LBP in this study supports previous findings that this problem is common in rubber farmers. The prevalence of approximately 50% is also consistent with findings reported in similar groups of participants[9,14]. As almost all of the participants who had LBP at the current time also had a history of LBP within the preceding 12 months, these results suggest that LBP in this group of participants was of recurrent nature.

In this current cohort, only individual and occupational

Table 1. Demographic characteristics (n=433)

Characteristics	n (%)
Age (mean±SD)	45.14±10.68 yrs
BMI (mean±SD)	24.73±4.17 kg/m^2
Sex	
-Male	140 (32.3%)
-Female	293 (67.7%)
Underlying disease	
-Yes	127 (29.3%)
-No	306 (70.7%)
Smoking status	
-Current smoker	100 (23.1%)
-Former smoker	8 (1.8%)
-Never smoker	325 (75.1%)
Alcohol drinking status	
-Current drinker	54 (12.5%)
-Former drinker	7 (1.6%)
-Never drinker	372 (85.9%)
Exposure to pesticides	
-Yes	126 (29.1%)
-No	307 (70.9%)
Educational level	
-Primary school	237 (54.7%)
-Secondary school	155 (35.8%)
-Post-secondary school	41 (9.5%)
Status	
-Owner operators	263 (60.7%)
-Employee	111 (25.6%)
-Both	59 (13.6%)
Flexibility level of back and leg muscles	
-Very low	78 (18.0%)
-Low	70 (16.2%)
-Moderate	189 (43.6%)
-Good	52 (12.0%)
-Very good	44 (10.2%)
Stability of lumbopelvic region	
-Level 0	333 (76.9%)
-Level 1	88 (20.3%)
-Level 2	10 (2.3%)
-Level 3	1 (0.2%)
-Level 4	0 (0%)
-Level 5	1 (0.2%)
Disability score (n=143)* (mean±SD)	9.61±7.29
Disability level (n=143)*	
-Minimal disability	137 (95.8%)
-Moderate disability	6 (4.2%)
-Severe disability	0 (0%)
-Crippled	0 (0%)
-Bed-bound/exaggerating their symptoms	0 (0%)

Table 1. Demographic characteristics (n=433) (continued)

Characteristics	n (%)
Physical activity levels	
-Low	243 (56.1%)
-Moderate	33 (7.6%)
-High	157 (36.3%)
Working experience (mean±SD)	20.38±11.54 yrs
Duration of work per day (mean±SD)	6±2.39 hrs
Having a secondary job	
-Yes	112 (25.9%)
-No	321 (74.1%)
Current tapping levels	
-Above eye	79 (18.2%)
-Eye	40 (9.2%)
-Thoracic	150 (34.6%)
-Waist	95 (21.9%)
-Knee	42 (9.7%)
-Below knee	27 (6.2%)
Duration of work in each task (range)	
-Tapping	1-9.5 hrs
-Collecting	0.5-8 hrs
-Sheeting	1-4 hrs
Duration at the current tapping level	
-<3 months	204 (47.1%)
-3-6 months	164 (37.9%)
-6-12 months	59 (13.6%)
->12 months	6 (1.4%)
Common posture at work	
-Repetitive trunk flexion	216 (50%)
-Standing and walking	195 (45%)
-Sitting	21 (4.8%)
-Reaching	1 (0.2%)
-Lifting	0 (0%)
Sleep hour (mean±SD)	5.35±1.51 h
Starting time to work or get up (mean±SD)	3.75±5.88 h
(mode)	01.00 h
Sufficient sleep	
-Yes	291 (67.2%)
-No	142 (32.8%)
Stress level	
-Mild stress	354 (81.8%)
-Moderate stress	69 (15.9%)
-High stress	10 (2.3%)
-Severe stress	0 (0%)

*n=participants who reported LBP at the current time

factors, but no psychosocial factors, were found to be associated with LBP. These findings are inconsistent with a previous study that demonstrated that all individual, occupational, and psychosocial factors were risk factors for LBP in rubber farmers[9]. This inconsistency might be related to the discrepancy in the components of the psychosocial factors examined between studies. The previous study only investigated psychosocial factors limited to farm work whereas this current study examined psychosocial factors related to both farm and non-farm work.

Table 2. Prevalence and adjusted odds ratio (OR_{adj}) with 95% confidence intervals (95%CI) of LBP within the preceding 12 months with respect to factors in the final modeling (n=433)

Variables	N	Prevalence n (%)	OR_{adj}	95% CI	*p*
Age	433	-	0.996	0.975-1.019	0.755
Gender					
-Male	140	79 (56.4%)	1.000		
-Female	293	162 (55.3%)	0.757	0.483-1.185	0.223
BMI	433	-	1.052	1.000-1.106	0.048*
Educational level					
-Primary school	237	153 (64.6%)	2.613	1.225-5.574	0.013*
-Secondary school	155	71 (45.8%)	1.203	0.581-2.492	0.618
-Post-secondary school	41	17 (41.5%)	1.000		
Underlying disease					
-Yes	127	82 (64.6%)	1.266	0.790-2.031	0.327
-No	306	159 (52.0%)	1.000		
Exposure to pesticides					
-Yes	126	81 (64.3%)	1.594	1.014-2.506	0.044*
-No	307	160 (52.1%)	1.000		
Physical activity					
-Low	243	123 (50.6%)	1.000		
-Moderate	33	21 (63.6%)	1.666	0.760-3.651	0.203
-High	157	97 (61.8%)	1.401	0.895-2.193	0.141
Tapping level					
-Above eye	79	36 (45.6%)	1.000		
-Eye	40	21 (52.5%)	1.557	0.704-3.443	0.275
-Thoracic	150	86 (57.3%)	1.748	0.981-3.115	0.058
-Waist	95	56 (58.9%)	1.641	0.875-3.078	0.123
-Knee	42	24 (57.1%)	1.483	0.668-3.294	0.333
-Below knee	27	18 (66.7%)	2.606	1.004-6.768	0.049*
Stress Level					
-Mild	354	195 (55.1%)	1.000		
-Moderate	69	40 (58%)	1.032	0.579-1.841	0.914
-High	10	6 (60%)	1.464	0.387-5.543	0.574
-Severe	0	0 (0%)	-	-	-

*$p \le 0.05$, Significance and OR_{adj} with 95%CI from the multivariate analysis

More psychosocial factors were therefore considered in this study. Nevertheless, the low level of stress found among this group of participants in spite of LBP may suggest that they are able to cope with the problems well.

The finding that BMI was significantly associated with LBP in rubber farmers concurs with previous studies[7,29]. The risk of LBP slightly increased with increasing BMI. The mechanisms underlying this association remain unclear, but this relationship may be due to the increased risk of lumbar disc degeneration particularly with an increased BMI of greater than 25 kg/m^2 [30].

The significant association between the educational level of rubber farmers and LBP confirms the previous study in rubber tappers that reported education at primary school level is a risk factor for LBP[9]. Each additional year of formal education was also found to be associated with decreased risk for disability pensioning from LBP[31]. This finding might be due to the limited possibility of upward mobility to less physically demanding tasks[32]. As a result, rubber farmers who graduated at primary school level might be at greater risk of career-long exposure to labor intensive work which is known to be risk factor for LBP. In contrast, previous studies in other farmers[28] reported that there were no associations between educational level and LBP. These would be due to participants in those studies mostly graduating from secondary school. Nevertheless, it must be noted that the educational level in this study referred to formal education at school, which does not normally teach strategies for minimizing LBP. In-depth interviews with some participants revealed that they had no knowledge on how to minimize LBP on the work site. Thus, the effect of back education for relieving

LBP could not be determined.

Interestingly, this study found an association between exposure to pesticides and LBP. Rubber farmers who exposed to pesticides were at increased risk of LBP by 1.5 times. Although pesticides use might differ between rubber and tobacco farming, tobacco farmers exposed to pesticides also reported an increased risk of chronic LBP by 2.37 times[33]. This finding might be explained via mechanical and neurological aspects. Mechanically, farmers must carry a heavy pesticide tank around while spraying the substance on the farm for prolonged periods. As a result, sustained spinal loading may induce LBP. Neurologically, pesticides could indirectly lead to LBP[34] as they may induce acute psychological effects including anxiety, depression, irritability and restlessness[35]. The pesticides may also cause damage to the nervous system and intensify pain perception[36].

The association between tapping below knee level and LBP was in line with the association between tapping below waist level and LBP reported in previous studies[9]. Working at this tapping level requires a certain degree of trunk flexion which stimulates the back muscle to work continuously[37]. Together with the repetitive trunk flexion found in rubber farming, this occupational factor could therefore be a potential risk for LBP.

The finding of mild to minimal functional disability in the majority of the participants who reported LBP in this study even though the pain intensity on average was moderate was also unanticipated. However, this phenomenon might be plausible if an individual uses drugs or medications that could mask pain perception. Some drugs or medications such as analgesics, muscle relaxants, and nonsteroidal anti-inflammatory drugs were found to be used in general workers[38,39]. A previous study revealed that one-third of rubber tappers used kratom (Mitragynine speciosa)[9] which has mild pain relieving effect[40]. Those rubber farmers who used these drugs would therefore report lower pain scores. Consequently, there is a risk of underreporting the LBP prevalence. In order to improve data accuracy, the use of drugs and medications should be recorded and be taken into account in the future studies.

Moreover, the healthy worker effect which enhances individuals who have no adverse effects from work to persist in their careers could be a potential bias in this study. It was noted that the participants in the current study had worked as rubber farmers for 21 years on average. Such a long work duration might help screen individuals who could no longer tolerate the work requirement for this profession. To minimize this form of bias, it would be better to study newly employed workers.

Strength and limitation

The study determined broad bio-psychosocial risk factors for their contribution to LBP among rubber farmers. However, the study has some limitations. First, this study did not obtain any data regarding the use of drugs or medications which might alter pain perception. Future studies should collect these data and also use in the analysis. Second, this study did not gather data about prior history of LBP so the association between this variable and LBP could not be ascertained. Third, this study evaluated physical load at work using only a questionnaire. To clearly confirm these results, further studies should assess physical load at work using observation or other objective examination. Fourth, when using factors from the results of the present study, one has to be aware that this study was a cross-sectional study. The causal relationship between exposure and outcome could not be established. Further research should employ a prospective design. Fifth, this study was conducted on rubber farmers so the results should not be generalized to other groups of farmers. Lastly, in the present study psychosocial risk factors only included sleep hours and stress level measured by the Suanprung stress test. Other important psychosocial factors may be identified in future work.

Conclusion

The results of this study suggest a high prevalence of LBP in rubber farmers. Individual and occupational factors were found to be associated with LBP. However, these factors might be altered if more variables are taken into account. Further research is needed to address preventive strategies to reduce LBP among rubber farmers.

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