นิพนธ์ต้นฉบับ

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Ergonomics and psychosocial problems among sugarcane harvesting laborers: a case study in Khon Kaen Province

การศึกษาปัญหาการยศาสตร์และจิตสังคมในกลุ่มแรงงานตัดอ้อย: กรณีศึกษาจังหวัดขอนแก่น

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ABSTRACT: Ergonomic problems are a major occupational hazard in agricultural work, often resulting from repetitive tasks and the use of unsuitable equipment or tools. Sugarcane harvesting laborers (SHL) play a crucial role in Thailand's sugar industry, yet remain highly exposed to physical and psychosocial risks due to the manual nature of their work. This study aimed to investigate ergonomic and psychosocial problems among SHL in Khon Kaen Province, Thailand. A total of 102 participants were randomly selected and assessed using structured interviews, ergonomic observation with the Rapid Entire Body Assessment (REBA), and psychosocial evaluation with the Thai version of the Job Content Questionnaire (Thai-JCQ). Data were analyzed using descriptive statistics. Most participants were female and middle-aged, working long hours daily and cutting approximately 3,000 stalks per day during the harvesting season. MSDs were most frequently reported in the lower back, shoulders, and hands/wrists over the past 7 days, and in the hip/thigh, shoulder, hand/wrist, and lower back over the past 3 months. REBA scores indicated very high ergonomic risk across all harvesting tasks, while psychosocial assessment revealed high job demands, limited job control, and considerable workplace hazards, despite high levels of social support. In conclusion, sugarcane harvesting laborers face substantial ergonomic and psychosocial risks that threaten their health and well-being. These findings provide evidence for targeted ergonomic interventions, organizational changes to improve job control, and policy measures to enhance occupational health and safety standards in the sugarcane industry.

Keywords: Sugarcane harvesting labors; Ergonomics; Rapid Entire Body Assessment (REBA); Psychosocial problem

บทคัดย่อ: ปัญหาด้านการยศาสตร์ถือเป็นความเสี่ยงสำคัญที่พบในงานเกษตรกรรม ซึ่งมักเกิดจากการทำงานซ้ำ ๆ และการใช้อุปกรณ์ที่ไม่เหมาะสมกับสรีระของผู้ปฏิบัติงาน แรงงานตัดอ้อย (Sugarcane Harvesting Laborers: SHL) เป็นกำลังหลักที่สำคัญในอุตสาหกรรมน้ำตาลของประเทศไทย แม้ว่าในปัจจุบันจะมีการใช้เครื่องจักรเพิ่มมากขึ้น แต่การเก็บเกี่ยวด้วยแรงงานคนยังคงมีอยู่จำนวนมาก โดยแรงงานต้องทำงานในท่าทางที่ไม่เหมาะสม เช่น การก้ม บิดลำตัว และใช้มือแขนในการตัด มัด และยกอ้อยขึ้นรถบรรทุก การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อสำรวจปัญหาด้านการยศาสตร์และปัญหาทางจิตสังคมของแรงงานตัดอ้อยในจังหวัดขอนแก่น กลุ่มตัวอย่างจำนวน 102 คนได้รับการประเมินโดยใช้แบบสอบถาม และประเมินท่าทางการทำงานโดย Rapid Entire Body Assessment (REBA) และการประเมินปัจจัยด้านจิตสังคมด้วยแบบสอบถาม Thai Job Content Questionnaire (Thai-JCQ) วิเคราะห์ข้อมูลด้วยสถิติเชิงพรรณนา ผลการศึกษาพบว่าแรงงานตัดอ้อยส่วนใหญ่เป็นเพศหญิงและอยู่ในช่วง 41 - 50 ปี ต้องทำงานเป็นเวลานานและตัดอ้อยจำนวนมากต่อวัน โดยมีการรายงานอาการปวดเมื่อยกล้ามเนื้อในหลายส่วนของร่างกาย โดยเฉพาะบริเวณหลังส่วนล่าง ไหล่ ข้อมือ และสะโพก การประเมิน REBA แสดงให้เห็นว่าท่าทางการทำงานอยู่ในระดับความเสี่ยงสูงมาก ขณะที่การประเมินด้านจิตสังคมพบว่ามีความต้องการงานสูง การควบคุมงานต่ำ และมีความเสี่ยงจากสภาพการทำงาน แม้ว่าจะได้รับการสนับสนุนทางสังคมค่อนข้างมากก็ตาม สรุปได้ว่าแรงงานตัดอ้อยต้องเผชิญกับความเสี่ยงทั้งทางการยศาสตร์และทางจิต

สังคม ซึ่งส่งผลกระทบต่อสุขภาพและความเป็นอยู่ของแรงงาน ผลการศึกษานี้ชี้ให้เห็นถึงความจำเป็นในการพัฒนามาตรการด้านการยศาสตร์ การจัดการงาน และนโยบายเพื่อยกระดับความปลอดภัยและคุณภาพชีวิตของแรงงานในอุตสาหกรรมน้ำตาลไทย

คำสำคัญ: กลุ่มแรงงานตัดอ้อย; การยศาสตร์; แบบประเมินท่าทางร่างกายทั้งลำตัว (REBA); ปัญหาจิตสังคม

1. INTRODUCTION

Agriculture is one of the most physically demanding occupations, with musculoskeletal disorders (MSDs) being a common health problem among agricultural workers worldwide. Risk factors include prolonged working hours, repetitive movements, awkward postures, and the handling of heavy loads, all of which can contribute to MSDs and reduced work capacity[1]. MSDs negatively affect quality of life by decreasing productivity both at work and in daily activities, leading to economic losses and long-term disability[2]. In addition to physical consequences, musculoskeletal discomfort has been shown to correlate with psychological stress, suggesting that physical strain and mental strain are closely interrelated among agricultural workers[3]. Prolonged exposure to awkward postures during farming tasks further increases the risk of MSDs, physical discomfort, and mental stress[4].

In Thailand, MSDs are highly prevalent among sugarcane harvesting laborers (SHL), particularly in the Northeast region. A recent survey reported that 74.3% of sugarcane laborers experienced MSDs, most commonly affecting the shoulders and lower back, while 36.3% reported poor quality of life[5]. Significant factors associated with poor quality of life included psychological problems such as depression and high stress, long working hours (more than 8 hours per day), and low income (less than 13,000 Baht per month)[5]. Despite the increasing adoption of mechanized harvesting, manual cutting remains widespread, requiring SHL to bend, twist, and lift repetitively throughout the harvesting process[6]. Previous research has shown that harvesting is the most frequently studied manual agricultural task, followed by load carrying, pruning, planting, and weeding, reflecting its importance as a source of occupational risk[7].

The high prevalence of MSDs, together with the psychosocial difficulties faced by SHL, highlights a pressing occupational health concern, addressing these risks demand urgent and systematic assessment. This study aims to investigate both ergonomic and psychosocial problems among sugarcane harvesting laborers in Khon Kaen Province, Thailand. These results provide a basis for addressing the combined effects of physical and psychosocial strain, contribute to occupational health knowledge, and inform the development of targeted interventions and policies to enhance the health, safety, and overall quality of life of agricultural workers.

2. METHODS

This cross-sectional study was conducted in Khon Kaen Province, Thailand, specifically in Baan Had District and three sub-districts; Koksamran, Nonsomboon and Baandong. Data collection was carried out at participants' workplaces by a team of researchers, all of whom received standardized training on interview techniques and ergonomic observation procedures. The study protocol and research instruments were reviewed and approved by the Human Research Ethics Committee of Mahidol University (MUPH 2015-146). Written informed consent was obtained from all participants in compliance with the Personal Data Protection Act (PDPA) of Thailand.

The inclusion criteria were: (1) sugarcane harvesting laborers (SHL) aged 21 years or older; (2) currently employed in manual sugarcane harvesting in Khon Kaen Province; and (3) willingness to participate voluntarily. Exclusion criteria were individuals diagnosed with gout, osteoarthritis, rheumatoid arthritis, or osteoporosis, as well as those with a history of severe musculoskeletal injuries or surgeries related to musculoskeletal disorders (MSDs). The sample size was 102. Participants were selected using stratified random sampling from lists of sugarcane harvesting groups in the selected district and sub-district to ensure representativeness.

Data collection instruments included: (1) demographic and socioeconomic characteristics (2) health behaviors (3) work characteristics (4) musculoskeletal disorders, assessed by the Standardized Nordic Musculoskeletal Questionnaire (NMQ)[8], which records symptoms in 10 body regions for the previous 7 days and 3 months; and (5) psychosocial factors, assessed by the Thai version of the Job Content Questionnaire (Thai-JCQ)[9]. The Thai-JCQ consists of 45 items covering six dimensions: job control (Q1–Q9), psychological job demand (Q10–Q22), physical job demand (Q23–Q25), job security (Q26–Q29), social support (Q30–Q37), and workplace hazards (Q38–Q45). Previous validation studies have reported acceptable reliability and construct validity for the Thai-JCQ[9].

Ergonomic risk was evaluated using the Rapid Entire Body Assessment (REBA) tool[10]. For each participant, photographs were taken during harvesting tasks with consent, ensuring PDPA compliance. Postures were selected for analysis based on tasks with the highest frequency and physical load, including cutting, bundling, and lifting. REBA evaluates two body groups, Group A (neck, trunk, and legs) and Group B (arms, forearms, and wrists), and generates a final score representing the risk of MSDs. Higher scores indicate greater ergonomic risk. Descriptive statistics were used to summarize demographic, occupational, and health characteristics.

3. RESULTS

A total of 102 sugarcane harvesting laborers (SHL) surveyed, the majority were female (70.6%) and most were aged 41–50 years (46.1%). The majority of participants had completed elementary education (82.4%). Over half of the participants had a body mass index (BMI) within the normal range (56.9%). Nearly half reported having sufficient income but no savings (48.0%). Details of demographic and socioeconomic characteristics are presented in Table 1.

Table 1 Demographic and socioeconomic characteristics of sugarcane harvesting laborers (n = 102)

	Number (%)
Gender	
Male	30 (29.4)
Female	72 (70.6)
Age (year)	
21 – 30	4 (3.9)
31 - 40	7 (6.9)
41 - 50	47 (46.1)
51 - 60	32 (31.4)
60 above	12 (11.8)
Education	
Elementary	84 (82.4)
Junior high school	12 (11.8)
senior high school and higher	6 (5.8)
BMI	
Less than 18.5	7 (6.86)
18.5 – 24.9	58 (56.87)
25.0 – 29.9	31 (30.39)
More than 30	6 (5.88)
Income management	
Sufficient and have savings	14 (13.73)
Sufficient but don’t have savings	49 (48.04)
Insufficient and have debt	36 (35.29)
Refuse to answer questions	3 (2.94)

Regarding health behaviors, most participants reported never smoking (84.3%) and not drinking alcohol (64.7%). The use of analgesics was common: acetaminophen was occasionally used by more than 80% of participants, whereas NSAIDs such as aspirin, naproxen, and ibuprofen were rarely used (reported as “never” by 77.5%). In terms of sleep, three-quarters reported sleeping 7–8

hours per night, with the majority perceiving their sleep quality as sufficient (79.4%) (Table 3). The detail are presented in Table 2.

Table 2 Health behaviour of sugarcane harvesting laborers (n = 102)

	Number (%)
Smoking	
No	86 (84.31)
Yes	13 (12.75)
Ex	3 (2.94)
Alcohol drinking	
No	66 (64.71)
Yes	27 (26.47)
Ex	9 (8.82)
Taking NSAIDS	
Never	36 (35.3)
Sometime	55 (53.92)
Often	11 (10.78)
Taking Acetaminophen	
Never	12 (11.77)
Sometime	83 (81.37)
Often	7 (6.86)
Taking Aspirin, naproxen, ibuprofen	
Never	79 (77.45)
Sometime	21 (20.59)
Often	2 (1.96)
Sleeping time	
Less than 7 hours	21 (20.59)
7 – 8 hours	77 (75.49)
More than 8 hours	4 (3.92)
Quality of sleep	
Sufficient	81 (79.41)
Insufficient	21 (20.59)

Work-related characteristics showed that most participants worked 7–8 hours per day (76.5%), and more than 40% worked 7 days per week. The typical sugarcane harvesting season lasted 4–6 months per year, and most participants had between 1–10 years of harvesting experience (61.8%). Cutting was the most common harvesting activity reported (48.9%). Outside of the harvesting season, agriculture was the primary secondary occupation (62.9%) (Table 3).

Table 3 Work characteristics of sugarcane harvesting laborers (n = 102)

	Number (%)
Duration time per day (hour)	
Less than 7	15 (14.71)
7 – 8	78 (76.47)
More than 9	9 (8.82)
Working day per week (day)	
Less than 5 days	20 (19.61)
5 days	27 (26.47)
6 days	12 (11.76)
7 days	43 (42.16)
Working day per year (month)	
1 – 3 months	12 (11.76)
4 – 6 months	46 (45.10)
7 – 9 months	29 (28.43)
10 – 12 months	15 (14.71)
Length of time working as sugarcane harvesting labors (year)	
1 - 10	63 (61.77)
11 – 20	29 (28.43)
21 – 30	5 (4.90)
More than 30	5 (4.90)
Activities	
Cutting	87 (48.88)
Bundle	55 (30.90)
Lifting and transfer	19 (10.67)
Drive the truck	7 (3.93)
Drive the harvesting machine	9 (5.06)
Other job	1 (0.56)
Other occupation when off sugarcane harvesting season	
Office	2 (1.90)
Grocery store	1 (0.95)
Hospital	1 (0.95)
Taxicab	4 (3.81)
Construction	2 (1.90)
Agriculture	66 (62.86)
Other job	29 (27.63)

The prevalence of musculoskeletal disorders (MSDs) was high. Within the past 7 days, MSDs were most frequently reported in the lower back (37.3%), shoulders (33.3%), and hands/wrists (30.4%). Over the past 3 months, the most commonly affected regions were the hip/thigh (26.5%), shoulder (23.5%), hand/wrist (22.6%), and lower back (22.6%). Full distributions are shown in Table 4.

Table 4 Distribution musculoskeletal disorders according to the body part (n = 102)

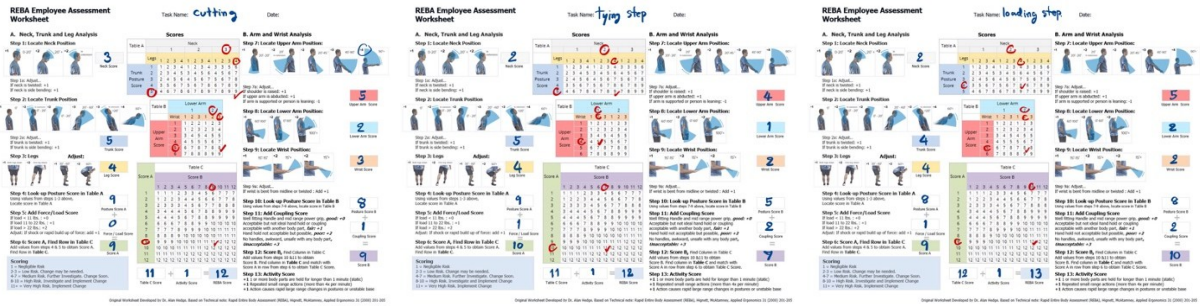
Part of body	*MSDs*	
	7 days (%)	*3 months* (%)
Neck	16 (15.69)	12 (11.76)
Shoulder	34 (33.34)	24 (23.53)
Elbow	13 (12.75)	9 (8.82)
Hand/wrist	31 (30.39)	23 (22.55)
Finger	22 (21.57)	15 (14.71)
Upper back	21 (20.59)	15 (14.71)
Lower back	38 (37.25)	23 (22.55)
Hip/Thigh	27 (26.47)	27 (26.47)
knee	26 (25.49)	20 (19.60)
Ankle/foot	17 (16.66)	11 (10.78)

Observational analysis of harvesting tasks (cutting, tying, and loading bundles) revealed that all three activities required awkward postures such as bending the trunk, twisting the wrist, and repetitive use of the arms and hands. On average, a laborer cut approximately 3,000 sugarcane stalks per day. REBA analysis was performed on a purposive subsample of 30 participants, selected to represent a range of body sizes across 10 harvesting zones. Posture photographs were taken with informed consent for analysis. REBA scores for cutting, tying, and loading tasks (Fig. 1-3) all indicated very high-risk levels, suggesting urgent need for ergonomic intervention (Fig. 4).

Fig. 1 Posture of cutting step

Fig. 2 Posture of tying step

Fig. 3 Step of loading sugarcane bundles onto the truck



(a) (b) (c)

Fig. 4 REBA score (a) cutting step (b) tying step (c) loading step

For psychosocial factors assessed by the Thai-JCQ, median cut-off scores indicated high levels of psychological job demand (50.9%), physical job demand (52.9%), job security (54.9%), social support (87.3%), and workplace hazards (58.8%). Job control was evenly distributed between high and low categories. Details are presented in Table 5.

Table 5 Thai-JCQ (n=102)

Part	*Number (%)*	*Max*	*Min*
Job control		70	26
High ≥ 47	51 (50)		
Low < 47	51 (50)		
Psychological job demand		69	31
High ≥ 46.2	52 (50.98)		
Low < 46.2	50 (49.02)		
Physical job demand		12	3
High ≥ 7	54 (52.94)		
Low < 7	47 (46.08)		
Job security		16	8
High ≥ 13	56 (54.90)		
Low < 13	46 (45.10)		
Social support		72	20
High ≥ 54	89 (87.25)		
Low < 54	13 (12.75)		
Hazard at work		24	8
High ≥ 10	60 (58.82)		
Low < 10	42 (41.18)		

*High was a score that ≥ median and Low was a score that < median

4. DISCUSSION

This study demonstrates that sugarcane harvesting laborers (SHL) in Khon Kaen Province face a considerable burden of musculoskeletal disorders (MSDs), particularly affecting the lower back, shoulders, and hands/wrists in the past week, and the hip/thigh, shoulder, hand/wrist, and lower back in the past three months. Ergonomic observation confirmed that harvesting tasks cutting, tying, and loading place workers at very high risk. These findings underscore the demanding nature of manual sugarcane harvesting, which requires repetitive bending, twisting, and heavy manual handling. The distribution of symptoms is consistent with established ergonomic evidence. Prior research has shown that trunk flexion, asymmetric lifting, and repetitive upper limb exertions are leading contributors to MSDs in agricultural work. The very high REBA scores recorded here reflect these biomechanical stressors: machete use involves forceful and repetitive wrist deviation, tying requires prolonged trunk flexion, and loading bundles demands heavy and asymmetric lifting. These exposures explain the persistence of MSDs among SHL despite partial mechanization in the sugar industry.

Psychosocial stressors were also prominent. Workers reported high psychological and physical demands, limited job control, and considerable workplace hazards, while social support levels were comparatively high. This pattern mirrors the demand–control model described in other agricultural and manual labor settings, where externally imposed schedules and limited autonomy heighten stress. Although social support may offer some protection, it is insufficient to counterbalance the combined effects of high demand and low control. The overlap of physical and psychosocial strain helps to explain the breadth and persistence of MSDs in this group.

Differences between short-term and longer-term symptom reporting provide further insight. Acute discomfort in the lower back and upper limbs within seven days likely reflects recent high-intensity cycles of cutting and loading, whereas hip and thigh pain over three months suggests cumulative effects of prolonged standing, walking on uneven terrain, and repeated squatting. This distinction indicates that both daily adjustments, such as task rotation or micro-breaks, and seasonal interventions, such as tool redesign or mechanized support, are needed to reduce risk.

Several practical implications emerge. Ergonomic interventions should focus on tool design and maintenance to reduce cutting force, adopting aids such as longer handles or intermediate staging points to minimize lifting strain, and reorganizing work to incorporate short breaks and task variation. Training on posture, lifting techniques, and workload pacing could further reduce biomechanical stress. Psychosocial improvements should address limited autonomy by allowing worker input on pacing or task allocation, strengthening supervisory practices that emphasize

safety, and embedding stress management or peer-support activities within training. At the policy level, procurement or buyer standards that incentivize safer practices may accelerate adoption of these measures.

The findings add to wider discussions of agricultural occupational health. Mechanization has eased workload in some sectors, yet manual sugarcane harvesting remains prevalent. The continued high prevalence of MSDs underscores structural challenges such as seasonal employment, limited financial security, and restricted access to alternative jobs. Effective prevention therefore requires not only ergonomic changes but also organizational and policy interventions that address the economic and psychosocial realities of agricultural labor.

This study has notable strengths. It combined worker self-reports with observational assessment (REBA) and examined psychosocial dimensions using the Thai-JCQ, providing a holistic view of risks. Field-based data collection increased ecological validity by capturing real working conditions. However, limitations must be acknowledged. The cross-sectional design prevents causal inference, self-reported data may involve recall or reporting bias, and the REBA subsample of 30 workers, although stratified, may not represent all variations in posture or environment. Future studies should employ longitudinal designs, incorporate objective exposure metrics such as wearable sensors, and examine associations between ergonomic risk, psychosocial factors, and health outcomes using multivariable models.

5. CONCLUSION

This study demonstrates that sugarcane harvesting laborers are highly exposed to both ergonomic and psychosocial risks, which together contribute to a high prevalence of musculoskeletal disorders (MSDs). These risks stem from physically demanding tasks such as repetitive bending, twisting, and heavy manual handling as well as psychosocial stressors including high job demands, limited job control, and seasonal employment with low financial security. Addressing these challenges requires integrated interventions: ergonomic improvements to tools and workflow, training in safe work practices, organizational measures to enhance autonomy, and supportive supervisory approaches. At the policy level, initiatives to strengthen occupational health standards and incentivize safer practices are essential. By tackling both physical and psychosocial factors simultaneously, it is possible to protect worker health and livelihoods while sustaining productivity in the sugar industry.

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