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Effectiveness of Strict Adherence to Ergonomic Advice on Quality of Work in Sugarcane Workers

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ABSTRACT

Introduction: The workers in this field often face tough physical challenges, such as repeating the same motions, working in uncomfortable positions and using heavy tools. These demands can put a strain on their bodies and lead to musculoskeletal disorders (MSDs) which are major cause of work related injuries and pain. Regular adherence to ergonomic advice, including the use of ergonomically designed tools and the adoption of safe work practices is necessary in reducing the MSDs among sugarcane workers. Therefore, strict adherence to ergonomic principles is essential for improving both the health outcomes and work performance of sugarcane workers.

Aim: To study the effectiveness of strict adherence to ergonomic advice on quality of work in sugarcane workers.

Methodology: Distribution of data collection sheets was done to 41 participants in Karad city. Descriptive data regarding the effectiveness of strict adherence to ergonomic advice on quality of work in sugarcane workers were collected.

Result: A total of 41 responses were collected. The participants included were between the age group 18 to 60 years. Both males and females were included. Before the intervention, almost 98% of workers felt that their musculoskeletal pain negatively affected their work performance. However, after the intervention, the situation improved dramatically.

Conclusion: Sugarcane harvesting presents considerable ergonomic challenges, leading to a high incidence of musculoskeletal disorders among workers. By promoting strict adherence to ergonomic principles, it is possible to reduce these risks and enhance the quality of work.

Keywords: *effectiveness, strict adherence, ergonomic advice, quality of work, sugarcane workers.*

1. INTRODUCTION

The most labour-intensive agricultural activities worldwide are sugarcane harvesting. The workers in this field often face tough physical challenges, such as repeating the same motions, working in uncomfortable positions and using heavy tools. These demands can put a strain on their bodies and increase the likelihood of developing musculoskeletal disorders(MSDs) which are major cause of work related injuries and pain. Given the high prevalence of MSDs among agricultural workers, it is crucial to implement effective strategies to reduce these risks and enhance overall work quality. [1]

Ergonomics is the applied science of designing work environments and tasks to fit the capabilities and limitations of the workers, plays a vital role in addressing these challenges. Ergonomics aims to enhance both safety and efficiency of workers by focusing on optimizing the workplace conditions and minimizing the physical strain. [2] Interventions like designing proper tool, educating them about safe work practices and doing some modifications at workplaces prove to be effective. For example, tools with long handles can reduce the need of bending, while padded grips can decrease hand strain. Similarly, training workers on proper lifting techniques and encouraging for frequent rest breaks can alleviate the physical stresses in them. However, the success of these interventions depends mainly on workers strict adherence to ergonomic advice. [3]

Sugarcane workers often operate in extreme environmental conditions, which further intensify physical stress. The repetitive nature of tasks, such as cutting and bundling sugarcane, combined with the weight of the tools and loads, makes them particularly susceptible to injuries in the lower back, shoulders and upper limbs. [4]

To make ergonomic interventions effective, its crucial to follow basic principles like keeping a neutral spine position, using tools designed for comfort and safety and taking regular breaks. Providing shaded rest areas and access to clean drinking water can further support workers health, well-being and productivity. [5]

The physical condition of sugarcane harvesters has a direct impact on the work performance. When workers experience pain or discomfort, it not only slows them down but also makes mistakes and accidents more likely. By reducing physical strain with better ergonomic practices, workers can stay more efficient and accurate. Additionally, good ergonomics can boost job satisfaction and morale, as workers feel less tired and are less likely to get hurt. Reducing the incidence of MSDs leads to better health and financial stability. Despite it is proven but still challenges remain to be implemented in the agricultural sector. To overcome these challenges, it is essential to involve the workers for implementation of ergonomic strategies. The participatory approach contributes to identify the problems and develop solutions. [6]

This study aims to assess the impact of strict adherence to ergonomic advice on quality of work among sugarcane workers. By utilizing the Nordic Musculoskeletal Questionnaire and Numerical Pain Rating Scale, this research will measure the effects of ergonomic interventions on musculoskeletal health and pain levels. The findings will offer valuable insights into how ergonomics can enhance worker safety, well-being and overall productivity in the sugarcane industry. [7]

MATERIALS REQUIRED

- Nordic Musculoskeletal Questionnaire
- Numerical Pain Rating Scale
- Internet Facility
- Data Collection sheet
- Patient information sheet
- Consent form
- Pen

METHODOLOGY

- Type of study: Experimental study
- Study design : Randomized Clinical Trial
- Place of study : Karad
- Sample size : 41
- Sampling method : Simple Random Sampling
- Study duration : 6 months

INCLUSION CRITERIA

- Workers aged between 18-60 years.
- Individuals with a minimum of one year of experience in sugarcane harvesting.
- Workers willing to participate in ergonomic training sessions.

EXCLUSION CRITERIA

- Workers with pre-existing musculoskeletal disorders unrelated to occupational activities.
- Individuals with medical conditions.
- Workers not willing to participate.

OUTCOME MEASURES

- Numerical Pain Rating Scale (NPRS) scale
- Nordic Musculoskeletal Questionnaire (NMQ)

ERGONOMIC ADVICE PROTOCOL

❖ **Posture Improvement**

1. Teach Proper Bending Techniques:
    - Encourage workers to bend at the knees and not the waist when picking up or cutting sugarcane.
    - Demonstrate a squatting or semi-squatting position using leg muscles rather than straining the back.
    - Advise keeping the back straight as much as possible during repetitive tasks.

❖ **Tool Ergonomics**

1. Use of Ergonomically Designed Tools:
    - Provide or recommend tools with long handles to minimize excessive bending.
    - Ensure that the grip of tools is padded and appropriate for the size of the worker's hand.
2. Sharpening Tools Regularly:
    - Sharpen cutting tools to reduce the force required during cutting, minimizing strain on the hands and shoulders.

❖ **Work Schedule and Rest Breaks**

1. Scheduled Breaks:
    - Advise taking 5–10 minute breaks every 1–2 hours to stretch and relieve muscle fatigue.
2. Active Recovery:
    - Incorporate stretching or light exercises during breaks to relax muscles and improve circulation.

❖ **Body Mechanics Training**

1. Training on Safe Lifting and Carrying:
    - Educate workers about lifting lighter loads and carrying them close to the body to minimize back strain.

❖ **Personal Protective Equipment (PPE)**

1. Support Belts:
    - Recommend lumbar support belts for workers with persistent lower back issues (use with proper guidance).

❖ **Physical Conditioning**

1. Strengthening Exercises:
    - Suggest simple exercises to strengthen core, back, and shoulder muscles (e.g. isometric exercises, planks, resistance band exercises).
2. Flexibility Training:
    - Incorporate daily stretches for the neck, shoulders, back, and legs to improve overall flexibility.

❖ **Environmental Adjustments**

1. Shade and Hydration:
    - Provide shaded areas for rest and encourage hydration to reduce heat-related fatigue, which can exacerbate musculoskeletal strain.
2. Team Support:
    - Foster teamwork for lifting or moving heavy objects to distribute physical strain.

Note : Continue this protocol from Day 1 to 2 weeks (45 mins/day for 5 days in a week) to see better results in quality of work improvement.

PROCEDURE

- This is a study of effectiveness of strict adherence to ergonomic advice on quality of work in sugarcane workers.
- This is study was conducted in Karad.
- An ethical clearance certificate was obtained by Institutional Ethical Committee of Krishna Vishwa Vidyapeeth "Deemed to be University", Karad.
- Subjects between the age group 18 to 60 years having minimum of 1 year of work experience were included in this study.
- Subjects were chosen by simple random sampling method according to the inclusion criteria and exclusion criteria.
- An informed consent was obtained from the subjects.
- Ergonomic advice was given to the subjects and they were asked to strictly adhere to it. Before giving the ergonomic advice, they were also asked about the pain. The pain assessment was taken. And after giving the ergonomic advice

and strict adhering to it again the pain assessment was taken.

- Those with pre-existing musculoskeletal disorders unrelated to occupational activities, individuals with medical conditions and participants who are not willing to participate in the study are excluded.
- This questionnaire is based on epidemiological studies to assess musculoskeletal complaints, particularly in the low back, neck, and shoulder regions. It features a 40-item forced-choice questionnaire and additional sections on specific body areas, facilitating detailed reporting of symptoms over various time frames. The questionnaire is also explained in regional Marathi language.
- Based on this the result was obtained.

2. RESULT

Table no. 1 : Demographic variables in the study

Age	Frequency of Sugarcane workers	Percentage
18 - 28 years	15	36.58 %
29 - 38 years	12	29.26 %
39 - 48 years	7	17.07 %
49 - 58 years	7	17.07 %

Interpretation :

The table depicts the knowledge about the demographic variables in this study. In 18 – 28 years age group, there are 15 (36.58 %) sugarcane workers. In 29 – 38 years age group, there are 12 (29.26 %) sugarcane workers. In 39 – 48 years age group, there are 7 (17.07 %) sugarcane workers. In 49 – 58 years age group, there are 7 (17.07 %) sugarcane workers.

Prevalence of Musculoskeletal Issues

Body Region	**Pre-Test Cases (%)**	**Post-Test Cases (%)**	**Change**
Shoulder Pain	21 (50.0%)	Reduced	Decreased
Elbow Pain	0 (0.0%)	0 (0.0%)	No change
Wrist/Hand Pain	14 (33.3%)	Reduced	Decreased
Upper Back Pain	3 (7.1%)	Reduced	Decreased
Lower Back Pain	21 (50.0%)	Reduced	Decreased
Hip/Thigh Pain	0 (0.0%)	0 (0.0%)	No change
Knee Pain	8 (19.0%)	Reduced	Decreased
Ankle/Foot Pain	0 (0.0%)	0 (0.0%)	No change

Table no. 2 : Prevalence of Musculoskeletal issue

Key Findings:

- Shoulder pain and lower back pain were the most common issues before the intervention, each affecting 50% of workers.
- Wrist/hand pain (33.3%) and knee pain (19.0%) were also prevalent.
- Post-intervention, the prevalence of musculoskeletal disorders reduced across all affected areas.

Before implementing ergonomic interventions, many sugarcane workers experienced significant musculoskeletal discomfort, with shoulder pain and lower back pain being the most common, affecting 50% of the participants. Wrist/hand pain (33.3%) and knee pain (19%) were also frequently reported.

After the intervention, there was a noticeable decline in reported musculoskeletal pain across all affected areas. The reduction indicates that the ergonomic strategies had a positive impact.

Impact of Musculoskeletal Issues on Quality of Work

Impact Severity	**Pre-Test Cases (%)**	**Post-Test Cases (%)**	**Change**
Quite less impact	15 (36.6%)	36 (85.7%)	Increase
Moderate impact	25 (61.0%)	5 (11.9%)	Significant decrease
Severe impact	1 (2.4%)	0 (0.0%)	Eliminated

Table no. 3 : Impact of Musculoskeletal Issues on Quality of Work

Key Findings:

- Before the intervention, 97.6% of workers reported musculoskeletal issues affecting their quality of work.
- Post-intervention, only 12.16% of workers reported any work-related impact due to musculoskeletal issues.
- The number of cases with moderate and severe impacts significantly decreased.

Before the intervention, almost 98% of workers felt that their musculoskeletal pain negatively affected their work performance. Most workers reported a moderate to severe impact, making tasks physically challenging.

However, after the intervention, the situation improved dramatically. Nearly 88% of workers reported quite less impact on their work due to musculoskeletal issues, and only about 12% still experienced some level of discomfort. The number of cases with a moderate impact dropped significantly, and severe impact cases were completely eliminated.

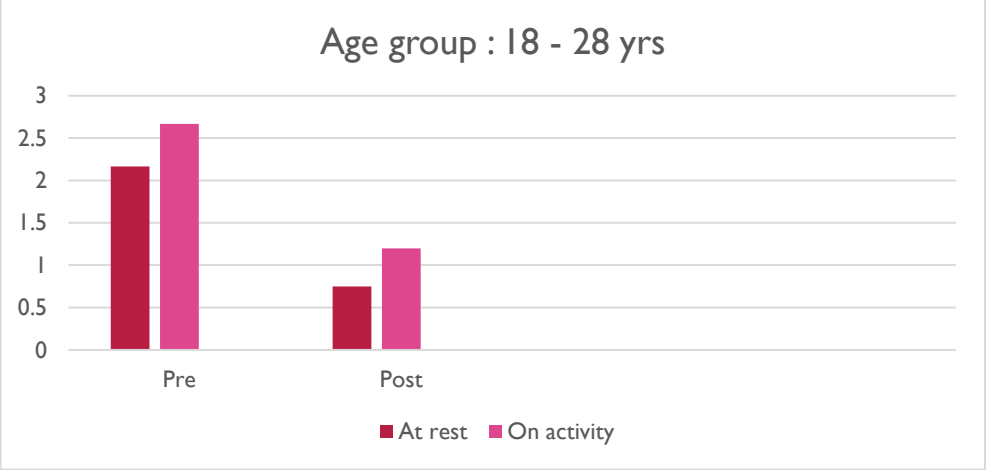
Impact of NPRS on Work Quality

Table No. 4 : NPRS (AT REST)

AGE	No. of Participants	Pre	Post	P - value	T - value
18 – 28 yrs	15	2.167 +_ 0.5774	0.7500 +_ 0.4523	<0.0001	6.189

Table no. 5 : NPRS (ON ACTIVITY)

Age	No. of Participants	Pre	Post	P - value	T - value
18 – 28 yrs	15	2.667 +_ 1.175	1.200 +_ 0.4140	0.0006	4.363



Graph no. 1 : NPRS Age group 18 to 28 years

Interpretation :

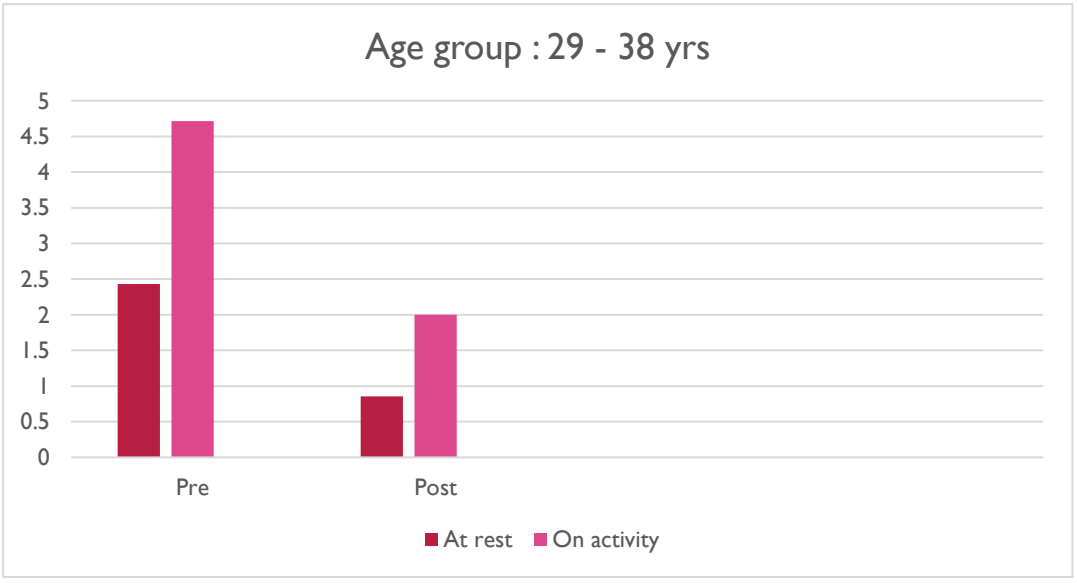
In 18 – 28 yrs of age group 15 participants participated in this study. According to the NPRS the subjects in this study complained of moderate pain. There is extremely significant difference between the subjects who received strictly adhered to the given ergonomic advice.

Table No. 6 : NPRS (AT REST)

AGE	No. of Participants	Pre	Post	P - value	T - value
29 – 38 yrs	12	2.429 +_ 0.5345	0.8571 +_ 0.6901	0.0053	4.260

Table No. 7 : NPRS (ON ACTIVITY)

AGE	No. of Participants	Pre	Post	P - value	T - value
29 – 38 yrs	12	4.714 +_ 0.7559	2.000 +_ 0.8165	0.0007	6.454



Graph no. 2 : NPRS Age group 29 to 38 years

Interpretation :

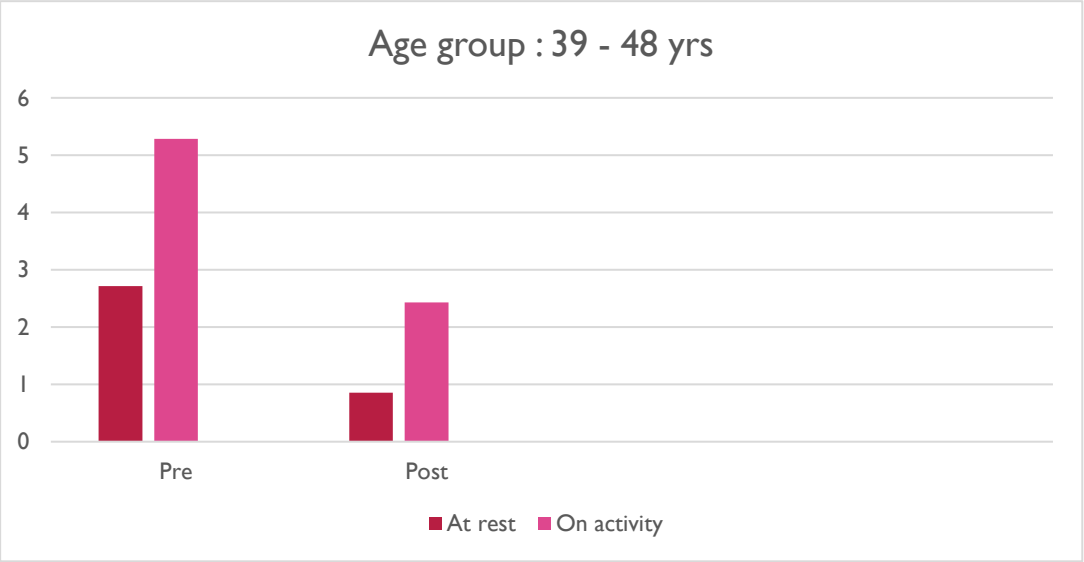
In 29 – 38 yrs of age group 12 participants participated in this study. According to the NPRS the subjects in this study complained of moderate pain. There is extremely significant difference between the subjects who received strictly adhered to the given ergonomic advice.

Table No. 8 : NPRS (ON REST)

AGE	No. of Participants	Pre	Post	P - value	T - value
39 – 48 yrs	7	2.714 +_ 0.4206	0.8571 +_ 0.6901	0.0004	7.120

Table No. 9 :NPRS (ON ACTIVITY)

AGE	No. of Participants	Pre	Post	P - value	T - value
39 – 48 yrs	7	5.286 +_ 0.5216	2.429 +_ 0.7868	0.0002	8.402



Graph no. 3 : NPRS Age group 39 to 48 years

Interpretation :

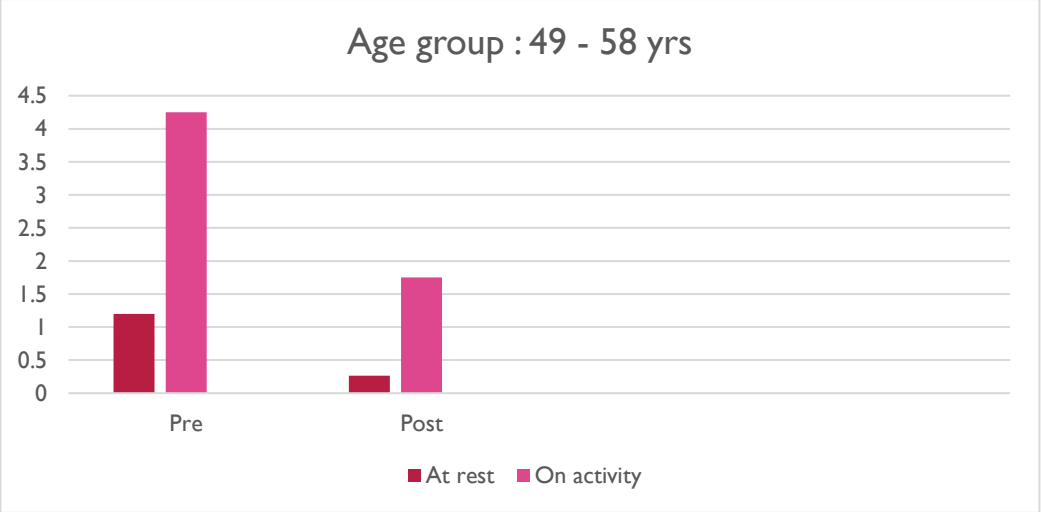
In 39 – 48 yrs of age group 7 participants participated in this study. According to the NPRS the subjects in this study complained of moderate pain. There is extremely significant difference between the subjects who received strictly adhered to the given ergonomic advice.

Table No. 10 :NPRS (ON REST)

AGE	No. of Participants	Pre	Post	P - value	T - value
49 – 58 yrs	7	1.200 +_ 0.6761	0.2667 +_ 0.4577	0.0021	3.761

Table No. 11 : NPRS (ON ACTIVITY)

AGE	No. of Participants	Pre	Post	P - value	T - value
49 – 58 yrs	7	4.250 +_ 0.7538	1.750 +_ 0.7538	<0.0001	10.856



Graph no. 4 : NPRS Age group 49 to 58 years

Interpretation :

In 49 – 58 yrs of age group 7 participants participated in this study. According to the NPRS the subjects in this study complained of moderate pain. There is extremely significant difference between the subjects who received strictly adhered to the given ergonomic advice.

3. DISCUSSION

Sugarcane harvesting is a physically demanding job that requires workers to spend long hours bending, lifting heavy loads and performing repetitive movements. These physical activities increase the risk of musculoskeletal disorders, fatigue and reduced productivity. To protect workers and improve efficiency, ergonomic interventions are essential. [8]

Harvesting sugarcane manually involves cutting, loading and transporting cane stalks, which places a significant strain on the body. Common ergonomic issues include awkward postures, repetitive motions, high physical exertion, exposure to extreme weather and extended working hours.

A study by Bodin et al. (2016) in El Salvador found that sugarcane workers frequently suffer from heat stress, dehydration and musculoskeletal disorders due to rigorous nature of their work. The research suggested implementing shaded rest areas, hydration programs and ergonomic tools to help reduce these risk. [8]

In India, many agricultural workers still rely on traditional methods, which further compound ergonomic issues. According to Nag and Nag (2004), inefficient tools and poor lifting techniques contribute to frequent work related injuries. The study emphasized the need for better tool designs and structured work rest schedules to lessen strain and enhance productivity. [10]

Following ergonomic advice has been shown to improve both work quality and efficiency. Using proper lifting techniques, mechanized tools and maintaining correct posture can significantly reduce fatigue and increase productivity.

For example, Thiyagarajan et al. (2011) studied the effects of redesigned sugarcane harvesting knives and found that these improved tools helped workers experience less hand fatigue while boosting efficiency, allowing them to harvest more sugarcane within the same period. [14]

Another study by Bodin et al. (2016) introduced OSHA'S Water Rest Shade(WRS) program, which provided workers with hydration backpacks, mobile shaded areas and scheduled breaks. Results showed that workers increased their water intake by 25% reported fewer heat stress symptoms and improved their daily output from 5.1 to 7.3 tons per person. These findings highlight the significant impact of even small ergonomic changes on health and productivity. [8]

One of the main benefits of ergonomic practices is reducing the risk of musculoskeletal disorders (MSDs). Encouraging proper postures, minimizing repetitive strain and decreasing excessive exertion can lower the chances of injuries. Research by Jirapongsuwan et al. (2023) showed that agricultural workers who underwent ergonomic training reported fewer musculoskeletal complaints than those who did not receive any training. [9]

Beyond MSD prevention, ergonomic strategies also help combat heat related illness. since sugar cane harvesting often takes place in extremely hot conditions workers are at high risk of dehydration heat exhaustion and heat stroke measures such as hydration stations shaded rest areas and scheduling work during cooling hours help mitigate these risks. Studies have confirmed that adequate hydration and planned breaks improve worker endurance and overall efficiency

Despite their clear benefits, ergonomic interventions face several obstacles in the sugarcane industry. One major challenge is resistance to change. Many workers have used traditional harvesting methods for years and may be hesitant to adopt new techniques and tools. Similarly, employers may be reluctant to invest in ergonomic equipment due to cost concerns.

Another significant issue is the lack of awareness and proper training. Many agricultural workers have limited access to occupational health and safety education, leading them to continue using unsafe work practices. Without proper knowledge, workers remain vulnerable to injuries and reduced efficiencies

Additionally ensuring compliance with ergonomic guidelines can be difficult. Large scale plantations may struggle to monitor whether workers are consistently following recommended practices.

To make ergonomic interventions more effective a well-rounded approach is needed. The following strategies can help integrate ergonomic principles into sugar cane harvesting :

1. **Developing Tailored Ergonomic Programs:** Designing interventions specific to sugarcane workers tasks, environmental conditions and cultural contexts can enhance effectiveness. Ergonomic tools should be customized to meet the unique needs of agricultural labourers.
2. **Providing Training and Education:** Regular training sessions should be conducted to teach workers proper lifting techniques, posture management and workload distribution. Reinforcing ergonomic principles through periodic workshops can help long term behavioural changes.
3. **Implementing Continuous Monitoring and Feedback:** Establishing a system to track adherence to ergonomic practices can identify areas needing improvement. supervisors should provide ongoing support and constructive feedback to ensure workers consistently follow safe practices.
4. **Investing in Mechanized Tools:** Employers should adopt mechanized harvesting tools that minimise manual labour while maintaining productivity. Advancements in agricultural equipment can significantly reduce physical strain, making harvesting safer and more efficient.

4. CONCLUSION

Sugarcane harvesting presents considerable ergonomic challenges, leading to a high incidence of musculoskeletal disorders among workers. However, by implementing proper ergonomic interventions, these risks can be minimized while enhancing productivity and work quality. This study underscores the need for structured ergonomic programs that combine practical interventions with training and education to improve both workers well-being and efficiency.

By conducting a detailed assessment using reliable tools such as the Nordic Musculoskeletal Questionnaire (NMQ) and the Numerical Pain Rating Scale (NPRS), this study will provide valuable insights into the impact of ergonomics in physically demanding industries. Research has already demonstrated that following ergonomic guidelines- such as staying hydrated, taking scheduled breaks, working in shaded areas and using ergonomically designed tools- helps reduce health risks while improving productivity. By prioritizing these best practices, the sugarcane industry can foster a safer, healthier and more supportive work environment for its workforce.

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