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Awareness of Knee Joint Protection Techniques Among Farmers Engaged in Squatting Activities

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Abstract

Background

Farming activities often require frequent squatting, kneeling, and manual handling of heavy loads, which place considerable stress on the knee joints and may contribute to the development of various knee-related musculoskeletal disorders. These factors may lead to knee pain, reduced functional ability, and a greater likelihood of developing knee-related disorders. However, the implementation of appropriate knee protection strategies can help minimize injury risk and preserve normal knee function.

Methods

A quantitative quasi-experimental study using a one-group pretest-posttest design was conducted among farmers who regularly performed squatting activities. The study was carried out in rural areas of Karad, Maharashtra, India, over a period of six months. A total of 160 farmers were selected using a convenience sampling technique. Awareness related to knee joint protection methods was assessed using a self-structured questionnaire. After obtaining informed written consent, participants completed the pre-test questionnaire. An educational intervention on knee joint protection techniques was then provided, followed by post-test assessment. The collected data were analyzed using suitable descriptive and inferential statistical techniques.

Result

The present study found a significant improvement in awareness of knee joint protection techniques following the educational intervention among farmers engaged in squatting activities. Among the participants, 85 (53.1%) reported knee pain, while 75 (46.9%) reported no knee pain. The majority belonged to the age group of 31-45 years, 78 (48.8%). Most participants worked for approximately 4 hours in squatting postures, 76 (47.5%), and 122 (76.3%) reported performing heavy lifting during deep squatting activities. Abnormal posture was observed in 86 (53.8%) of participants. Pre-intervention awareness showed that 27 (16.8%) had poor awareness, 127 (79.4%) had moderate awareness, and only 6 (3.8%) had good awareness. After the educational intervention, 0 (0.0%) participants remained in the poor category, 21 (13.1%) demonstrated moderate awareness, and 139 (86.9%) achieved good awareness. The improvement in awareness was statistically significant ($p < 0.001$).

Conclusion

The significant improvement in post-intervention awareness scores highlights the importance of structured educational programs in promoting knowledge related to knee health. Increasing knowledge about knee joint protection strategies may help reduce the risk of occupational knee injuries, prevent functional limitations, and contribute to lowering the future burden of knee osteoarthritis among farmers involved in repetitive squatting activities.

Categories: Occupational Health, Physical Medicine & Rehabilitation, Preventive Medicine
Keywords: awareness, farmers, knee joint protection, knee pain, musculoskeletal disorders, occupational health, squatting activities

Introduction

Agricultural employment places substantial physical demands on workers and has been linked with a high burden of musculoskeletal conditions [1,2]. Farmers are frequently exposed to repetitive movements, prolonged squatting, kneeling, bending, and heavy lifting during routine agricultural activities [1,3,4]. Squatting is commonly required during various agricultural activities such as planting, weeding, harvesting, and irrigation [3,5]. Prolonged repetitive squatting can increase mechanical loading on the knee joint, potentially causing pain and limiting an individual's ability to perform daily activities [5]. The knee joint is a major weight-bearing joint that plays a vital role in mobility and daily activities [6]. Excessive loading of the

knee during high-flexion activities can increase compressive forces on the articular cartilage, menisci, ligaments, and surrounding soft tissues [5,7]. Biomechanical evidence indicates that deep knee flexion substantially increases the load transmitted through both the tibiofemoral and patellofemoral joints [5]. Repeated exposure to such loading patterns may accelerate degenerative changes within the knee joint structures [7].

Patellofemoral pain is a common musculoskeletal disorder frequently observed in physically active individuals and workers exposed to repetitive loading of the knee joint [8,9]. Research has reported that activities involving frequent squatting are associated with an increased risk of developing patellofemoral pain syndrome [8]. Occupational activities characterized by frequent squatting and kneeling have been identified as significant risk factors for the development of knee osteoarthritis [3,10,11]. Workers who spend prolonged periods in knee-straining postures have a greater likelihood of developing chronic knee symptoms than those in less physically demanding occupations [10,11]. Knee osteoarthritis is a leading cause of pain, disability, and reduced quality of life worldwide [12-14]. Occupational activities such as squatting, kneeling, climbing, and heavy lifting have been consistently linked to the development as well as progression of knee osteoarthritis [10,11].

Previous studies have indicated that farmers experience a high prevalence of knee pain because of repetitive occupational exposure and cumulative joint loading [1,4,15]. Persistent knee pain may adversely affect mobility, decrease work productivity, and restrict participation in routine daily activities [12,15]. Awareness of knee joint protection techniques is an important aspect of musculoskeletal health promotion and injury prevention [16,17]. Knee joint protection techniques are strategies designed to reduce excessive stress on the knee joint during occupational and daily activities [16]. These techniques include maintaining proper posture, avoiding prolonged deep squatting, using correct lifting methods, modifying work practices, taking rest breaks, and performing strengthening exercises [2,16,17].

The adoption of knee joint protection principles may help reduce the incidence of knee pain and prevent long-term joint damage among farmers engaged in repetitive squatting activities [16,18]. Educational interventions and workplace health programs have been shown to improve knowledge and preventive behaviors related to musculoskeletal disorders [16-18]. Increased awareness enables workers to identify occupational risk factors and implement safer movement strategies during work activities [16,17]. Despite the high prevalence of knee disorders among farmers, awareness regarding knee joint protection techniques remains limited in many rural communities [1,2]. Lack of knowledge regarding preventive measures may contribute to the continued occurrence of knee pain and disability among agricultural workers [1,15]. Assessment of awareness levels among farmers is therefore necessary to identify existing knowledge gaps and to develop effective educational interventions [16,17]. Enhancing awareness regarding knee joint protection strategies may contribute to the prevention of work-related knee injuries, improve functional abilities, and promote better quality of life among farmers involved in frequent squatting activities [16-18]. Therefore, this study was conducted to evaluate the awareness of knee joint protection techniques among farmers involved in repetitive squatting activities.

Materials And Methods

A quantitative quasi-experimental study using a one-group pretest-posttest design was conducted in Karad, Maharashtra, India, over a six-month period to assess awareness of knee joint protection techniques among farmers engaged in regular squatting activities. A quantitative approach with a descriptive cross-sectional survey design was adopted. The study was conducted in rural communities and agricultural fields in selected areas of Karad. A total of 160 farmers were selected using a convenience sampling technique. The target population consisted of farmers aged 18-60 years who were engaged in regular squatting activities during farming work. The accessible population included farmers fulfilling the inclusion criteria and available during the data collection period. Data were collected using a self-structured questionnaire developed by the authors specifically for this study, along with posture assessment and manual muscle testing (MMT) of the lower-limb muscles using a published open-access assessment method [19]. Written informed consent was obtained from all participants before data collection. The data collection procedure included obtaining informed consent, assessing awareness using the self-structured questionnaire, performing posture assessment, conducting MMT of the lower-limb muscles, and compiling the findings into a master chart. Individuals with a previous history of knee replacement surgery, lower-limb fractures or knee injuries within the preceding six months, neurological disorders affecting lower-extremity function, severe cognitive deficits that could interfere with comprehension, or those unwilling to participate were excluded. The collected data were analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation, and inferential statistics using the chi-square test in SPSS (IBM Corp., Armonk, NY) under the guidance of a statistician. The sample size was calculated using the following formula:

$$n = Z^2pq/L^2$$

where confidence level = 0.875 (87.5% confidence level), corresponding Z value is approximately 1.54, assumed awareness (p) = 19% = 0.19 (assumed prevalence due to previous prevalence estimate in the target population) [20].

Allowable error (L) = 0.05

$$q = 1 - p = 1 - 0.19 = 0.81$$

$$n = (1.54)^2 \times 0.19 \times 0.81/(0.05)^2,\ n = 146$$

Based on this calculation, the minimal required sample size was 146 participants. To improve the precision of the study and account for possible incomplete responses, a total of 160 eligible farmers recruited and included in the final analysis.

Study design and setting

A quantitative quasi-experimental study with a pre-intervention and post-intervention assessment was conducted to assess awareness of knee joint protection techniques among farmers engaged in regular squatting activities. The study was conducted in rural communities and agricultural fields in selected areas of Karad, Maharashtra, India.

Study duration

The study was conducted over a period of six months from February 27, 2026, to August 27, 2026. During this period, eligible farmers were recruited, informed consent was obtained, baseline data and pre-intervention awareness were assessed, the educational intervention was provided, and post-intervention awareness was evaluated.

Study population and sample

The target population consisted of male and female farmers aged 18-60 years who were engaged in agricultural activities involving frequent or prolonged squatting. A total of 160 farmers were recruited using a convenience sampling technique. The accessible population included farmers who fulfilled the inclusion criteria and were available during the data collection period.

Data collection

A 20-item self-structured Yes/No questionnaire, developed by the authors specifically for this study, was used to assess awareness of knee joint protection techniques. The questionnaire consisted of four sections covering clinical-related information, awareness of knee joint protection, knowledge of knee joint protection, and practice-based knee joint protection. Each correct response was assigned a score of 1, and each incorrect response was assigned a score of 0, giving a total possible score of 20. Awareness was categorized as poor (0-6), moderate (7-14), and good (15-20). The complete questionnaire is provided in the Appendix. Lower-limb muscle strength was assessed using MMT based on a published open-access assessment method [19].

Abnormal Posture

Squatting posture was assessed by direct observation during the participant's usual squatting activity. Posture was classified as normal when the participant maintained appropriate knee alignment, controlled knee flexion, and a neutral spinal position during squatting. Posture was classified as abnormal when one or more deviations from these criteria were observed, including inappropriate knee alignment, excessive forward displacement of the knees, or loss of neutral spinal alignment.

Squatting posture was assessed through observational assessment during the participants' usual squatting activities. The observed parameters included knee alignment, symmetry of weight distribution, hip position, ankle and foot position, and visible signs of discomfort. Posture was classified as normal or abnormal according to the predefined observational criteria used in the study. No standardized assessment tool was used unless otherwise specified.

Intervention protocol

The intervention consisted of an educational program on knee joint protection techniques for farmers engaged in squatting activities. The participants were educated about maintaining appropriate squatting posture, avoiding excessive forward movement of the knees when feasible, distributing body weight evenly between both lower limbs, avoiding heavy lifting while in a deep squat, and taking regular breaks during prolonged squatting activities. Instructions regarding safer lifting techniques and modification of occupational activities were also provided to minimize excessive stress on the knee joints. The intervention aimed to improve participants' awareness of knee joint protection techniques during farming activities.

Potential confounders

Potential confounding factors considered in the study included age, sex, body weight/BMI, duration and

frequency of squatting, occupational exposure to heavy lifting, previous knee injury, history of knee pain, use of knee support or brace, previous surgery, and lower-limb muscle strength. These factors may influence knee-related symptoms or awareness independently of the educational intervention. Relevant demographic, clinical, occupational, and functional information was therefore recorded during data collection to describe the study population and consider their potential influence when interpreting the findings.

Inclusion and exclusion criteria

The study included male and female farmers aged 18-60 years who were engaged in agricultural activities involving frequent or prolonged squatting. Participants with previous knee replacement surgery, recent lower-limb fracture or knee injury, neurological disorders affecting the lower extremity, severe cognitive impairment that could interfere with comprehension of the questionnaire or educational intervention, or unwillingness to participate were excluded.

Ethical considerations and IRB/IEC approval

The study was conducted after obtaining ethical approval from the Krishna Vishwa Vidyapeeth Institutional Ethics Committee, Karad. The committee issued approval KVV/IEC/03/2026. The study was approved under Protocol Number 476/2025-2026, titled “Awareness of Knee Joint Protection Techniques Among Farmers Engaged in Squatting Activities,” and was conducted under the guidance of Dr. Mayuri Shah, Assistant Professor, Department of Neurosciences, Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad. Written informed consent for participation and open-access publication was obtained from all participants.

Statistical analysis

Data were entered and organized using Microsoft Excel 2010 (Microsoft Corporation, Redmond, WA, USA). Descriptive statistics, including frequencies, percentages, mean, and standard deviation, were used to summarize the participants' responses. A chi-square test was performed to examine associations between categorical variables. A paired t-test was used to compare pre-intervention and post-intervention awareness scores. A p-value of <0.05 was considered statistically significant.

Results

A total of 160 farmers engaged in squatting activities participated in the study. Among them, 85 (53.1%) reported experiencing knee pain, while 75 (46.8%) reported no knee pain, indicating a high prevalence of knee-related symptoms among the study population. The age distribution showed that the majority of participants belonged to the age group of 31-45 years, 78 (48.7%), followed by the age group of 46-60 years, 45 (28.1%), and the age group of 18-30 years, 37 (23.1%). This suggests that middle-aged farmers constituted the largest proportion of the sample. Regarding occupational exposure, 76 (47.5%) of participants reported working in squatting postures for approximately 4 hours per day, while 39 (24.3%) worked for 3 hours, 20 (12.3%) for 2 hours, and 25 (15.6%) for more than 4 hours daily. Furthermore, 122 (76.2%) of participants reported performing heavy lifting while in deep squatting positions, indicating substantial mechanical stress on the knee joints. Postural assessment revealed that 86 (53.75%) of participants demonstrated abnormal posture, whereas 74 (46.25%) exhibited normal posture. Muscle strength assessment showed that most participants had grade 5 muscle strength at the hip (flexion, extension, abduction), knee (flexion, extension), and ankle (plantarflexion, dorsiflexion), although a proportion demonstrated reduced muscle strength. Pre-intervention awareness assessment revealed that 127 (79.3%) had moderate awareness regarding knee joint protection techniques, 27 (16.8%) had poor awareness, and only 6 (3.75%) had good awareness. These findings indicate inadequate knowledge of knee joint protection practices among the majority of participants before the educational intervention. Following the educational intervention, awareness levels improved considerably. None of the participants remained in the poor awareness category, while 21 (13.1%) demonstrated moderate awareness and 139 (86.8%) achieved good awareness. Comparison of pre- and post-intervention scores demonstrated a statistically significant improvement in awareness levels ($p < 0.001$), confirming the effectiveness of the educational program. Overall, the findings suggest that farmers engaged in squatting activities are exposed to multiple risk factors for knee problems. A total of 160 farmers engaged in squatting activities participated in the study. Among them, 85 (53.1%) reported experiencing knee pain, while 75 (46.8%) reported no knee pain, indicating a high prevalence of knee-related symptoms among the study population. The age distribution showed that the majority of participants belonged to the age group of 31-45 years, 78 (48.7%), followed by the age group of 46-60 years, 45 (28.1%), and the age group of 18-30 years, 37 (23.1%). This suggests that middle-aged farmers constituted the largest proportion of the sample. Regarding occupational exposure, n = 76 , (47.5%) participants reported working in squatting postures for approximately 4 hours per day. Additionally, many participants demonstrated limited awareness of knee joint protection techniques. However, educational intervention significantly enhanced their knowledge and awareness regarding knee joint protection.

Table *1* shows that 85 (53.1%) farmers experienced knee pain, whereas 75 (46.8%) did not report knee pain, suggesting that knee pain is common among farmers engaged in squatting activities.

Knee pain	Number (n)	Percentage (%)
Yes	85	53.1%
No	75	46.8%

TABLE 1: Distribution of farmers according to the presence of knee pain

n, number of participants with the response

Table 2 shows that 76 (47.5%) farmers performed squatting activities for approximately 4 hours daily, followed by 39 (24.3%) for 3 hours, 25 (15.6%) for more than 4 hours, and 20 (12.3%) for 2 hours.

Working hours (hrs)	Number (n)	Percentage (%)
2 hrs	20	12.5%
3 hrs	39	24.4%
4 hrs	76	47.5%
More than 4 hrs	25	15.6%

TABLE 2: Distribution of farmers according to working hours in squatting activities

n, number of participants with response; hrs, working hours

Table 3 shows that the majority of farmers, 78 (48.7%), belonged to the age group of 31-45 years, followed by 45 (28.1%) aged 46-60 years and 37 (23.1%) aged 18-30 years.

Age (years)	Number (n)	Percentage (%)
18-30 years	37	23.1%
31-45 years	78	48.7%
46-60 years	45	28.1%

TABLE 3: Distribution of farmers according to age group

n, number of participants with response

Table 4 shows that 122 (76.2%) farmers performed heavy lifting combined with deep squatting, whereas 38 (23.7%) did not, indicating a high exposure to knee stress during farming activities.

Lifting	Number (n)	Percentage (%)
Yes	122	76.2%
No	38	23.7%

TABLE 4: Distribution of farmers according to heavy lifting with deep squatting

n, number of participants with response

Table 5 findings demonstrate that 86 (53.75%) farmers exhibited abnormal posture, while 74 (46.25%) showed normal posture, suggesting that faulty posture may contribute to knee-related problems.

Posture	Number (n)	Percentage (%)
Normal	74	46.25%
Abnormal	86	53.75%

TABLE 5: Distribution of farmers according to postural assessment

n: number of participants with response

Abnormal posture: presence of one or more observed deviations from the predefined squatting-posture criteria, including inappropriate knee alignment, excessive forward displacement of the knees, or loss of neutral spinal alignment.

Table 6 shows that the majority of farmers, 103 (64.3%), had grade 5 hip flexion muscle strength, whereas 57 (35.6%) had grade 4 strength.

Hip flexion (MMT)	Number (n)	Percentage (%)
Grade 5	103	64.3%
Grade 4	57	35.6%
Grade 3	0	0%
Mean±SD	4.64±0.48	-

TABLE 6: Distribution of farmers according to hip flexion MMT grades

n, number of participants with response; MMT, manual muscle testing

Table 7 shows that the majority of farmers, 103 (64.3%), had grade 5 hip extension muscle strength, whereas 57 (35.6%) had grade 4 strength.

Hip extension	Number (n)	Percentage (%)
Grade 5	103	64.3%
Grade 4	57	35.6%
Grade 3	0	0%
Mean MMT±SD	4.64±0.48	-

TABLE 7: Distribution of farmers according to hip extension MMT grades

n, number of participants with response; MMT, manual muscle testing

Table 8 shows that the majority of farmers, 103 (64.3%), had grade 5 hip abduction muscle strength, whereas 57 (35.6%) had grade 4 strength.

Hip abduction (MMT)	Number (n)	Percentage (%)
Grade 5	103	64.3%
Grade 4	57	35.6%
Grade 3	0	0%
Mean MMT±SD	4.64±0.48	-

TABLE 8: Distribution of farmers according to hip abduction MMT grades

n, number of participants with response; MMT, manual muscle testing

Table *9* shows that 94 (58.7%) farmers had grade 5 knee flexion muscle strength, 43 (26.8%) had grade 4 strength, and 23 (14.3%) had grade 3 strength.

Knee flexion (MMT)	Number (n)	Percentage (%)
Grade 5	94	58.7%
Grade 4	43	26.8%
Grade 3	23	14.3%
Mean MMT±SD	4.443±0.733	-

TABLE 9: Distribution of farmers according to knee flexion MMT grades

n, number of participants with response; MMT, manual muscle testing

Table *10* shows that 94 (58.7%) farmers had grade 5 knee extension muscle strength, 43 (26.8%) had grade 4 strength, and 23 (14.3%) had grade 3 strength.

Knee extension	Number (n)	Percentage (%)
Grade 5	94	58.7%
Grade 4	43	26.8%
Grade 3	23	14.3%
Mean MMT±SD	4.443±0.733	-

TABLE 10: Distribution of farmers according to knee extension MMT grades

n, number of participants with response; MMT, manual muscle testing

Table *11* shows that most farmers, 144 (90%), demonstrated grade 5 ankle plantarflexion muscle strength, while 16 (10%) had grade 4 strength. No participant exhibited grade 3 strength.

Ankle plantarflexion (MMT)	Number (n)	Percentage (%)
Grade 5	144	90%
Grade 4	16	10%
Grade 3	0	0%
Mean MMT±SD	4.9±0.300	-

TABLE 11: Distribution of farmers according to ankle plantarflexion MMT grades

n, number of participants with response; MMT, manual muscle testing

Table *12* shows that most farmers, 144 (90%), demonstrated grade 5 ankle dorsiflexion muscle strength, while 16 (10%) had grade 4 strength. No participant exhibited grade 3 strength.

Ankle dorsiflexion	Number (n)	Percentage (%)
Grade 5	144	90%
Grade 4	16	10%
Grade 3	0	0%
Mean MMT±SD	4.9±0.300	-

TABLE 12: Distribution of farmers according to ankle dorsiflexion MMT grades

n, number of participants with response; MMT, manual muscle testing

Table *13* shows that before the educational intervention, the majority of farmers demonstrated moderate awareness regarding knee joint protection techniques, whereas only a small proportion had good awareness.

Awareness (pre)	Numbers (n)	Percentage (%)
Poor	27	16.8%
moderate	127	79.3%
good	6	3.75%
Mean±SD	8.68±2.426	-

TABLE 13: Distribution of farmers according to pre-awareness level

n, number of participants with response

Table *14* shows that across all age groups, most farmers exhibited moderate awareness levels, while fewer participants demonstrated good awareness. The differences observed were statistically significant ($p < 0.001$).

Age group of 18-30 years	Number (n)	Percentage (%)
Poor	7	18.9%
Moderate	27	72.9%
Good	3	8.1%
Mean±SD	9.243±2.938	-

TABLE 14: Distribution of pre-awareness levels according to the age group of 18-30 years

n, number of participants with response

Table *15* shows that across all age groups, most farmers exhibited moderate awareness levels, while fewer participants demonstrated good awareness. The differences observed were statistically significant ($p < 0.001$).

Age group of 31-45 years	Number (n)	Percentage (%)
Poor	14	17.7%
Moderate	62	79.4%
Good	2	2.5%
Mean±SD	8.40±2.321	-

TABLE 15: Distribution of pre-awareness levels according to the age group of 31-45 years

n, number of participants with response

Table *16* shows that across all age groups, most farmers exhibited moderate awareness levels, while fewer participants demonstrated good awareness. The differences observed were statistically significant ($p < 0.001$).

Age group of 46-60 years	Number (n)	Percentage (%)
Poor	6	13.3%
Moderate	38	84.4%
Good	1	2.2%
Mean±SD	8.75±2.16	-

TABLE 16: Distribution of pre-awareness levels according to the age group of 46-60 years

n, number of participants with response

Table *17* shows that after the educational intervention, 139 (86.8%) farmers demonstrated good awareness, 21 (13.1%) had moderate awareness, and no participants remained in the poor awareness category. This indicates a substantial improvement in awareness following education.

Awareness (post)	Numbers (n)	Percentage (%)
Poor	0	0%
Moderate	21	13.1%
Good	139	86.8%
Mean±SD	13.84±1.158	-

TABLE 17: Distribution of farmers according to post-awareness level

n, number of participants with response

Table *18* shows that post-intervention findings showed that the majority of farmers across all age groups achieved good awareness regarding knee joint protection techniques, demonstrating the effectiveness of the educational program irrespective of age.

Age group of 18-30 years	Number (n)	Percentage (%)
Poor	0	0%
Moderate	3	8.1%
Good	34	91.89%
Mean±SD	14.10±1.100	-

TABLE 18: Distribution of post-awareness levels according to the age group of 18-30 years

n, number of participants with response

Table *19* shows that post-intervention findings showed that the majority of farmers across all age groups achieved good awareness regarding knee joint protection techniques, demonstrating the effectiveness of the educational program irrespective of age.

Age group of 31-45 years	Number (n)	Percentage (%)
Poor	0	0%
Moderate	13	16.6%
Good	65	83.3%
Mean±SD	13.78±1.24	-

TABLE 19: Distribution of post-awareness levels according to the age group of 31-45 years

n, number of participants with response

Table *20* shows that post-intervention findings showed that the majority of farmers across all age groups achieved good awareness regarding knee joint protection techniques, demonstrating the effectiveness of the educational program irrespective of age.

Age group of 46-60 years	Number (n)	Percentage (%)
Poor	0	0%
Moderate	5	11.11%
Good	40	88.88%
Mean±SD	13.73±1.037	-

TABLE 20: Distribution of post-awareness levels according to the age group of 46-60 years

n, number of participants with response

Table *21* shows that a comparison between pre- and post-awareness levels revealed a significant improvement following the educational intervention. Good awareness increased from 6 (3.75%) to 139 (86.8%), while poor awareness decreased from 27 (16.8%) to 0 participants. The difference was statistically significant ($t = 28.75$, $p < 0.001$), confirming the effectiveness of the educational program.

Awareness	Pre, n (%)	Post, n (%)
Poor	27 (16.8%)	0 (0%)
Moderate	127 (79.3%)	21 (13.1%)
Good	6 (3.75%)	139 (86.8%)
Mean±SD	8.68±2.426	13.84±1.158
p-value	<0.0001	-
t-statistic	28.75	-
df	159	-
Cohen's dz	2.27	-

TABLE 21: Comparison of pre- and post-awareness levels

n, number of participants with response

Discussion

The present study was undertaken to assess the level of awareness regarding knee joint protection techniques among farmers involved in squatting activities and to evaluate the effectiveness of a structured educational intervention. A total of 160 farmers participated in the study. More than half of the participants (53.1%) reported knee pain, indicating a considerable burden of knee-related symptoms among this occupational group. Prolonged squatting, repetitive movements, and heavy lifting are common physical demands in agricultural work and may contribute to increased mechanical stress on the knee joint. Previous research has also reported a substantial burden of musculoskeletal disorders among agricultural workers [1,2].

Nearly half of the participants (48.7%) belonged to the age group of 31-45 years. Approximately half of the participants reported spending around 4 hours per day in squatting postures, while 76.2% reported heavy lifting during deep squatting activities. Prolonged occupational squatting, kneeling, and heavy lifting can increase the mechanical demands placed on the knee joint, particularly when these activities are performed repetitively over long periods. Previous studies have examined the relationship between occupational squatting, kneeling, heavy lifting, and knee-related changes [3,4].

Postural assessment demonstrated that 53.75% of participants had abnormal posture. Poor posture during agricultural activities may influence lower-limb biomechanics and increase mechanical loading on the knee. Appropriate posture and ergonomic work practices are therefore important components of occupational musculoskeletal health promotion, particularly among workers who regularly perform physically demanding agricultural activities [2,6].

The pre-intervention assessment showed that the majority of participants (79.3%) had moderate awareness, whereas only 3.75% demonstrated good awareness regarding knee joint protection techniques. This suggests that although participants may have had some basic knowledge regarding knee protection, comprehensive awareness of preventive strategies was limited. Previous literature has emphasized the importance of education, exercise, and self-management in improving knowledge and promoting appropriate management strategies for knee-related musculoskeletal conditions [7,8].

Following the educational intervention, awareness improved considerably. Good awareness increased from 3.75% before the intervention to 86.8% after the intervention, while no participant remained in the poor-awareness category. The comparison between pre- and post-intervention awareness scores demonstrated a highly significant improvement ($t = 28.75$, $p < 0.001$). This finding suggests that the structured educational program was associated with a substantial improvement in participants' awareness regarding knee joint protection techniques.

The improvement in awareness may be related to the practical and occupation-specific content of the educational intervention, which included appropriate squatting techniques, safe lifting methods, posture correction, and knee protection strategies. Previous studies have highlighted the role of patient education and self-management interventions in improving knowledge and supporting appropriate strategies for musculoskeletal health [7,9].

From a physiotherapy perspective, these findings highlight the potential importance of community-based education and ergonomic training among farmers. Physiotherapists can provide practical education regarding body mechanics, safe squatting, lifting techniques, posture correction, and activity modification. Workplace-based preventive approaches have also been investigated for the management and prevention of occupational knee pain [10].

Although the educational intervention resulted in a significant improvement in awareness, increased knowledge should not automatically be interpreted as a reduction in knee pain, injury, or long-term musculoskeletal disorders. The present study primarily evaluated awareness before and after the intervention; therefore, whether this improvement results in sustained behavioral changes or reduced knee-related symptoms requires further investigation. Longer-term studies with follow-up assessments may help determine whether improved awareness leads to sustained changes in occupational practices and knee-related health outcomes.

Overall, the findings demonstrate a substantial improvement in awareness regarding knee joint protection techniques following the structured educational intervention. Considering the considerable exposure to prolonged squatting and heavy lifting among the participants, regular ergonomic education and physiotherapy-led awareness programs may be useful components of occupational musculoskeletal health promotion among farmers [1,2].

The findings of the study were interpreted in relation to the measured outcome variables. The prevalence of knee pain among participants highlights the importance of considering the physical demands associated with prolonged squatting and farming activities. The pre- and post-intervention awareness scores were compared to evaluate changes in knowledge regarding knee joint protection techniques. The observed postural findings were considered in relation to squatting habits and ergonomic risk factors. Muscle-strength findings were discussed only where corresponding MMT data were available.

Strengths of the study

The study focused on farmers engaged in squatting activities, a population exposed to occupational demands that may affect knee health. It assessed awareness of knee joint protection techniques in a rural farming population and evaluated changes in awareness following the educational intervention.

Limitations of the study

The study was conducted in a specific rural setting using convenience sampling, which may limit the generalizability of the findings. The use of a self-structured questionnaire and observational postural assessment may introduce measurement limitations. If post-intervention pain and MMT were not assessed, changes in pain and muscle strength could not be determined.

Future scope

Future studies should include larger and more diverse farming populations, standardized posture-assessment methods, and validated questionnaires where appropriate. Further research should also include pre- and post-intervention assessment of knee pain, muscle strength, and functional outcomes, with longer follow-up to determine whether improvements in awareness translate into sustained changes in farming practices.

Conclusions

The present study suggests that awareness of knee joint protection techniques is an important consideration among farmers engaged in frequent or prolonged squatting activities. The study assessed awareness regarding correct knee alignment, maintaining a neutral spine, controlled squatting, appropriate squatting depth, warm-up, avoidance of sudden movements, and knee and thigh muscle strengthening practices. Clinical factors such as knee pain, previous knee injury, use of knee support, previous surgery, and knee cracking or clicking were also recorded.

The findings highlight the importance of promoting appropriate knee joint protection techniques and correct squatting practices among farmers to support knee health during occupational activities. Squatting posture assessment and MMT provided additional information regarding postural characteristics and lower-limb muscle strength. However, the findings should be interpreted considering the study design and the use of a structured questionnaire. Further research involving larger populations, validated assessment tools, and objective clinical assessments is recommended to strengthen the evidence and support the development of effective educational and preventive strategies for farmers.

Appendices

Self-structured questionnaire

Demographic Information

Questions: To collect basic demographic and occupational information, including age, gender, height, weight, BMI, occupation, squatting frequency, and duration of squatting.

1. Name:

2. Weight:

3. Age:

4. Gender:

5. Height:

6. Weight:

7. BMI:

8. Occupation:

9. Average squatting frequency

10. Duration of squatting -

Section A: Clinical Information

Purpose: To collect information regarding the participant's knee-related clinical history and symptoms, including knee pain, previous knee injury, use of knee support or brace, previous surgery, and cracking/clicking sounds during squatting.

Questions:

1. Do you have a history of knee pain?
□ Yes
□ No

If yes, duration:
2. Have you had any previous knee injury in the last 10 years?
□ Yes
□ No

3. Do you use any knee support or brace during activities?
□ Yes
□ No

4. Have you undergone any previous surgery?
□ Yes
□ No

5. Do you experience a cracking or clicking sound in your knee while squatting?
□ Yes
□ No

Section B: Awareness of Knee Joint Protection

Purpose: To assess the participant's awareness of correct knee joint protection techniques during squatting, including knee alignment, knee position, neutral spine, warm-up, and avoidance of sudden or jerky movements.

Questions:

6.Do you know correct knee alignment during squatting?
□ Yes
□ No

7. Do you align your knee behind your toes while squatting?
□ Yes
□ No

8.Do you maintain a neutral spine position during squatting?
□ Yes
□ No

9. Do you perform warm-up exercises before squatting?
□ Yes
□ No

10. Do you avoid sudden jerky movements while squatting?
□ Yes
□ No

Section C: Knowledge of Knee Joint Protection

Purpose: To assess the participant's knowledge regarding practices that may help protect the knee joint during squatting, including controlled knee bending, proper back position, knee-foot alignment, responding to knee pain, and the effect of excessive squatting depth.

Questions:

11. Do you stop squatting when knee pain occurs?
□ Yes
□ No

12. Do you know that bending the knee slowly and in a controlled manner helps prevent knee injury?
□ Yes
□ No

13. Do you know that squatting with a straight back reduces stress on the knees?
□ Yes
□ No

14. Do you know that keeping the knees in line with the feet helps protect the knee joint during Squatting?
□ Yes
□ No

15. Do you know that squatting too deep can increase stress on the knee joint if done incorrectly?
□ Yes
□ No

Section D: Practice-Based Knee Joint Protection

Purpose: To assess the participant's reported practices and understanding related to correct squatting posture, knee and thigh muscle strengthening, squat range, the effect of body weight on knee stress, and the perceived protective effect of correct squatting techniques.

Questions:

16. Do you follow correct squatting posture?
□ Yes
□ No

17. Do you perform exercises to strengthen your knee and thigh muscles?
□ Yes
□ No

18. Are you aware of the recommended range of motion for performing a squat safely?
□Yes
□ No

19. Do you know that body weight affects stress on the knee during squatting?
□ Yes
□ No

20. Do you believe learning correct squatting techniques can protect the knee joint?
□ Yes
□ No

Scoring

Each correct response was assigned a score of 1, while each incorrect response was assigned a score of 0. The total score was calculated by summing the scores of all questionnaire items.

Total score = 20

The total possible score was (0 to 20).

Awareness was categorized as:

- Poor awareness: (0 to 6)
- Moderate awareness: (7 to 14)
- Good awareness: (15 to 20)

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Vishwajeet K. Kanase, Mayuri R. Shah

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Disclosures

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