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Association of knee pain with working position and other factors among dairy farmers: A study in West Java, Indonesia

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Abstract. Dairy farmers have been shown to have a high risk of knee pain. The squatting position when milking a cow can create awkward knee posture and high compression at the knee joint. The present study aimed to identify the prevalence of knee pain among dairy farmers and determine the association of knee pain with squatting position and other factors among dairy farmers in West Java. This cross-sectional study included 117 participants from West Java, Indonesia between May 2017 and June 2017. The participants filled a standardized interview form as well as the Knee Injury and Osteoarthritis Outcome Score questionnaire. Working position was observed. An association was found between knee pain and the squatting position. In multivariate analysis, the factors associated with knee pain were a working period of 6–10 years and a working period of >10 years. The study found that the prevalence of knee pain among dairy farmers was 88%. Our findings suggest that there is a relation between knee pain and the squatting work position. The primary risk factor for knee pain is a working period of 6 years and above.

1. Introduction
Knee pain is one of the skeletal muscle disorders experienced by many workers and is a common health problem worldwide. Knee pain can affect Activities of Daily Living (ADLs) by making it difficult to perform tasks. Activities that put continuous pressure on the knees, such as squatting, kneeling, standing, driving, climbing, and lifting heavy weights, can cause knee pain, and complaints of knee pain are often chronic or persistent [1,2].

Dairy ranchers perform tasks that require heavy physical activity, such as lifting heavy loads and removing work equipment, and work in odd positions, thus, many workers complain of musculoskeletal disorders until they are unable to work. Dairy farmers are required to milk cows at least twice a day to prevent mastitis in the cows. When milking cows, dairy farmers work in odd positions where they have to squat or kneel. Previous studies have mentioned that working postures involving squatting or kneeling are related to knee pain [2-4].

In Indonesia, 35%–45% of the workforce was in the agricultural sector between 2004 and 2014 [5]. The livestock sub-sector is the third largest employment sub-sector, and it has increased from 9.89%
in 2007 to 11.51% in 2011. Additionally, the livestock sub-sector has the highest labor productivity. According to data from Indonesian Central Bureau of Statistic, in 2011, the number of cattle ranchers in Indonesia was 5.9 million and the number of dairy cows was 14.2 million, with East Java province producing the largest amount of cow’s milk, followed by West Java province [5,6].

The health condition of dairy farmers in Indonesia is not widely known. A study by Bogor Agricultural Institute at dairy farms in Bogor in 2014 found that cattle ranchers do not have sufficient access to occupational health services. Additionally, most treatments are personally financed, and usually, farmers seek healthcare if the health problem is severe enough. These issues can interfere with livestock productivity owing to the decreasing number of dairy farmers and increasing demand for cattle products each year [7].

This study aimed to determine the prevalence and extent of knee pain in dairy farmers and assess the relationship of knee pain with working position, squatting duration, sociodemographic factors (age, sex, nutritional status, smoking habit, and exercise habit), and socio-occupational factors (working period and lifting load) in dairy farmers from West Java, Indonesia.

2. Methods
A cross-sectional study was conducted at the Regional Technical Implementation Unit (RTIU) Center of Dairy Cattle Breeding and Livestock Feeds in Lembang, West Java, Indonesia between May 2017 and June 2017. The study protocol was approved by the Health Research Ethics Committee, Faculty of Medicine, Universitas Indonesia-Cipto Mangunkusumo Hospital.

The study included all dairy farmers from the RTIU along with assisted groups in West Bandung regency. Among 122 dairy farmers considered for inclusion, three could not participate as they were not at their locations during sampling. Of the remaining 119 dairy farmers, two were excluded because of sports injuries. Thus, a total of 117 participants were analyzed.

The dependent variable was the level of knee pain perceived by the participants in the last 1 week, and it was determined with the Knee Injury and Osteoarthritis Outcome Score (KOOS) questionnaire. The independent variables were the working position: duration of squatting in the full-squatting position, half-squatting position, and tiptoe squatting position; sociodemographic factors (age, sex, nutritional status, sports habit, education, and smoking habit); and socio-occupational factors (working period and lifting load).

Primary data were collected through an interview, weight and height measurements, recommended weight limit (RWL) and lifting index (LI) calculations for lifting load, the KOOS questionnaire, and observation of the work position when milking a cow. The data were analyzed using SPSS 20 program.

3. Results
The prevalence of knee pain in dairy farmers has been presented in Table 1. Of the 117 participants, 103 (88%) had knee pain, with 98 (84%) reporting mild knee pain (KOOS scores 67–99) and 5 (4%) reporting moderate knee pain (KOOS scores of 65, 64, 61, 60, and 40 in the 5 participants). None of the participants had severe knee pain.

| Knee pain   | n  | %  |
|-------------|----|----|
| No          | 14 | 12 |
| Yes         | 103| 88 |
| - Mild      | 98 | 84 |
| - Moderate  | 5  | 4  |
| - Severe    | 0  | 0  |

Table 1. Knee pain in the participants.
According to the KOOS questionnaire, knee pain subscales were assessed. The majority of participants had mild complaints for pain (78.6%), symptoms (87.2%), ADLs (75.2%), and Quality of Life (QoL; 76.1%). With regard to the sports subscale, most of the participants had no complaints (70.9%).

For the subscale assessing daily activities, 45 participants complained of mild pain when performing activities, 22 complained of moderate pain, and 1 complained of severe pain. Most participants did not mention any disruption in activities, such as walking up and down stairs, standing up, walking, riding a vehicle, shopping, wearing and removing shoes, going to the bathroom, sitting, and other activities involving knee bending.

For the subscale assessing QoL, 56 participants mentioned that knee pain did not reduce their activities, 48 mentioned that knee pain slightly reduced their activities, and 15 mentioned that knee pain reduced their activities. However, most participants (107 participants) mentioned that knee pain did not reduce their confidence when moving.

On observing the participants while milking a cow, it was found that all the participants were in the full-squatting position. Additionally, 93 participants (79.5%) changed to a half-squatting position, and 38 participants (32.5%) changed to a tiptoe squatting position. With regard to squatting time during a single working day, participants were in the squatting position for a median time of 108 min 45 s, half-squatting position for a median time of 5 min, and tiptoe squatting position for a median time of 3 min 12 s.

With regard to sociodemographic factors, more than half of the participants were aged over 40 years (52.3%), with the youngest participant aged 23 years and the oldest aged 56 years. Almost half of the participants had high school or equivalent education (47.9%). Almost all participants were male (97.4%) and had a non-obese nutrition status (96.6%). According to the Brinkman index for smoking, most of the participants were smokers (55 mild smokers [47%] and 54 medium smokers [46.2%]). Almost all participants had bad exercise habits (94.9%).

With regard to socio-occupational factors, most participants had been working as a dairy farmer for >10 years (57.2%). The median LI (Lifting Index) values were 13.16 times RWL (Recommended Weight Limit) for lifting grass feed once, 3.21 times RWL for concentrated feed, and 2.15 times RWL for a can of milk.

In bivariate analysis, there were correlations of knee pain with squatting position, age ≥40 years, working period >5 years, and lifting grass feed and concentrated feed (p < 0.05).

It was found in multivariate analysis that a working period of 6 years and above was independently related with knee pain (Table 2).

| Variable                      | Crude OR | Adjusted OR | p-value | 95% CI   |
|-------------------------------|----------|-------------|---------|----------|
| Squatting position            | 7.36     |             |         |          |
| Squatting duration >109 min   | 2.76     | 2.59        | 0.109   | 0.611    | 11.054  |
| Age ≥40 years                 | 23.19    | 3.35        | 0.427   | 0.169    | 66.615  |
| High school education/equivalent | 2.98   | 0.55        | 0.474   | 0.105    | 2.850   |
| Working period of 6–10 years  | 9.04     | 7.351       | 0.027   | 1.258    | 42.955  |
| Working period of >10 years   | 51.86    | 26.09       | 0.036   | 1.243    | 547.58  |
| Lifting grass feed            | 7.36     |             |         |          |
| Lifting concentrated feed     | 7.36     |             |         |          |
4. Discussion

Knee pain is one of the many musculoskeletal complaints in workers. This study assessed the prevalence of knee pain in dairy farmers and found that 88% of dairy farmers complained of knee pain in the last 1 week.

The reported prevalence of pain varies. Park et al. assessed dairy ranchers in Gyeonggi, South Korea and reported that the prevalence of pain in the lower extremities (legs and knees) was 11.7% [8]. Another study on dairy farmers in Sweden reported that the prevalence of knee pain was 40–41% [9]. These prevalences greatly differ from the prevalence noted in this study, and the differences might be associated with differences in the farm types and data retrieval methods. Farms in South Korea and Sweden incorporate parlor-type farming models, whereas this study was conducted on dairy farmers from farms in Indonesia that incorporate stanchion-type farming models. Moreover, the studies in South Korea and Sweden used a Nordic questionnaire to assess musculoskeletal complaints, whereas the present study used the KOOS questionnaire to assess knee pain. Furthermore, in the study from Korea, the questionnaire was filled at the KOSHA health center (KOSHA), and this might have resulted in a low prevalence rate, as participants who came to fill out the questionnaire might have been healthy.

In this study, all participants were in the squatting position when milking a cow. This is because the cow’s udder is parallel to a dairy farmer’s knees. Moreover, the median duration of squatting in 1 day was 108 min 45 s. This duration can vary depending on the number of cows being milked and the milk production of each cow. The participants changed their positions from squatting to half-squatting or tiptoe squatting during milking the cow, and the duration of squatting in each position varied. These changes in position and differences in duration depend on the work habits and working conditions of the dairy farmers.

In the bivariate analysis, the squatting position was associated with knee pain (crude OR = 7.36). Other studies have mentioned that odd working positions, such as squatting and long exposure, can cause knee pain [1,3,10,11]. Our finding is consistent with these previous results.

The sociodemographic factors assessed in this study were age, sex, nutritional status, education, smoking habit, and exercise habit. Bivariate analysis showed that age ≥40 years was related to knee pain (crude OR = 23.189). Other studies have suggested that an increase in age is associated with changes in bone and joint structures and increased pain thresholds [2,4,12]. Our finding is consistent with these previous results. Thus, it is recommended to reduce the workload among workers aged ≥40 years.

Bivariate analysis showed that female sex was not associated with knee pain. This finding is in contrast to the results of the study by Miranda et al. These authors found that the risk of knee pain was higher in women than in men (OR = 1.6) [13]. The difference in the results might be associated with the small number of women participants in the present study. This study included 3 women who had worked for 6 months as dairy farmers. However, all these women had knee pain, which was not present before working as dairy farmers.

Nutrition status was not associated with knee pain. This finding is in contrast to the results of previous studies that identified a strong association between obesity and knee joint diseases, including osteoarthritis. The Chingford study showed that an increase in the body mass index by 2 units is associated with an increase in the OR for rheumatoid osteoarthritis on radiography by 1.36 points [14]. The difference in the results might be associated with the small number of obese participants in the present study. This study included four obese participants, and of these, three had knee pain, indicating that 75% of participants with obesity developed knee pain.

Almost half of the participants had high school or equivalent education (47.9%). Bivariate analysis did not indicate a relationship between education and knee pain. Previous results on the relationship between education and knee pain are contradictory. A previous cohort study on knee osteoarthritis and work requiring flexion of the knee showed no association between education and knee osteoarthritis [15]. In Korea, a previous study reported that the prevalence of knee pain was higher in workers with education below high school [8].
Although most of the participants in this study were smokers (97.4%), bivariate analysis did not show a relationship between smoking and knee pain. Previous results on the relationship between smoking and knee pain are contradictory. The study by Miranda et al. showed an increased risk of knee pain in smokers (OR = 1.3) [13]. However, other studies have found a protective effect of smoking on cartilage [16, 17]. Further research is needed on the relationship between smoking habit and knee pain.

Most participants had poor exercise habits (94.9%), and only six participants reported performing sports activities for at least 30 min twice a week in the last 6 months. Bivariate analysis showed that exercise habit had no significant association with knee pain. The effects of physical activity, such as exercise, on the knee joint remain unclear. Some studies have suggested that sports, such as swimming and cycling, have a protective effect on the knee joint, as they strengthen the joint and improve blood flow [18, 19]. However, some studies have mentioned that certain movements, such as running and lifting, can damage the patellofemoral joint, depending on the intensity and duration of activity [13-20].

The socio-occupational factors assessed in this study were working period and lifting load. More than half of the participants had been working as a dairy farmer for >10 years (57.3%). Bivariate analysis showed that the working period was related to knee pain (crude OR = 51.86). This finding is consistent with the results of previous studies that suggested an association between long-term exposure to underlying factors and high risk of knee pain [13, 20-22].

The working period was a dominant factor related to knee pain. For a working period of 6–10 years, the adjusted OR was 7.35 (95% CI 1.25–42.95, p = 0.027), and for a working period of >10 years, the adjusted OR was 26.09 (95% CI 1.24–547.59, p = 0.036). A previous study found that workers who performed tasks involving knee joint loading and who worked for >10 years had a high risk of developing knee osteoarthritis and that long-term repetitive tasks involving the knee joint were associated with knee complaints [20].

The findings of this study indicate that a working period of 6 years and above has a high relation with knee pain. Some approaches to reduce the risk of knee pain include allowing rotation to other work divisions, evaluating risks in the work environment, and altering the design of the workplace to make it more ergonomic. In addition, dairy farmers can use objects for sitting, such as a seat/stool, when milking a cow in order to reduce pressure on the knees.

Dairy farmers perform work involving high loads. The loads include cow milk cans in two dairy cycles and cattle feed with two parts grass feed and one part concentrated feed for each cow (Table 3).

| No | Lifting load      | Recommended Weight Limit (RWL) | Range Lifting Index (LI) |
|----|-------------------|--------------------------------|--------------------------|
| 1  | Grass feed        | 1.9 Kg                         | 5.26–15.79               |
| 2  | Concentrated feed | 15.6 Kg                        | 3.21–6.41                |
| 3  | Milk can          | 18.6 Kg                        | 0.54–2.42                |

Bivariate analysis showed that lifting grass feed and lifting concentrated feed were associated with knee pain (both, crude OR = 7.36). We found that the LI values for grass feed and concentrated feed exceeded the RWL, and thus, there was an increased risk of musculoskeletal injury. This finding is consistent with the findings of previous studies that reported excessive burden on the knee joint as a risk factor for knee pain [13, 20].

According to the study by Cooper et al. [23], heavy lifting increases the risk of knee joint diseases, such as osteoarthritis, and the risk will be even more if the work involves a squatting position (OR 5.4, 95% CI 1.4–21.0). The high risk is due to the mechanisms of cartilage and menisci damage from increased pressure to the knee joint associated with heavy loads [23].
The high loads carried by dairy farmers are part of the job. The stress on the farmers can be reduced by decreasing the size of the feeding funnel, providing lifting aids such as carts, and changing the approach of lifting by improving the position and distance between the feed and the cow.

5. Conclusions
The study found that the prevalence of knee pain among dairy farmers was 88%. Our findings suggest that there is a relation between knee pain and the squatting work position. The primary risk factor for knee pain is a working period of 6 years and above.

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