INTRODUCTION

Global industrial development results in multiple work-related injuries and diseases including musculoskeletal disorders (MSDs).[1] Among MSDs, low back pain (LBP), defined “as a sharp or dull pain or muscular stiffness occurring in the back, i.e., the region between the lower costal margins and gluteal folds, the pain being either localized or radiating into the lower extremities (ischialgia),”[2] is a leading cause of disability among workforce worldwide.[3-5] Occupational exposure causes 37% of the estimated LBP global burden.[1,5] Further, in industrialized countries, it accounts for about 20%-30% of all workers’ compensation...
In the United States, about 70%–85% of the population experiences back pain at least once in their lifetime, and the annual and point prevalence rates are 15%–45% and 30%, respectively.[8] Further, in the US population, back pain was the most prevalent cause of years lived with disabilities in 2016.[9]

A study evaluating back pain prevalence in Al-Qaseem, Saudi Arabia, showed that some occupations were correlated with having appreciable back pain such as unskilled worker (17.9%), skilled worker (16.1%), professional worker (24.4%), etc.[10] Similarly, in Riyadh, a study on work-related MSDs among construction workers found that 16.5% of the participants had LBP.[11]

In Saudi Arabia and other developing countries, less attention is directed toward occupational safety, workplace hazards and work-related injuries and illnesses, particularly MSDs. Despite the production, packaging and distribution of paint involving processes with moderate levels of heavy-duty physical work including lifting, pulling and pushing, reports on the paint industry occupation-related LBP in Saudi Arabia are rare. Accordingly, the present study aims to determine the prevalence of LBP among workers of a paint factory in the Eastern Province of Saudi Arabia and identify the most significant contributing risk factors. The study would provide baseline data on the prevalence of LBP and risk factors among workers in the paint industry of the region.

MATERIALS AND METHODS

This self-administered, cross-sectional survey using a convenience sample of workers from a paint factory in the Eastern Province of Saudi Arabia was conducted between March 1 and April 30, 2015.

The study included the paint factory workers aged 18–65 years with jobs that required manual handling (lifting, pushing and pulling of loads), awkward postures and driving vehicles. Only those workers that consented to participate in the study were included. Further, the workers were asked if they had a medical history of back problems (such as spinal injury, cauda equina syndrome, inflammation, tumor or osteoporosis) and those who did, were excluded from the study. In addition, office workers and those with a psychiatric illness history were also excluded from the study.

All participants were appraised of the details of the study and its outcome and a signed informed consent form was obtained (either in English or Arabic, as preferred). Respondents were informed that participation was voluntary and anonymity would always be maintained. The study was approved by the Institutional Review Board at Imam Abdulrahman Bin Faisal University (IRB-2018-03-150).

Data were collected using a modified version of a validated questionnaire (in both English and Arabic), as previously used by Behisi et al.[12] For this study, the section addressing back pain location and medical evaluation was excluded for the purpose of this survey, and eventually, the questionnaire contained five sections. The first section elicited information about the worker (age, nationality, education, weight, height and smoking habits) and their job characteristics (job type and employment duration by years), while the second section elicited information regarding LBP in the past 12 months. The questionnaire used skip patterns for those without LBP. The third section characterized the severity of LBP on a scale of 1–5 (1 = very mild; 5 = very severe), and sick leaves and light duty were used as indicators. The fourth section obtained information about the interference of pain with work, life and sleep (no interference, some interference or daily interference). The fifth section obtained information about exercise type (aerobic, strength exercise and no exercise program) and duration, if applicable. The questionnaire was pilot tested on 10 employees to assess the clarity of the questions and no changes were recommended, and thus these responses were also included in the final analyses. For workers with language difficulties, the questions were read out and their responses were recorded. A research staff member was available to assist in understanding questions, if required.

Three experienced occupational health professionals from the Department of Family and Community Medicine, College of Medicine, Al Khobar, Saudi Arabia, visited the worksite and independently assessed job activities in each department through interview of workers and observation of their work activities. Accordingly, the experts rated the likely risk of LBP using a scale of 1 (least risk) to 100 (greatest risk), and a mean point scale for the sum of the activities was derived for each department to produce an LBP risk scale.
Data were analyzed using SPSS version 16.0 (SPSS, Inc., Chicago, IL, USA). \( P \leq 0.05 \) was considered significant. Point estimates and 95% confidence interval (CI) are included when appropriate. A descriptive analysis indicating the number and percentage of subjects was calculated for questionnaire variables. Chi-square tests were used to evaluate the association of occupational risk factors and the presence of LBP.

Variables were combined to generate numerical scales. Smoking status was converted from a categorical to a single variable (smoking scale). Aerobic and strength-building exercise variables were combined to create a single exercise scale. Further, a symptom pain scale was generated after combining the interference of LBP with work, life and sleep. Spearman rank correlation was used to detect the relationships between demographic/behavioral variables and scaled variables.

**RESULTS**

Of the total 150 employees at the paint factory, 26 were office staff and thus excluded from the study, while 22 were not available at the time of conducting this study. All the remaining employees (\( N = 102 \)) agreed to participate in the study; none had a previous medical history of back problems. Therefore, the questionnaire was administered to 102 employees and all responded. The mean age of the respondents was 35.8 ± 8.3 years and the majority of workers were non-Saudi (72.5%). Most workers (33.3%) had secondary school-level, 28.4% primary school-level and 23.5% university-level education. The body weight of most workers was either normal (41.2%) or overweight (40.2%). The mean work duration was 9.6 years. About 29% were current smokers and about 9% were former smokers. Many of the workers did not have an exercise program. About 47% and 68% did not have an aerobic and strength exercise program, respectively [Table 1]. In addition, 42 workers (41%) did not do both aerobic and strength exercises.

With respect to the type of job, most employees were either skilled workers (22.5%) or forklift operators (16.7%). Regarding shift, most workers (70.6%) had a morning shift [Table 2]. In the preceding 12 months, the annual prevalence of LBP among all workers in this paint factory was 44.1%. About 49% of workers with LBP reported moderate pain intensity and 62.2% had more than three episodes of pain in the past 12 months. Among workers with LBP, 46.7% experienced pain intensity that did not increase during work, while for 60% and 77.8%, the intensity of pain decreased a few hours after work and a week away from work, respectively [Table 3]. With respect to the impact of LBP, 40% of workers with LBP took sick leave and 31.1% required lighter assignments. In addition, pain had some interference with work in 53.3%, with life in 57.8% and with sleep in 55.6% [Table 4].

Multivariate analyses indicate significant associations between LBP and nationality (relative risk [RR] = 1.93, 95% CI = 1.29–2.88), smoking (RR = 1.85, 95% CI = 1.20–2.83) and aerobic exercise (RR = 2.37, 95% CI = 1.19–4.71). LBP

### Table 1: Characteristics of the recruited population

| Characteristic | n (%) |
|----------------|-------|
| **Age (years)** |       |
| <30            | 30 (29.4) |
| 30-40          | 38 (37.3) |
| >40            | 34 (33.3) |
| **BMI**        |       |
| Underweight (<18.5) | 3 (2.9) |
| Normal (18.5-24.9) | 42 (41.2) |
| Overweight (25.0-29.9) | 41 (40.2) |
| Obese (≥30)    | 16 (15.7) |
| **Nationality** |     |
| Saudi          | 28 (27.5) |
| Non-Saudi      | 74 (72.5) |
| **Education**  |     |
| Did not attend school | 3 (2.9) |
| Primary school  | 29 (28.4) |
| Secondary school | 34 (33.3) |
| Technical training | 12 (11.9) |
| University      | 24 (23.5) |
| **Work duration (years)** |       |
| <10            | 63 (61.8) |
| 10-20          | 26 (25.5) |
| >20.0          | 13 (12.7) |
| **Smoking**    |     |
| Never          | 63 (61.8) |
| Ex-smoker      | 9 (8.8) |
| Current smoker  | 30 (29.4) |
| **Aerobic exercise** |       |
| None           | 48 (47.1) |
| ≤3 days/week    | 23 (22.5) |
| >3 days/week    | 31 (30.4) |
| **Strength exercise** |       |
| None           | 67 (65.7) |
| ≤3 days/week    | 21 (20.6) |
| >3 days/week    | 14 (13.7) |

**BMI** – Body mass index

### Table 2: Work characteristics

| Characteristic | n (%) |
|----------------|-------|
| **Job type**   |     |
| Worker         | 13 (12.7) |
| Skilled worker  | 23 (22.5) |
| Filling operator| 13 (12.7) |
| Mixing operator | 13 (12.7) |
| Forklift operator | 17 (16.7) |
| Technician      | 5 (4.9) |
| Storekeeper     | 3 (2.9) |
| Sale order processor | 3 (2.9) |
| Supervisor      | 12 (11.8) |
| **Shift type**  |     |
| Morning         | 72 (70.6) |
| Evening         | 30 (29.4) |
risk was 1.93 times higher for Saudis than for non-Saudis, 1.85 times higher for smokers than non-smokers and 2.37 times higher for those performing aerobic exercises <3 days/week than those performing aerobic exercises >3 days/week [Table 5].

This study found that LBP was more common among Saudi workers (n = 19/28; 67.9%) than among non-Saudi workers (n = 26/74; 35.1%). Most Saudi workers were low skilled (67.9%), while the majority of non-Saudi workers were high skilled (67.6%). Low-skilled labor is generally characterized by lower educational attainment such as a high school diploma, which typically results in lower wages. Further, the majority of Saudi workers were overweight/obese (60.7%) and a current or former smoker (57.1%). A higher proportion of non-Saudi workers were found to engage in aerobic (56.8%) and strength (40.5%) exercises than Saudi workers (42.9% and 17.9%, respectively). Owing of LBP, about 74% of Saudi workers took sick leave, while 63.2% of them required light duty. LBP interfered with the work, life and sleep of 89.5%, 94.7% and 84.2% of the Saudi workers. Chi-square comparisons among Saudi and non-Saudi were significant (P = 0.05) for the following factors: type of job, smoking status, strength exercise, sick leave, light duty and LBP interfering with work, life and sleep [Table 6].

The LBP risk scale developed by the experts was used to examine its relationship with jobs performed in each department. The LBP risk scale was found to be significantly inversely correlated with age (r_s = −0.213, P = 0.032) and work duration (r_s = −0.295, P = 0.003).

From the symptom pain scale regarding the interference of pain with work, life activities and sleep, a harmful association was found with smoking (r_s = 0.259, P = 0.008) and a protective relationship with exercise (r_s = −0.241, P = 0.015).

**DISCUSSION**

Back pain is a common problem worldwide among industrial workers exposed to physical exertion, repeated bending, twisting and heavy lifting at work. However, in Saudi Arabia, there are few studies addressing LBP among factory workers. This study addressed LBP within a paint factory in Saudi Arabia and found that 44.1% of the respondents had LBP. The prevalence of LBP in similar industries worldwide ranges from 11.5% to 69.7%. This study found that for the presence of LBP, nationality was a contributing factor, with Saudi workers being twice at risk of LBP. Further, smoking is almost twice as high among Saudi workers compared with non-Saudi workers. Our study also found a significant relationship between smoking (both current and former smokers) and LBP, and this result is consistent with findings of previous studies. Smoking causes degeneration of the intervertebral discs by interference with disc metabolism, proteoglycan and collagen synthesis, likely resulting in back pain.

Similar to the findings of Behisi et al., this study found that performing aerobic exercises <3 days/week is a risk factor for LBP.
factor for LBP. Further, this study also found that the combination of aerobic and strength exercise reduced the likelihood of LBP. However, strength exercise was not found to reduce the likelihood of LBP, which contrasts with the findings of Behisi et al.,[13] who found that performing strength exercises >3 days/week reduced back pain risk.

Table 5: Personal and occupational risk factors associated with lower back pain in the preceding year

| Independent variable | Back pain in the past year | P       | Relative risk |
|----------------------|----------------------------|---------|---------------|
|                      | No, n (%)                  | Yes, n (%) |               |
| Age (years)          |                            |          |               |
| ≤30.0*               | 17 (56.7)                  | 13 (43.3) | 0.908         | 0.9686   |
| 30.1-40.0            | 21 (55.3)                  | 17 (44.7) | 0.949         | 0.9822   |
| >40.0                | 19 (55.9)                  | 15 (44.1) | 0.949         | 0.9822   |
| Nationality          |                            |          |               |
| Saudi                | 9 (32.1)                   | 19 (67.9) | 0.003         | 1.9313   |
| Non-Saudi*           | 48 (64.9)                  | 26 (35.1) |              |          |
| Education            |                            |          |               |
| Less than secondary* | 19 (59.4)                  | 13 (40.6) | 0.600         | 0.8633   |
| Secondary            | 18 (52.9)                  | 16 (47.1) | 0.751         | 0.9141   |
| More than secondary  | 20 (55.6)                  | 16 (44.4) |              |          |
| Job type             |                            |          |               |
| Low skilled workers* | 25 (58.1)                  | 18 (41.9) | 0.695         | 0.9147   |
| High skilled workers | 32 (54.2)                  | 27 (45.8) |              |          |
| Work duration (years)| ≤10.0*                     | 35 (55.6) | 28 (44.4)     | 0.882     | 0.9630   |
|                      | >10.0                      | 14 (53.8) | 12 (46.2)     | 0.734     | 0.8889   |
| Shift type           |                            |          |               |
| Morning              | 41 (56.9)                  | 31 (43.1) | 0.735         | 1.0839   |
| Evening*             | 16 (53.3)                  | 14 (46.7) |              |          |
| BMI                  |                            |          |               |
| Underweight/normal   | 25 (55.6)                  | 20 (44.4) | 0.953         | 0.9868   |
| Overweight/obese*    | 32 (56.1)                  | 25 (43.9) |              |          |
| Smoking              |                            |          |               |
| Never                | 42 (66.7)                  | 21 (33.3) | 0.005         | 1.8462   |
| Ex-/current smoker*  | 15 (38.5)                  | 24 (61.5) |              |          |
| Aerobic exercise     |                            |          |               |
| None≤3 days weekly*  | 33 (46.5)                  | 38 (53.5) | 0.0138        | 2.3702   |
| >3 days weekly       | 24 (77.4)                  | 7 (22.6)  |              |          |
| Strength exercise    |                            |          |               |
| None≤3 days weekly*  | 48 (54.5)                  | 40 (45.5) | 0.522         | 1.2727   |
| >3 days weekly       | 9 (64.3)                   | 5 (35.7)  |              |          |

*Reference group. BMI – Body mass index

There was only a slightly higher proportion of overweight/obesity among Saudi workers compared with non-Saudi workers (60.7% vs. 54.1%, respectively). However, non-Saudi workers perform aerobic exercise about 24% more than Saudi workers and twice as much strength exercise. These differences underlie the importance of nationality as a predictive risk factor associated with LBP among Saudi workers. However, due to additional job security, Saudi workers may have been more comfortable in reporting LBP and asking for sick leaves compared with non-Saudi workers, who may fear losing their jobs. Irrespective of overweight and obesity, are independent risk factors for MSDs.[37] Lord et al.[38] and Fernand and Fox[39] have found that the shape and geometry of the lumbosacral spine are important in the occurrence of LBP. The relationship between changes in the lumbar spine angles and LBP was examined in several studies, with varying results.[40‑41] Further, other studies have found that individuals with a high BMI and waist–hip ratio have increased lumbosacral angles, which increases the risk and incidence of LBP through biomechanical changes in the lumbosacral spine.[37,40,41]

From the LBP risk scale, this study found that an increase in age and work tenure were inversely proportional to the frequency of LBP. These findings are consistent with that of a study where work tenure has been indicated to be protective.[4] This is likely because over a period, production-line workers may move to office-based jobs owing to LBP or as a promotion or administrative reassignment, which would result in less physically demanding work.[4]

Occupational studies have rarely been undertaken in Saudi paint factories. Therefore, this study identifies a small-scale
paint factory and adds to the cumulative knowledge of small business occupational exposures. This study has few limitations. First, the responses were limited to a single factory. Second, administration of a questionnaire to a diverse workforce speaking multiple languages could have resulted in some unreliable responses. Third, the study depends on self-reporting LBP, and thus there is a lack of objective clinical measures of LBP. Fourth, as this is a cross-sectional study, workers with severe LBP may have already left employment before the study was conducted.

This study has important implications for the near-term economic development in the Kingdom of Saudi Arabia. The findings indicate that occupational LBP is more common among Saudi workers than non-Saudi workers, and that the amount of aerobic exercise by Saudi workers is less. Therefore, the authors recommend that policymakers should implement programs that promote aerobic exercise, proper nutrition and smoking cessation among workers, especially Saudis. This is even more important considering that in the coming years, Saudis would represent a greater proportion of the industrial workforce, including in physically demanding jobs. Economic development in Saudi Arabia may concurrently result in workplaces instituting LBP prevention programs, which in turn could significantly improve productivity and decrease compensation costs.

CONCLUSION

This study demonstrates that LBP is common among factory workers. Smoking is common and is associated with LBP. Many workers did not exercise, and lack of exercise was associated with an increased risk of LBP. Furthermore, LBP was more frequent among Saudi than non-Saudi workers. These results have important implications for preventive efforts.

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Conflicts of interest

There are no conflicts of interest.

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