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The Relationship between Risky Work Behaviors and Self-Reported Knee Pain among Malaysian Railway Workers

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Authors' contributions

This work was carried out in collaboration between all authors. Author SARA designed the study, managed data analysis, and wrote the methods and the final draft. Author AMQ managed results interpretation and took part in writing the first and final draft. Author KG designed the study, managed data collection and analysis, and literature search. Authors AD and KER managed literature search and took part in writing the first draft of the manuscript. Author DWH took part in the revision of the first draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: Knee pain is one of the most common musculoskeletal pains at workplace and its prevalence ranges from 10 to 60%. Risky work behaviors are established risk factors. They result in functional impairment, disability and reduce quality of life.
Objectives: This study aims to determine the relationships between risky work behaviors and knee

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pain among Malaysian railway workers.
Materials and Methods: A cross-sectional study was carried out on 513 railway workers across eight states within Peninsular Malaysia. Socio-demographics, risky work behaviors, occupational safety and history of knee pain were obtained by direct interviews using a structured closed ended questionnaire. Descriptive, bivariate and multiple logistic regression analyses were performed.
Results: The prevalence of self-reported knee pain over the past one year was 31.6%. Multivariate analysis yielded six significant predictors of knee pain: Socio-demographics (tertiary education); risky work behaviors (lifting or carrying heavy objects, working in uncomfortable position of knee joint, repeated flexion and extension of knee joint, continuous sitting work); and occupational safety (applying Personal Protective Equipment - PPE during work).
Conclusion: The significant associations between knee pain and risky work behaviors in railway workers point to urgent need for preventive measures, particularly in high risk occupations.

Keywords: Knee pain; occupational; railway; work behaviors.

1. INTRODUCTION

The knee is one of the most common sites for regional musculoskeletal pain [1]. Approximately 20% of the general adult population report having knee pain [2]. In working populations prevalence rate of knee pain varies between 10-60% depending on age, occupation [3,4] and definition of knee pain [2,5,6]. The latest Korea National Health and Nutrition Examination Survey (KNHANES) defined knee pain as "the presence of pain in the knee joint lasting 30 or more days during the most recent 3 months" [1].

Knee pain is a significant determinant of functional impairment and disability and often presents without evidence of internal derangement [7]. People with knee pain had significantly lower quality of life than those without knee pain [1,5].

Numerous epidemiological studies have identified risk factors that are associated with knee pain. An ageing Asia with longer lifespan suggests greater numbers of knee pains, among other chronic conditions [1]. Female gender, low education level, manual occupation, obesity are risk factors for knee pain, and are associated with increasing severity of knee pain [1,5]. Among manual laborers, it has been shown that both short and long term work-related knee-straining activities, such as sustained kneeling, knee bending, squatting, heavy lifting, and prolonged standing are risk factors for knee pain [3,7-10].

Knee pain has substantial negative impacts on labor force participation, causing work absenteeism, increased workers compensation [11] and substantial consumption of healthcare resources [12]. Primary prevention is essential to relieve the burden of knee pain in human workforce for potential benefits from societal, individual, and employer perspectives [12]. Effective strategies to increase work productivity should focus on reducing knee pain or physical disability especially among manual or semi-manual laborers [13]. Innovative approaches to improve ergonomic practices of a sample of floor layers have been shown to reduce knee pain [14]. However, there is very little evidence based research to guide clinicians in the prevention and management of work-related lower limb injuries and disease [7].

Workplace injuries and occupational health diseases that demand increased worker compensation remain high in Malaysia [15]. There is a sparse published data on prevalence of knee pain among railway workers. As part of global initiative to foster primary prevention and to promote an understanding, this study aims to assess the prevalence and factors associated with self-reported knee pain in Malaysian railway workers - a population with high risk of developing knee pain.

2. MATERIALS AND METHODS

2.1 Study Setting and Population

This study was conducted as part of the Malaysian Railways Population Based Study (MRPBS), a cross-sectional study that explored the level and determinants of symptomatic knee osteoarthritis knowledge among railway workers [16]. The baseline measurements were conducted between May-June 2012 with the aim to report prevalence and risky work behaviors associated with perceived knee pain among the study population. A total of 513 workers registered with Workers Cooperative Society of

Malaysian Railways (Keretapi Tanah Melayu Berhad - KTMB) from eight states of Peninsular Malaysia volunteered their consent to participate in study.

2.2 Measurements

A self-administered questionnaire was distributed. The first part included questions on the socio-demographics and work characteristics. Knee pain was assessed by the following questions:

> Do you have unilateral or bilateral knee pain on most days for at least one month over the past one year? This question was defined and modified on the bases of first United States National Health and Nutrition Examination Survey (NHANES I) [17]. Risky work behaviors were classified according to the National Institute of Occupational Safety and Health (NIOSH), 2013 guidelines, and the questionnaire included questions on: (1) Lifting or carrying heavy loads; (2) Working in an uncomfortable position of knee joint; (3) Working in vibrating vehicles or tools; (4) Repeated flexions and extensions of knee joint; (5) Working at pace set by machine; (6) Continuous kneeling or squatting during work; (7) Working in continuous sitting position; (8) Working in continuous standing position. Occupational safety was assessed by two questions: (1) Do you use Personnel Protective Equipment (PPE) during work? and; (10) Have you received appropriate training on job safety issues before employment? [18].

2.3 Ethical Consideration

This study complied with the Helsinki Declaration guidelines. Following institutional board review, Workers Cooperative Society of KTMB granted permissions and final ethical approval. Respondents were assured that information would be confidential and participation would not affect their work status. A written consent was obtained from those who agreed to participate.

2.4 Statistical Analysis

Analysis was performed by using Statistical Package of Social Sciences (SPSS) software, version 16.0. Descriptive statistics were obtained for all study variables. Simple logistic regression analysis was used to obtain odds ratios (OR) and to assess association between perceived knee pain and categorical variables of study. Multiple logistic regression analysis using Backward Wald technique was performed to obtain significant predictors of knee pain. All independent variables showing significant associations with perceived knee pain in bivariate analysis were included in multivariate analysis. Multi-collinearity between independent variables was checked by value of standard error (SE) not exceeding 5. The accepted level of significance in study (p) was set below 0.05.

3. RESULTS

3.1 Socio-demographic Characteristics of the Respondents

A total of 513 workers (70.4%) volunteered consent to participate in this study. One hundred sixty two (31.6%) of the 513 workers had knee pain in the last month. The mean (±SD) age of the respondents was 41.4 (±10.7) years and 34.9% were aged 50 years or older. The majority of respondents were males (74.9%), white-collar workers (52.0%), and graduated high school (71.2%). The mean (±SD) work duration of respondents was 17.6 (±10.8) years and the majority (68.4%) sustained employment for 10 years or more. The mean (±SD) of daily working hours was 8.4 (±0.9) hours and the majority (72.1%) presumed service for less than 9 hours per day. One hundred twenty six (24.6%) were employed on a shift basis (Table 1).

3.2 Risky Work Behaviors among Respondents

Table 2 shows respondents risky work behaviours. The majority of the respondents (52.4%) worked in a prolonged seated posture while 43.9% of them sustained a continuous standing posture during work. Respondents who lift heavy objects accounted for 33.7%. Respondents whose work required repeated flexion and extension of the knee joint constituted 28.7%, while respondents working in an uncomfortable position of the knee joint and requiring continuous kneeling constituted 28.3% and 24.4% respectively. Respondents working in vibrating vehicles and machines constituted 22.2% and 16.4% respectively. Although majority (63.2%) of the respondents received appropriate job training and safety before employment, only 26.9% of them applied personal protective equipment (PPE) during work.

Table 1. Socio-demographics and work characteristics of the respondents (n=513)

Characteristic	N	%
Gender		
Male	384	74.9
Female	129	25.1
Age group (years)		
20-34	157	30.6
35-49	177	34.5
≥ 50	179	34.9
Education level		
High School	365	71.2
Tertiary	148	28.8
Occupation		
Blue-collar	246	48.0
White-collar	267	52.0
Work duration (years)		
< 10	162	31.6
≥ 10	351	68.4
Daily working hours		
< 9	370	72.1
≥ 9	143	27.9
Work on shift		
Yes	126	24.6
No	387	75.4
Perceived knee pain		
Yes	162	31.6
No	351	68.4

3.3 Association between Socio-demographic Factors and Perceived Knee Pain among Respondents

Table 3 shows the association between socio-demographic factors and knee pain among respondents. Knee pain was higher in males (35.2%) compared to females (20.9%) (OR= 2.0, 95% CI 1.3-3.34, p=0.003). Knee pain was higher among workers aged 50 years or older (40.8%) in comparison to those aged 20-34 years (22.3%) (OR=2.4, 95% CI 1.5-3.9, p<0.001). Respondents with tertiary education (61.5%) reported higher knee pain as compared to respondents with high school education (28.8%) (OR=1.6 95% CI 1.0-2.3, p=0.032). Blue-collar workers (41.1%) reported higher knee pain as compared to white- collar workers (22.8%) (OR= 2.4, 95% CI 1.6-3.4, p<0.001). Workers employed for 10 years or more (36.5%) experienced higher knee pain in comparison to junior employees (30.7%) (OR=2.2, 95% CI 1.4-3.3, p=0.001).

3.4 Association between Risky Work Behaviors and Perceived Knee Pain among Respondents

Table 4 shows the association between risky work behaviors and knee pain among respondents. Higher prevalence of knee pain was found among those who reported the following behaviors: lifting heavy loads (OR= 6.7, 95% CI 4.4-10.1, p<0.001), working in an uncomfortable position of the knee joint (OR=6.4, 95% CI 4.2-9.8, p<0.001), working with vibrating vehicles (OR= 3.7, 95% CI 2.4-5.8, p<0.001), repeated flexion and extension of the knee joint (OR=4.3, 95% CI 2.9-6.5, p<0.001), working in a pace set by machines (OR= 2.9, 95% CI 1.8-4.7, p< 0.001), continuous kneeling or squatting position during work (OR=4.7, 95% CI 3.1-7.2, p<0.001), working in a continuous sitting posture (OR=1.6, 95% CI 1.1-2.3, p=0.013). Higher prevalence of knee pain was also found among those working in a continuous standing posture (OR=1.8, 95% CI 1.2-2.6, p=0.002), those who apply PPE during work (OR=4.5, 95% CI 3.0-6.8, p<0.001) and those who did not receive appropriate job training before employment (OR=3.5, 95% CI 2.2-5.4, p<0.001).

Table 2. Risky work behaviors among respondents (n=513)

Characteristics	Yes N (%)
Risky work behaviours	
Lift or lower heavy objects	173 (33.7)
Work in an uncomfortable position of the knee joint	145 (28.3)
Work in vibrating vehicles or tools	114 (22.2)
Repeated flexion and extension of the knee joint	147 (28.7)
Work at a pace set by machine	84 (16.4)
Continuous kneeling or squatting during work	125 (24.4)
Work in a sitting position continuously	269 (52.4)
Work in a standing position continuously	225 (43.9)
Occupational safety	
Apply Personal Protective Equipment (PPE) during work	138 (26.9)
Appropriate job training before employment	324 (63.2)

3.5 Factors Associated with Knee Pain by Multiple Logistic Regression Analysis among Respondents

The final model from multiple logistic regression analysis yielded seven significant predictors of knee pain among railway workers. Because of multicollinearity between age and duration of work, age was removed from the model to make it stable. The most significant predictor of knee pain was working in continuous sitting posture (OR=3.1, 95% CI 1.8-5.3, p<0.001) followed by applying PPE during work (OR=2.8, 95% CI 1.5-5.2, p=0.001), tertiary education (OR=2.7, 95% CI 1.6-4.7, p<0.001), lifting heavy objects (OR=2.7, 95% CI 1.4-5.2, p=0.003), working with uncomfortable knee position (OR=2.5, 95% CI 1.3-4.9, p=0.006) and repeated flexion and extension of knee (OR=2.0, 95% CI 1.1-3.5, p=0.025). The total model was significant (p<0.001) and accounted for 25% of variance (Table 5).

4. DISCUSSION

The prevalence of self-reported knee pain among Malaysian railway workers was 31.5%, which is higher than that found among nurses (21%) [19], home care workers (22%) [20] and ammunition factory workers (10.3%) [21], but is lower than that of construction workers (38.4%) [22]. As elicited in the final model, socio-demographics and risky work behaviors were significant predictors of self-reported knee pain.

The association between socio-demographics and knee pain showed mixed results across different studies [4,21,23]. Self-reported knee pain was much higher among males than females, as men performed heavier manual work than female counterparts. Staff above 50 years of age had higher prevalence of knee pain compared to those with younger age, possibly due to age related knee degeneration. The prevalence of knee pain was significantly higher among workers with tertiary education; this could be due to response bias in low literacy group; concealing pain because of layoff fear. Those with over 10 years of employment complained significantly more knee pain compared to ones with shorter employment. Longer employment duration could be a cause of extra knee strain and pain; Linda et al. [22] also found similar results.

Table 3. Association between socio-demographics and perceived knee pain (n=513)

Characteristics	With knee pain N (%)	Without knee pain N (%)	OR	95% CI	P-value
Gender					
Male	135 (35.2)	249 (64.8)	2.0	1.3-3.3	0.003
Female	27 (20.9)	102 (79.1)	1		
Age group (years)					
20-34	35 (22.3)	122 (77.7)	1		
35-49	54 (30.5)	123 (69.5)	1.5	0.9-2.5	0.091
≥ 50	73 (40.8)	106 (59.2)	2.4	1.5-3.9	< 0.001
Education level					
High School	105 (28.8)	260 (71.2)	1		
Tertiary	91 (61.5)	57 (38.5)	1.6	1.0-2.3	0.032
Occupation					
Blue-collar	101 (41.1)	145 (58.9)	2.4	1.6-3.4	< 0.001
White-collar	61 (22.8)	206 (77.2)	1		
Work duration (years)					
< 10	34 (21.0)	128 (79.0)	1		
≥ 10	128 (36.5)	223 (63.5)	2.2	1.4-3.3	0.001
Daily working hours					
< 9	115 (31.1)	255 (68.9)	1		
≥ 9	47 (32.9)	96 (67.1)	1.1	0.7-1.6	0.696
Work on shift					
Yes	43 (34.1)	83 (65.9)	1.2	0.8-1.8	0.479
No	119 (30.7)	268 (69.3)	1		

** Simple logistic regression was used to obtain the OR*

Table 4. Association between risky work behaviors and perceived knee pain (n=513)

Characteristics	With knee pain N (%)	Without knee pain N (%)	OR	95% CI	P-value
Risky work behaviours					
Lift or carry heavy objects					
Yes	102 (59.0)	71 (41.0)	6.7	4.4-10.1	< 0.001
No	60 (17.6)	280 (82.4)	1		
Work in an uncomfortable position of the knee joint					
Yes	89 (61.4)	56 (38.6)	6.4	4.2-9.8	< 0.001
No	73 (19.8)	295 (80.2)	1		
Work in vibrating vehicles or tools					
Yes	63 (55.3)	51 (44.7)	3.7	2.4-5.8	< 0.001
No	99 (24.8)	300 (75.2)	1		
Repeated flexion and extension of the knee joint					
Yes	81 (55.1)	66 (44.9)	4.3	2.9-6.5	< 0.001
No	81 (22.1)	285 (77.9)	1		
Work at a pace set by machine					
Yes	44 (52.4)	40 (47.6)	2.9	1.8-4.7	< 0.001
No	118 (27.5)	311 (72.5)	1		
Continuous kneeling or squatting during work					
Yes	73 (58.4)	52 (41.6)	4.7	3.1-7.2	< 0.001
No	89 (22.9)	299 (77.1)	1		
Work in a sitting position continuously					
Yes	98 (36.4)	171 (63.6)	1.6	1.1-2.3	0.013
No	64 (26.2)	180 (73.8)	1		
Work in a standing position continuously					
Yes	87 (38.7)	138 (61.3)	1.8	1.2-2.6	0.002
No	75 (26.0)	213 (74.0)	1		
Occupational safety					
Apply Personal Protective Equipment (PPE) during work					
Yes	78 (56.5)	60 (43.5)	4.5	3.0-6.8	< 0.001
No	84 (22.4)	291 (77.6)	1		
Appropriate job training before employment					
No	131 (40.4)	193 (59.6)	3.5	2.2-5.4	<0.001
Yes	31 (16.4)	158 (83.6)	1		

** Simple logistic regression was used to obtain the OR*

Table 5. Multiple logistic regression analysis (Backward Wald); factors associated with knee pain among respondents (n=513)

Predictors	B	SE	Wald	Exp (B)	95% CI		P value
					Lower	Upper	
Tertiary education	1.006	0.275	13.38	2.7	1.6	4.7	< 0.001
Work ≥ 10 years	0.488	0.290	2.82	1.6	0.9	2.9	0.093
Lift or carry heavy objects	0.996	0.334	8.87	2.7	1.4	5.2	0.003
Work in an uncomfortable position of the knee joint	0.931	0.340	7.51	2.5	1.3	4.9	0.006
Repeated flexion & extension of knee joint	0.675	0.302	5.00	2.0	1.1	3.5	0.025
Work in a sitting position continuously	1.127	0.274	16.95	3.1	1.8	5.3	< 0.001
Apply PPE during work	1.038	0.307	11.46	2.8	1.5	5.2	0.001

** Variables entered: All significant variables in Bivariate Analysis ** Exp(B) gives the Odds Ratio (OR)*

Lifting heavy loads puts excessive strain on knee joints, causing internal derangements like menisci tears, inflammation and other joint pathologies [16,21,24]. There was a strong association between heavy lifting and knee pain; similar findings were noted in construction and factory workers [21,24].

Railway workers who worked with awkward knee postures had obviously higher knee pain than those who did not. Respondents with sustained kneeling and squatting during work showed significantly higher knee pain compared to those who did not report this behavior; Previous studies also reported identical observations [4,22]. During awkward postures articular surfaces of knee are exposed to prolonged - unequal pressure, resulting in meniscus injury [4,24,25].

Working in vibrating vehicles or tools was associated significantly with knee pain in this study; which is in line with other studies listing vibrations as a risk factor [21,26,27]. It is well documented that vibrations have negative effects on nerves, vessels, muscles and joints [28,29].

Repetitive strains at tibio-femoral or patella-femoral joints during work predispose knee to greater risk of pain [4,30]. Railway workers whose job demands frequent flexions and extensions of knee had significantly more knee pain in comparison to those who did not report such behavior. This finding was consistent with observations reported in other occupations [4,30].

Static loading of joints and muscles during prolonged sitting and standing causes knee pain [31], and staff working in such postures had significantly higher knee pain than those who did otherwise; other researches also concluded that static work is a cause of pain [4,22].

Respondents working at pace set by machine had significantly greater knee pain than other groups; showing consistency with previous studies [25,32]. Fast pace work is another muscle-skeletal disease (MSD) factor, as muscles, joints and tendons do not get the needed rest resulting in damage [33].

Knee pain was significantly higher among those who donned personal protective equipment compared to those who did not. In Lilli's study, 2002 [34], the majority of floor layers put on knee pads and more than half used lifting assistance, but their relationship to knee or musculoskeletal pain was not mentioned. In fact, our finding that PPE are not protective of knee pain is unexpected; the rule of personal protective equipment and its effectiveness in knee pain needs to be explored in future studies. This study is a survey that investigated the prevalence and associated factors of knee pain, so. the reasons and clinical diagnosis of the pain were beyond its scope. In the literature, the common causes of knee pain include Chondromalacia patellae, knee injury, and arthritis [21,26,27].

This study has its limitations. The first one is its cross-sectional design which is not a proper design to establish causal relationship between the variables. Other limitations are the absence of a clear definition of the 'heavy work load' in the questionnaire. The body mass index and previous trauma of knee are not included in this study, which may make additional limitations.

5. CONCLUSION

This study found high prevalence of self-reported knee pain among Malaysian railway workers. Work related factors and socio-demographic factors were associated with reported knee pain among Malaysian railway workers. This study might initiate the innovative working methods to abstain from the postures which predispose to knee strain.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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