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Prevalence and factors associated with lateral epicondylitis among hospital healthcare workers

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Background: Hospital healthcare workers have been reported to have a high prevalence of musculoskeletal disorders, but their association with lateral epicondylitis (LE) is unknown. This study aimed to clarify the prevalence of LE and its associated factors among hospital healthcare workers.

Methods: The present study included all staff members of a secondary emergency hospital who provided their consent to participate. Participants with a history of elbow joint trauma were excluded from this study. The diagnostic criteria for definite LE were: (1) pain in the elbow joint within 2 weeks of the study; (2) pain in the lateral epicondyle region on resisted extension of the wrist with the elbow extended; and (3) tenderness in the lateral epicondyle. The diagnosis of LE was defined by meeting all criteria. Age, height, weight, sex, dominant hand, occupation, years of employment, smoking history, drinking history, personal computer usage history, and smartphone usage history were investigated using a questionnaire. A physical examination, in addition to evaluation of pain in the lateral epicondyle, grip strength and wrist extension strength were measured. A statistical analysis was used to assess the prevalence of LE and its associated factors. All investigations, including the diagnosis of LE, were performed by a single orthopedic specialist.

Results: We evaluated 544 individuals, corresponding to approximately 80% of all staff members. The median age was 39 years (interquartile range, 30-48). The study population included 154 males and 390 females. The occupations of the participants were as follows: nurses (n = 265), doctors (n = 47), clerks (n = 93), therapists (n = 27), certified care workers (n = 23), medical technologists (n = 22), pharmacists (n = 19), and others (n = 48). LE was diagnosed in 30 limbs/30 individuals with a prevalence of approximately 5.5%. There was no difference in the prevalence of LE among occupations ($P = .85$). A logistic regression analysis revealed that age (odds ratio, 1.05; 95% confidence interval 1.01-1.1; $P = .01$) and smoking history (odds ratio, 2.94; 95% confidence interval 1.01-8.56; $P = .04$) were independently associated with LE.

Conclusion: This study was conducted to evaluate the prevalence of LE among hospital healthcare workers. The prevalence of LE was 5.5%, and LE was independently associated with age and smoking history.

Lateral epicondylitis (LE) is an enthesopathy associated with injury and degenerative changes at the origin of the tendon of the extensor carpi radialis brevis (ECRB) muscle.[17] LE is one of the most common overuse syndromes, with a reported prevalence of 1%-10%.[6,15,26,28] The age at the onset of LE is between the 30s and 50s, and there is no sex difference.[1,15,17,26,28] The clinical symptoms of LE include pain or burning around the lateral epicondyle of the humerus.[17] It affects most activities of daily living and can lead to considerable functional disability and a loss of performance in occupational and sports activities.[26] It is generally self-limiting, and most cases can be successfully treated with conservative approaches, such as activity modification and physiotherapy, with up to 80% of cases recovering within one year.[4] However, LE

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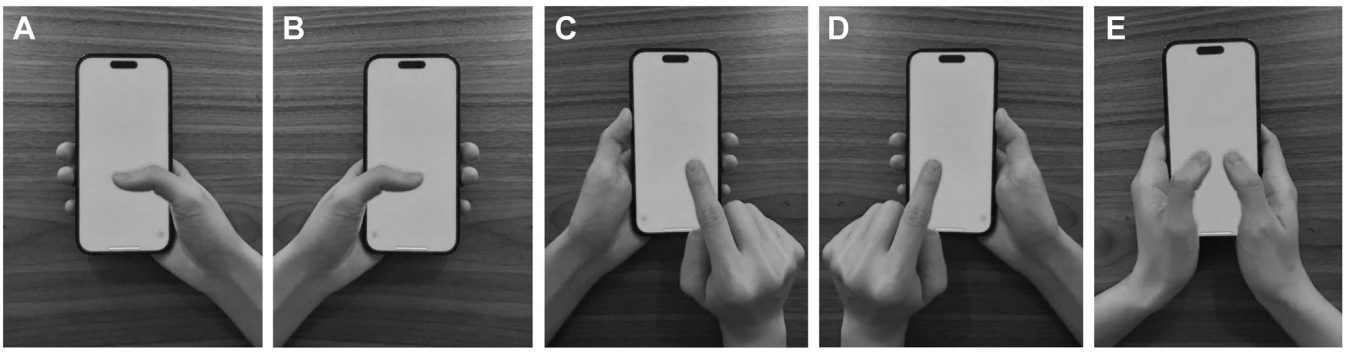

Figure 1 The smartphone operation method was selected from the following five groups. This figure assumes a right-handed participant. (**A**) One-handed, dominant-hand operation; (**B**) One-handed, nondominant hand operation; (**C**) Both-handed, dominant hand operation; (**D**) Both-handed, nondominant hand operation; (**E**) Both-handed operation.

sometimes necessitates sick leave or surgical treatment, which can be a significant financial burden.[4,26] Additionally, it has been reported that when LE is an occupational disease, it takes longer to improve symptoms and return to work.[5]

Epidemiological studies of LE have been conducted in the general population, workers, and athletes, and a high prevalence rate has been reported in workers.[6,15,26,28] Among workers, the prevalence of LE is high in occupations that place stress on the upper extremities, and work content such as heavy lifting and repetitive movements have been reported as associated factors.[9,15,23,24,26,28] In addition, regarding lifestyle habits, an association with a history of smoking has been reported.[8,26] However, the association between occupation, lifestyle habits, and LE has not yet been sufficiently clarified. Hospital healthcare workers have a high prevalence of musculoskeletal disorders, and the prevalence of upper extremity disorders is reported to be approximately 15%.[7,11,22,27] Although hospital healthcare workers include many occupations and the loads placed on the elbow are expected to be diverse, there have been no reports investigating their association with LE. In addition, with regard to lifestyle habits, joint pain associated with the excessive use of smartphones has been reported in recent years, but the association with LE remains unclear.[3,30]

This study aimed to clarify the prevalence of LE and its associated factors in hospital healthcare workers.

Materials and methods

Participants

This cross-sectional study used a self-administered questionnaire and physical examination. This study was conducted from December 1, 2021, to March 31, 2022. All staff members of the secondary emergency hospital at the start of the study were included. Participants agreed to participate in the study after being informed that their data would be published if they gave their consent to participate. Participants with a history of elbow joint trauma (fracture, ligament injury, etc.) were excluded.

Diagnosis of LE

The diagnosis of LE was based on self-reported symptoms and clinical signs according to the Japanese Orthopaedic Association guidelines.[1] The diagnostic criteria for definite LE were (1) pain in the elbow joint within 2 weeks of the study, (2) pain in the lateral epicondyle region on resisted extension of the wrist with the elbow extended, and (3) tenderness in the lateral epicondyle. LE was diagnosed when all criteria were met. The duration of pain in (1) was established based on previous studies.[28] Tenderness in (3) was considered positive if it was observed in the lateral epicondyle or adjacent tissue (up to 4 cm distal to the epicondyle) and elicited any degree of palpation tenderness.[13]

Self-administered questionnaire

The questionnaire items included age, height, weight, sex, dominant hand, occupation, years of employment, smoking history, drinking history, personal computer (PC) usage history (presence or absence of usage history, average daily usage time), smartphone usage history (presence or absence of usage history, average daily usage time, operation method, and evaluation of excessive use), and presence of elbow pain within 2 weeks. As shown in Figure 1, the smartphone operation method was selected from five groups. The Japanese version of the Smartphone Addiction Scale-Short Version was used.[14,29] In accordance with previous research, we defined smartphone addiction as a score of $\geq$31 for men and $\geq$33 for women.[14,29]

Physical examination

We evaluated the presence of tenderness in the lateral epicondyle and performed a resisted wrist extension test. Muscle strength was determined by measuring the grip strength and wrist extension strength. A digital dynamometer (grip strength: Takei Scientific Instruments Co., Tokyo, Japan; wrist extension strength: Sakai Medical Co., Tokyo, Japan) was used to measure muscle strength. Grip strength was measured using the standardized position recommended by the American Society of Hand Therapists. Subjects were seated with their shoulder in adduction and neutral rotation, the elbow flexed at 90°, the forearm in a neutral position, and the wrist between 0° and 30° extension and 0° and 15° ulnar deviation.[25] Wrist extension strength was measured using the Break test in a sitting position, with the forearm supported in a 30° elbow flexion position and the wrist in a 35° extension position.[10] Each muscle strength measurement was performed twice; each subject was given a rest period of 10 seconds, and the average value was used. All physical examinations and muscle strength measurements were performed by a single orthopedic specialist.

Statistical analysis

Continuous variables were expressed as the mean (±SD), and categorical variables were expressed as percentages (%). The association between the presence of LE and related factors was compared using the t-test or Mann-Whitney U-test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. Grip strength and wrist extension strength were

Table I
Demographic data among participants.

	Over all	Nurse	Clerk	Doctor	Therapist	Certified care worker	Medical technologist	Pharmacist	Radiological technologist	Nutritionist	Caregiver	*P* value
Total no. of participants	544	265 (48.7%)	93 (17.1%)	47 (8.6%)	27 (5%)	23 (4.2%)	22 (4%)	19 (3.5%)	14 (2.6%)	12 (2.2%)	8 (1.5%)	
Age[†] (y)	39 (30.48)	39 (30.47)	43 (37.50)	39 (30.50)	32 (26.37)	33 (25.45)	42 (32.49)	32 (28.36)	44 (29.56)	45 (37.51)	33 (27.45)	<.001[‡]
Sex (male)	154 (28.3%)	28 (10.6%)	33 (35.5%)	31 (66%)	12 (44.4%)	12 (52.5%)	8 (36.4%)	7 (41.2%)	9 (64%)	1 (8.3%)	3 (38%)	<.001[‡]
BMI[*]	21.2 (±2.9)	20.7 (±2.3)	21.7 (±3.2)	22.1 (±3.2)	21.6 (±3.2)	22.3 (±3.7)	21 (±2.4)	20.7 (±3.2)	20.9 (±2.7)	21.6 (±3.3)	23.2 (±4)	.1

BMI, body mass index.
[*]The values are given as the mean and the standard deviation.
[†]The values are given as the median, with the interquartile range in parentheses.
[‡]Signifcant at $P < .05$.

Table II
Prevalence of LE among participants.

	Over all	Nurse	Clerk	Doctor	Therapist	Certified care worker	Medical technologist	Pharmacist	Medical engineer	Radiological technologist	Nutritionist	Caregiver	*P* value
Total no. of participants	544	265 (48.7%)	93 (17.1%)	47 (8.6%)	27 (5%)	23 (4.2%)	22 (4%)	19 (3.5%)	14 (2.6%)	14 (2.6%)	12 (2.2%)	8 (1.5%)	
Total no. of participants with LE	30 (5.5%)	17 (6.4%)	6 (6.5%)	1 (2.1%)	1 (3.7%)	1 (4.3%)	1 (4.5%)	1 (5.2%)	0 (0%)	1 (7.1%)	0 (0%)	1 (12.5%)	.85

LE, lateral epicondylitis.

Table III
The results of a univariate analysis with the presence of LE as the outcome.

	LE	Non-LE	*P* value
Age† (y)	48.5 (40-55)	39 (30-48)	.00‡
Dominant (right)	28 (93%)	482 (94%)	.92
Sex (male)	7 (23.3%)	147 (28.6%)	.53
BMI*	21.5 (±3.2)	21.2 (±2.9)	.61
Smoking habit	5 (16.7%)	35 (6.8%)	.04*
Drinking habit	7 (23.3%)	97 (18.9%)	.55
PC			
Presence of usage history	23 (76.7%)	469 (91.2%)	.01*
Hours/d*	2.8 (±2.6)	2.8 (±2.1)	.97
Smartphone			
Presence of usage history	30 (100%)	514 (100%)	-
Hours/d*	2.1 (±1.2)	2.2 (±1.3)	.43
Smartphone addiction	4 (13.3)%	66 (12.8%)	.94
Operation methods			.01*
A	1 (3.3%)	147 (28.6%)	
B	2 (6.7%)	52 (10.1%)	
C	27 (90%)	279 (54.3%)	
D	0 (0%)	7 (1.4%)	
E	0 (0%)	29 (5.6%)	

LE, lateral epicondylitis; *BMI*, body mass index; *PC*, personal computer.
*The values are given as the mean and the standard deviation.
†The values are given as the median, with the interquartile range in parentheses.
‡Signifcant at $P < .05$.

compared between the affected and unaffected sides in the LE group. We divided the participants into two groups: clerks and practical workers (doctors, therapists, certified care workers, medical technologists, pharmacists, medical engineers, radiological technologists, nutritionists, and caregivers) and compared the prevalence of LE. A logistic regression analysis was performed using LE as the objective variable, and items that showed significance in the univariate analysis were included as explanatory variables. Age (10-year interval) was entered into the model as a categorical variable. To ensure the robustness of the results, we estimated the 95% confidence interval (CI) using the bootstrap method. In this study, the 95% CI for the odds ratio (OR) was calculated from a logistic regression analysis with 10,000 resamplings. All statistical analyses were performed using STATA/MP (version 15, StataCorp, College Station, TX, USA). *P* values of <0.05 were considered to indicate statistical significance. This study was approved by the regional ethics board.

Results

We evaluated 554 individuals, corresponding to approximately 80% of all the staff members. Ten individuals who met the exclusion criteria were excluded; therefore, 544 individuals were included in the study.

Table 1 presents the demographic data of the participants. The median age of the participants was 39 years (interquartile range, 30-48 years). The study population included 154 males (28%) and 390 females (72%). The occupations of the participants were as follows: nurses (n = 265), nurses (n = 47), clerks (n = 93), therapists (n = 27), certified care workers (n = 23), medical technologists (n = 22), pharmacists (n = 19), medical engineers (n = 14), radiological technologists (n = 14), nutritionists (n = 12), and caregivers (n = 8). Nurses accounted for approximately half of the participants.

The prevalence of LE is shown in Table 2. LE was diagnosed in 30 limbs/30 individuals with a prevalence of approximately 5.5%. There was no significant difference in the prevalence of LE among occupations ($P = .85$). In relation to the prevalence of LE, the participants were classified into two groups (clerks and practical workers) and compared, but there was no significant difference between them [6.5% (6/93) vs. 5.3% (24/451), $P = .66$].

Table IV
The results of the logistic regression analysis.

Factor	Odds ratio	95% confidence interval	*P* value
Age	1.05	1.01-1.10	.01*
Male	0.82	0.33-2.05	.67
Smoking habit	2.94	1.01-8.56	.04*
PC usage history	0.38	0.15-1.01	.05
Smartphone operation methods	1.15	0.94-1.42	.18

PC, personal computer.
*Signifcant at $P < .05$.

Table 3 shows the results of a univariate analysis with the presence of LE as the outcome. Regarding the association between physical information and LE, the mean age was significantly higher in the LE group ($P = .00$), whereas there were no significant differences in the dominant hand, sex, or body mass index. As for the association between lifestyle habits and LE, smokers were significantly more common in the LE group ($P = .04$). For PC, the percentage of usage history was significantly lower in the LE group ($P = .01$); however, there was no association with daily usage time. Although there was no relationship between smartphone usage duration and addiction rate, method C was significantly more common in the LE group ($P = .01$). Grip strength was significantly lower on the affected side than on the unaffected side in the LE group [22.8 kg (±7.9) vs. 24.9 kg (±7.3) kg, $P = .00$]. Wrist extension strength was also significantly lower on the affected side than on the unaffected side in the LE group [11.3 kg (±4.5) vs. 14 kg (±4.2), $P = .00$].

Table 4 shows the results of the logistic regression analysis. Age (OR, 1.05; 95% CI, 1.01-1.1; $P = .01$) and smoking history (OR, 2.94; 95% CI, 1.01-8.56; $P = .04$) were identified as independently associated factors.

Discussion

The prevalence of LE among hospital healthcare workers in this study was 5.5%, and age and smoking history were independently associated with LE. Based on the results of this study, we discuss the influence of occupation and lifestyle on LE.

Against the background of long working hours, prolonged posturing, and repetitive movements, healthcare workers are considered to have a high prevalence of musculoskeletal disorders.[7,11,22,27] While the prevalence of elbow joint disorders among upper limb disorders is approximately 15%, there have been no reports on its association with LE.[7,11] Epidemiological studies of the general population have reported that the prevalence of LE is 1%-3%.[26,28] On the other hand, studies of workers such as cooks, office workers, and manual workers have reported a high prevalence of LE (approximately 10%).[6,15,21,26] The possibility that different diagnostic criteria may have influenced the results needs to be considered; however, these reports suggest that LE is more prevalent in workers. The prevalence of LE in this study was 5.5%, which is not higher than that reported in previous studies on workers. There were no significant differences in the prevalence of LE between occupations or between the two groups of occupations (clerks and practical workers). This result may be attributed to differences in diagnostic criteria and the fact that the load placed on the upper limbs of hospital healthcare workers (even among the same occupational group) is very diverse. However, our report may be helpful in understanding the current status of LE as an occupational injury in hospital healthcare workers.

In the present study, age and smoking history were found to be independently associated with LE. Regarding age, LE is a common

disorder in individuals of working age, and it is reported to frequently occur between the ages of 30 and 50, with the peak of onset occurring in the prime years between 40 and 50 years of age.[1,15,17,26,28] It has been reported that a degenerative process is at the root of the condition of LE, not inflammation.[20] Nirschl and Pettrone pathologically revealed that LE is a chronic enthesopathy caused by repetitive microtrauma at the origin of the ECRB.[20] Furthermore, in cadaveric studies, it has been confirmed that degeneration at the origin of ECRB progresses with aging, and this may be one of the reasons why LE is more common in middle-aged and elderly people than in young people.[19] A similar trend was observed in this study, with the prevalence tending to be higher in middle-aged and older participants than in young people. Regarding smoking habits, an association with LE has been reported in previous studies.[8,26] Similarly, in this study, the smoking rate was significantly higher in the LE group. Smoking interferes with blood circulation to the tendon, exposing it to the risk of injury as well as delaying or preventing healing during the recovery period.[8,26] Former smokers are also at higher risk for LE, suggesting that previous exposure to smoking may have persistent effects on the vascular system.[26] Some studies have reported a correlation between the amount of smoking and the size of rotator cuff tear lesions, although the location of the lesions is different, and it is important to check smoking habits and teach smoking cessation in the treatment of LE.[18]

Although there was no association with LE in this study, musculoskeletal disorders associated with PC and smartphone use have recently been reported. PCs and smartphones have become necessities not only for work but also for daily life. It has been reported that PC use is associated with LE due to repetitive motions during keyboard and mouse use, which place particular stress on the forearm extensor muscles.[2,12] In our study, no association was observed. In addition, the long-term use of smartphones has been reported to cause various types of musculoskeletal pain. In a systematic review, Zirek et al reported that the prevalence of elbow joint pain among smartphone users was 14%-15%, while no studies investigated its association with LE.[30] In this study, none of the smartphone-related items (eg, smartphone usage time or addiction scale) were associated with LE. In addition, although the LE group had a higher percentage of specific operation methods (method C), this difference was not statistically significant in the logistic regression analysis. With the spread of electronic medical records and changes in lifestyle habits, the influence of PCs and smartphones on LE may change in the future. An association with tendinopathy has also been reported based on a dynamic analysis of smartphone operating methods, and a more detailed investigation of the association with LE, including dynamic analyses, is expected in the future.[3,16]

The present study was associated with some limitations. First, it was conducted using a cross-sectional design, which might not provide definitive information about cause-and-effect relationships. Second, although the diagnosis of LE was made based on a physical examination, other tests (eg, radiography, ultrasound, and magnetic resonance imaging) were not performed, and the possibility of other diseases could not be ruled out. Third, smoking habits were only examined in current smokers, and the effect of a past smoking history on LE was not investigated. In addition, the effect of smoking on LE was not investigated. Fourth, it is possible that individuals with the same occupations, such as operating room nurses and ward nurses, may have different loads placed on the elbow; however, this study was not able to distinguish between them. To evaluate this, it was necessary to conduct a detailed investigation of factors such as working content and working hours. Finally, the other factors mentioned in previous studies that could be associated with LE (sports history, educational background, and mental condition) were not evaluated.

Conclusion

This study was conducted to evaluate the prevalence of LE among hospital healthcare workers. The prevalence of LE was 5.5%, and LE was independently associated with age and smoking history.

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