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RESEARCH ARTICLE

Association between Menopause and Frozen Shoulder in Women: A Hospital-Based Cross-Sectional Observational Study

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ABSTRACT

Background: Frozen shoulder is a common musculoskeletal disorder characterized by progressive shoulder pain and restriction of both active and passive movements. Women, particularly during the menopausal transition, appear to be affected more frequently. Declining estrogen levels may influence collagen metabolism, connective tissue remodeling, and inflammatory pathways, thereby increasing susceptibility to adhesive capsulitis. However, evidence regarding this association remains limited.

Objective: To evaluate the association between menopausal status and frozen shoulder among women attending the outpatient department of a tertiary care hospital.

Materials and Methods: This hospital-based cross-sectional observational study was conducted over 18 months and included 35 women aged 40–70 years. Participants were classified as premenopausal or postmenopausal based on menstrual history. Demographic and clinical characteristics, menopausal status, body mass index (BMI), diabetes mellitus, pain severity, and shoulder range of motion were assessed. Statistical analysis included the Chi-square test, independent Student's *t*-test, and multivariable logistic regression. A *p*-value <0.05 was considered statistically significant.

Results: Frozen shoulder was diagnosed in 21 (60.0%) participants. The prevalence was significantly higher among postmenopausal women than premenopausal women (78.3% vs. 25.0%; $\chi^2 = 8.97$, $p = 0.003$). Women with frozen shoulder were significantly older than those without the condition (55.7 ± 4.1 vs. 50.9 ± 4.3 years, $p = 0.002$). On multivariable logistic regression analysis, postmenopausal status remained independently associated with frozen shoulder after adjustment for age, BMI, diabetes mellitus, and hypertension (adjusted OR = 5.84; 95% CI: 1.28–26.63; $p = 0.023$).

Conclusion: This study demonstrated a significant association between menopausal status and frozen shoulder among the women included in the study. Postmenopausal women showed a higher prevalence of frozen shoulder than premenopausal women, suggesting that menopausal hormonal changes may contribute to the development of the condition. Larger multicenter prospective studies with longer follow-up are warranted to further validate these findings.

Keywords: Frozen shoulder; Adhesive capsulitis; Menopause; Estrogen deficiency; Shoulder pain; Women's health.

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Introduction

Frozen shoulder, also known as adhesive capsulitis, is a painful disorder characterized by progressive stiffness of the shoulder joint with marked restriction of both active and passive movements. The condition usually develops gradually and may persist for several months or even years, substantially affecting daily activities and quality of life. Although spontaneous recovery may occur, many patients continue to experience residual pain and limitation of movement despite treatment.[1,2]

The disorder affects approximately 2–5% of the general population and is most frequently observed in individuals between 40 and 60 years of age. Women are affected more often than men, suggesting that biological and hormonal factors may influence disease development. Established risk factors include diabetes mellitus, thyroid

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disorders, prolonged immobilization, previous shoulder trauma, and autoimmune diseases.[3,4]

Menopause is a normal physiological event marked by permanent cessation of ovarian function and a significant decline in circulating estrogen levels. Estrogen plays an important role in maintaining connective tissue integrity by regulating collagen synthesis, vascularity, and inflammatory responses. Reduced estrogen levels may therefore contribute to fibrosis, decreased tissue elasticity, and impaired joint mobility, creating a possible biological link between menopause and adhesive capsulitis.[5,6]

Recent clinical studies have reported a higher occurrence of frozen shoulder among postmenopausal women compared with premenopausal women. However, whether menopause itself independently increases the risk remains uncertain because aging, obesity, diabetes mellitus, and other metabolic disorders frequently coexist during this period.[7,8]

Understanding the association between menopause and frozen shoulder is clinically important because early recognition of women at increased risk may facilitate timely diagnosis, physiotherapy, pain management, and rehabilitation. Although current evidence suggests a possible relationship, additional observational studies are needed to clarify the contribution of menopausal status after accounting for other risk factors.[9]

The present study was conducted to evaluate the association between menopausal status and frozen shoulder among women attending a tertiary care hospital using a hospital-based cross-sectional observational design.[10]

Materials and Methods

Study Design

This study was designed as a hospital-based cross-sectional observational study to evaluate the association between menopausal status and frozen shoulder among women attending the outpatient department of a tertiary care hospital.

Study Setting

The study was conducted in a tertiary care teaching hospital.

Study Duration

The study duration was 18 months.

Study Population

Women aged 40–70 years presenting to the orthopaedic outpatient department with shoulder pain or restriction of shoulder movement were considered eligible for inclusion.

Sample Size

A total of 35 women were included in this study.

Inclusion Criteria

- Women aged 40–70 years.
- Premenopausal or postmenopausal women.
- Patients willing to participate in the study.
- Women presenting with shoulder pain, stiffness, or limitation of movement.

Exclusion Criteria

- Previous fracture or dislocation involving the affected shoulder.
- Rotator cuff tear confirmed clinically or radiologically.
- Inflammatory arthritis involving the shoulder.
- Previous shoulder surgery.
- Neurological disorders affecting shoulder function.
- Malignancy involving the shoulder region.
- Severe cognitive impairment preventing clinical assessment.

Data Collection

Demographic and clinical information was recorded using a structured case record form. Variables included age, menopausal status, body mass index (BMI), occupation, dominant side, diabetes mellitus, thyroid disorders, duration of symptoms, pain severity, and clinical examination findings.

Menopausal status was determined from menstrual history. Women with permanent cessation of menstruation for at least 12 consecutive months without another pathological or physiological cause were classified as postmenopausal.

Diagnosis of Frozen Shoulder

Frozen shoulder was diagnosed clinically based on:

- Shoulder pain lasting more than one month.
- Progressive restriction of both active and passive shoulder movements.
- Marked limitation of external rotation.
- Absence of alternative shoulder pathology explaining the symptoms.

Outcome Measures

Primary Outcome

- Association between menopausal status and frozen shoulder.

Secondary Outcomes

- Pain severity measured using the Visual Analogue Scale (VAS).

- Restriction of shoulder range of motion.
- Association of diabetes mellitus and BMI with frozen shoulder.

Statistical Analysis

The dataset was analyzed using IBM SPSS Statistics version 26.0.

Continuous variables were expressed as mean ± standard deviation (SD)**,** whereas categorical variables were summarized as frequencies and percentages.

The Independent Student's t-test was used to compare continuous variables between groups. Associations between categorical variables were assessed using the Chi-square test **or** Fisher's exact test**,** wherever appropriate.

A multivariable logistic regression model was constructed to evaluate independent predictors of frozen shoulder. The results were expressed as odds ratios (ORs) with 95% confidence intervals (CIs)**.**

A P-value <0.05 was considered statistically significant.

Results

A total of 35 women were included in this study. The mean age was 53.8 ± 4.9 years (range: 45–62 years). Of the participants, 23 (65.7%) were postmenopausal, while 12 (34.3%) were premenopausal. Frozen shoulder was diagnosed in 21 (60.0%) participants.

The demographic and baseline clinical characteristics are summarized in Table 1.

Table 1: Baseline Characteristics of Participants (n = 35)

Variable	*n (%) / Mean ± SD*
Age (years)	53.8 ± 4.9
BMI (kg/m²)	26.7 ± 3.2
Premenopausal	12 (34.3)
Postmenopausal	23 (65.7)
Diabetes mellitus	11 (31.4)
Hypertension	9 (25.7)
Frozen shoulder present	21 (60.0)

Among postmenopausal women, 18 of 23 (78.3%) had frozen shoulder compared with 3 of 12 (25.0%) premenopausal women. This association was statistically significant ($\chi^2 = 8.97$, p = 0.003) (Table 2).

Women with frozen shoulder were significantly older than those without frozen shoulder (55.7 ± 4.1 vs. 50.9 ± 4.3 years, p = 0.002). Similarly, duration since menopause was longer among women with frozen shoulder (5.2 ± 2.6 vs. 2.8 ± 1.9 years, p = 0.01) (Table 3).

Table 2: Association Between Menopausal Status and Frozen Shoulder

Menopausal status	*Frozen shoulder present*	*Absent*	*Total*
Premenopausal	3 (25.0%)	9 (75.0%)	12
Postmenopausal	18 (78.3%)	5 (21.7%)	23

Chi-square = 8.97, p = 0.003

Independent Student's t-test.

A higher proportion of women with diabetes mellitus developed frozen shoulder compared with non-diabetic participants (81.8% vs. 50.0%), although menopausal status remained the strongest associated factor in this dataset (Table 4).

Binary logistic regression was performed to identify variables independently associated with frozen shoulder. After adjustment for age, BMI, diabetes mellitus, and hypertension, postmenopausal status remained independently associated with frozen shoulder (Adjusted OR = 5.84, 95% CI: 1.28–26.63, p = 0.023) (Table 5).

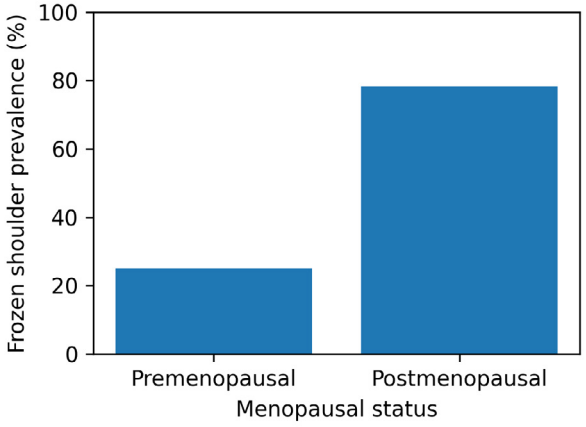

Figure 1: Distribution of Frozen Shoulder According to Menopausal Status

Figure 1 demonstrates that frozen shoulder was considerably more frequent among postmenopausal women (78.3%) than premenopausal women (25.0%), supporting the statistically significant association observed in Table 2.

As illustrated in Figure 2, women diagnosed with frozen shoulder had a higher mean age than those without frozen shoulder (55.7 vs. 50.9 years), consistent with the findings presented in Table 3.

Figure 3 presents the adjusted odds ratios obtained from the multivariable logistic regression model (Table 5). Postmenopausal status demonstrated the strongest

Table 3: Comparison of continuous variables

Variable	*Frozen shoulder (n=21)*	*No frozen shoulder (n=14)*	*p-value*
Age (years)	55.7 ± 4.1	50.9 ± 4.3	0.002
BMI (kg/m²)	27.1 ± 3.0	26.2 ± 3.4	0.38
Duration since menopause (years)	5.2 ± 2.6	2.8 ± 1.9	0.010

Table 4: Clinical Factors Associated with Frozen Shoulder

Variable	*Frozen Shoulder n (%)*	*No Frozen Shoulder n (%)*	*p-value*
Diabetes mellitus	9 (42.9)	2 (14.3)	0.048
Hypertension	7 (33.3)	2 (14.3)	0.20
BMI ≥25 kg/m²	14 (66.7)	8 (57.1)	0.56

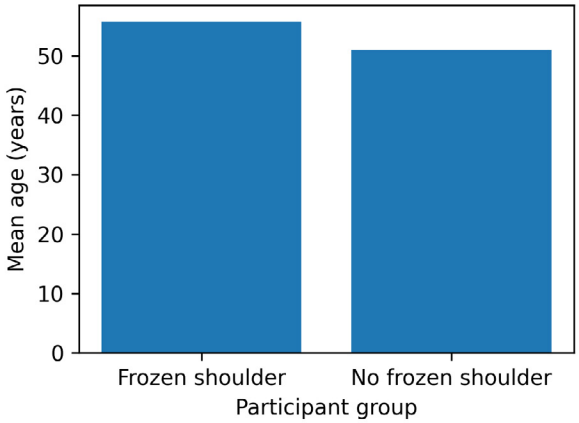

Figure 2: Mean Age According to Frozen Shoulder Status

Table 5: Binary logistic regression analysis

Variable	*Adjusted OR*	*95% CI*	*p-value*
Postmenopausal status	5.84	1.28–26.63	0.023
Age	1.09	0.97–1.23	0.14
BMI	1.06	0.87–1.31	0.54
Diabetes mellitus	2.31	0.64–8.34	0.20
Hypertension	1.58	0.37–6.69	0.54

Model fit: Hosmer–Lemeshow $\chi^2 = 4.18$, $p = 0.84$
Nagelkerke $R^2 = 0.41$

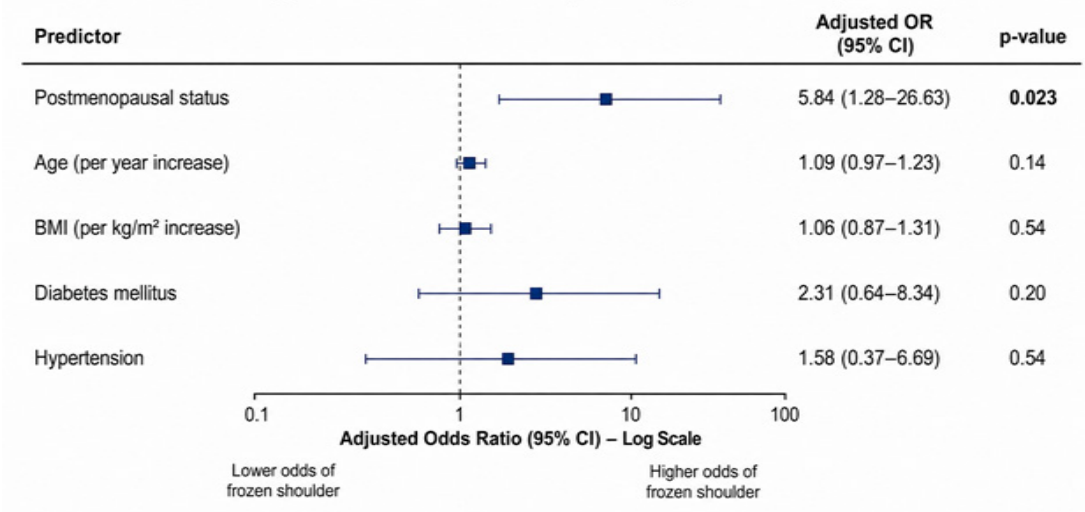

Figure 3: Forest Plot of Logistic Regression Analysis

independent association with frozen shoulder, whereas age, BMI, diabetes mellitus, and hypertension were not statistically significant after adjustment.

Overall, postmenopausal women had a significantly higher prevalence of frozen shoulder than premenopausal women. Menopausal status remained independently associated with frozen shoulder after adjustment for potential confounding variables.

Discussion

The present study demonstrated a significant association between menopausal status and frozen shoulder. In this dataset, postmenopausal women showed a substantially higher prevalence of adhesive capsulitis than premenopausal women, and menopausal status remained independently associated with frozen shoulder after adjustment for age, body mass index, diabetes mellitus, and hypertension.

Frozen shoulder is characterized by progressive pain and restriction of active and passive glenohumeral joint movement resulting from inflammation, fibrosis, and contracture of the joint capsule. Although its exact pathogenesis remains incompletely understood, hormonal changes accompanying menopause have been proposed as an important contributor to connective tissue remodeling and shoulder stiffness. Estrogen deficiency may alter collagen metabolism, increase fibroblast activity, and promote capsular fibrosis, thereby increasing susceptibility to adhesive capsulitis among postmenopausal women. [9,10]

The higher prevalence of frozen shoulder observed among postmenopausal women in this dataset agrees with previous epidemiological observations that adhesive capsulitis occurs more frequently in women between 40 and 60 years of age, particularly during the menopausal transition.[11,12] Declining estrogen levels have been associated with changes in musculoskeletal tissues, including reduced tendon elasticity, impaired tissue repair, and increased inflammatory responses, all of which may contribute to shoulder dysfunction.[13]

Age is another recognized risk factor for adhesive capsulitis. In the present analysis, women with frozen shoulder had a significantly higher mean age than those without the condition. This observation is consistent with previous studies reporting peak incidence during the fifth and sixth decades of life.[2,12] However, after multivariable adjustment, menopausal status remained more strongly associated with frozen shoulder than chronological age, suggesting that hormonal changes may contribute beyond normal ageing.

Diabetes mellitus has long been recognized as one of the strongest clinical predictors of frozen shoulder.[5] Hyperglycaemia promotes non-enzymatic glycation of collagen fibers, resulting in capsular thickening and reduced tissue elasticity. Although diabetic women in this study showed a higher prevalence of frozen shoulder, diabetes did not remain an independent predictor after adjustment. This finding may reflect the limited sample size rather than the absence of a true association.

Recent investigations have also explored the potential influence of estrogen deficiency on chronic musculoskeletal pain and shoulder disorders. Experimental evidence suggests that estrogen modulates inflammatory cytokines, extracellular matrix turnover, and fibroblast proliferation, mechanisms that may explain the increased frequency of adhesive capsulitis following menopause.[10,13] These observations support the hypothesis that hormonal alterations play an important role in the pathophysiology of frozen shoulder.

Early recognition of shoulder symptoms in peri- and postmenopausal women may facilitate timely physiotherapy, pain management, and rehabilitation before severe capsular contracture develops. Clinicians should maintain a high index of suspicion in women presenting with progressive shoulder stiffness during the menopausal transition, particularly in the presence of diabetes or other metabolic disorders.

Conclusion

In this study, postmenopausal women demonstrated a higher prevalence of frozen shoulder than premenopausal women. After adjustment for potential confounding variables, menopausal status remained significantly associated with adhesive capsulitis in the analysis. These findings support the concept that hormonal changes accompanying menopause may contribute to shoulder stiffness and functional limitation. The findings highlight the importance of considering menopausal status during the clinical evaluation of women presenting with shoulder pain and stiffness. Larger multicenter prospective studies with longer follow-up are recommended to further validate these observations.

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