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# Awareness of Home Exercises and Shoulder Stiffness in Community-Dwelling Adults Aged 60 Years and Older: A Cross-Sectional Study

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## Abstract

### Background

Age-related changes, reduced physical activity, and prolonged sedentary behaviour may affect shoulder mobility and contribute to musculoskeletal problems in older adults. Home exercises are an important component of physiotherapy management. However, awareness of home exercises does not necessarily indicate actual exercise participation or adherence to prescribed programmes. This study aimed to assess awareness of home exercises, determine the proportion of participants with shoulder stiffness, and evaluate the association between shoulder stiffness and a sedentary lifestyle among older adults.

### Objectives

The primary objective of this study was to determine the proportion of adults aged 60 years and older with study-defined shoulder movement restriction in selected settings in Karad, Maharashtra. The secondary objectives were to (1) assess awareness of home exercises and shoulder health using a 15-item questionnaire; (2) examine the association between a sedentary lifestyle and shoulder movement restriction; and (3) assess the correlation between awareness scores and pain intensity measured using the Numeric Pain Rating Scale (NPRS).

### Methodology

A cross-sectional observational study was conducted among 94 adults aged 60 years and older. Participants were recruited from community areas, old-age homes, residential areas, and the physiotherapy OPD of Krishna College of Physiotherapy, Karad. Awareness of home exercises was assessed using a 15-item self-developed questionnaire. Pain intensity was measured using the NPRS, and shoulder range of motion was assessed using a universal goniometer. Data were analysed using descriptive statistics, chi-square tests, and Pearson's correlation analysis in IBM SPSS Statistics, version 29.0 (IBM Corp., Armonk, NY, USA).

### Result

Among the 94 participants, 52 (55.3%; 95% CI: 45.3%-65.0%) demonstrated study-defined shoulder movement restriction. A sedentary lifestyle was identified in 59 participants (62.8%). A statistically significant association was observed between a sedentary lifestyle and shoulder movement restriction ($\chi^2(1, N = 94) = 9.98$, $p = 0.002$; $\phi = 0.326$). Regarding awareness, 45 participants (47.9%) demonstrated moderate awareness, 27 (28.7%) demonstrated good awareness, and 22 (23.4%) demonstrated poor awareness. Awareness scores were negatively correlated with pain intensity measured using the NPRS ($r = -0.641$, 95% CI: -0.747 to -0.504, $p < 0.001$). The distribution of shoulder movement restriction across awareness categories was examined descriptively because of potential overlap in questionnaire content.

### Conclusion

The findings demonstrated an association between a sedentary lifestyle and shoulder stiffness within the study sample. Awareness scores were negatively correlated with pain intensity. However, because of the cross-sectional design, convenience-based recruitment, and lack of multivariable adjustment, these findings cannot establish causation or be generalised to the wider geriatric population. Further adequately powered community-based studies are required to investigate these relationships.

**Categories:** Pain Management, Physical Medicine & Rehabilitation, Geriatrics
**Keywords:** awareness, geriatric population, home exercise, pain, physiotherapy, sedentary behaviour, shoulder stiffness

## Introduction

Population ageing is an important public health concern because age-related changes in muscle strength, joint mobility, connective tissue properties, and functional capacity may increase the risk of musculoskeletal

limitations among older adults. These limitations can interfere with independence and activities of daily living. Regular physical activity is an important component of healthy ageing and is recommended throughout later life [1, 2].

Sedentary behaviour is common among older adults and is a potentially modifiable aspect of daily living. A systematic review examining adults aged 65 years and older found consistent evidence that moderate-to-vigorous physical activity was favourably associated with quality of life, whereas evidence regarding the association between sedentary behaviour and quality of life was inconsistent [3]. Other research has reported associations between sedentary behaviour and adverse health outcomes in older adults, although findings vary according to the outcomes assessed and measurement methods used [4]. Reducing prolonged sitting and encouraging regular movement may therefore be important components of preventive healthcare. Physiotherapy can contribute through patient education, exercise prescription, and monitoring of functional limitations [5, 6].

Shoulder pain and stiffness are important musculoskeletal problems that may interfere with activities of daily living, including dressing, grooming, reaching, and personal care. In a population-based study conducted as part of the North West Adelaide Health Study, Hill CL et al. reported that 22.3% of 3,206 participants experienced pain, aching, or stiffness in either shoulder on most days [7]. The study also found that shoulder symptoms were associated with poorer health-related quality of life and physical functioning. These findings highlight the clinical importance of shoulder problems in the community and the need to assess shoulder symptoms and movement restriction among older adults. However, prevalence estimates may vary according to the population studied, the symptoms assessed, and the diagnostic criteria applied.

Shoulder stiffness is a clinical condition characterised by restricted glenohumeral movement, with or without pain. It may develop through different mechanisms, including capsular contracture, prolonged immobilisation, degenerative changes, and other soft tissue restrictions. These changes can contribute to reduced shoulder mobility and difficulty performing functional activities. Management depends on the underlying cause and may include appropriate therapeutic exercises and physiotherapy [8, 9]. Age-related changes in tissue properties and muscle performance may increase susceptibility to movement limitations. Reduced physical activity and prolonged periods without adequate shoulder movement may further contribute to functional restriction [9, 10]. Early identification of shoulder movement restriction may therefore help physiotherapists provide appropriate assessment, education, and exercise interventions.

Physical exercise is an established strategy for maintaining physical function and independence in older adults. Evidence from systematic reviews and meta-analyses suggests that appropriately designed exercise programmes can improve physical performance and aspects of quality of life in older populations [11, 12]. Home exercise programmes extend therapeutic activity beyond supervised clinical sessions and may provide a practical approach to maintaining mobility and function in individuals with shoulder disorders. Their effectiveness depends partly on appropriate exercise selection, the individual's understanding of the prescribed programme, and adherence to the exercises [13, 14].

Adherence to home exercise programmes can be challenging among older adults. Personal factors, programme characteristics, motivation, and understanding of exercise instructions may influence participation. Patient education, feedback, follow-up, and supportive delivery methods may help improve adherence [14, 15]. Clear instructions, demonstrations, and written or visual educational materials may also help older adults understand how to perform prescribed exercises correctly [16, 17]. Home-based exercise programmes have been studied in older adults following hospitalisation and in individuals with functional limitations. Evidence suggests that appropriately designed programmes may support improvements in physical activity, mobility, and functional performance, although adherence remains an important consideration [18].

Health awareness and health literacy may also influence physical activity behaviour. A systematic review reported associations between health literacy and physical activity in older adults, suggesting that the ability to understand and use health information may support healthier physical activity behaviours [19]. In relation to shoulder health, awareness of home exercises may include knowledge of the benefits of regular shoulder movement, appropriate exercises, posture, pain management, and the importance of seeking professional assessment when required.

The primary objective of this study was to determine the proportion of adults aged 60 years and older with study-defined shoulder movement restriction in selected settings. The secondary objectives were to (1) assess awareness of home exercises and shoulder health using a 15-item self-developed questionnaire; (2) examine the association between a sedentary lifestyle and shoulder movement restriction; and (3) assess the correlation between awareness scores and pain intensity measured using the Numeric Pain Rating Scale (NPRS). Awareness was assessed using a self-developed questionnaire, while bilateral active and passive shoulder range of motion (ROM) was evaluated using a universal goniometer. The study aimed to describe the proportion of participants with movement restriction and examine associations within the study sample rather than establish causal relationships.

# Materials And Methods

## Study design and setting

A cross-sectional observational study was conducted among adults aged 60 years and older in selected settings in Karad, Maharashtra, India, from February 27, 2026 to August 26, 2026. Participants were recruited from community areas, residential areas, old-age homes, and the physiotherapy OPD of Krishna College of Physiotherapy, Karad. The study aimed to determine the proportion of participants with study-defined shoulder movement restriction, assess awareness of home exercises and shoulder health, examine the association between a sedentary lifestyle and shoulder movement restriction, and assess the correlation between awareness scores and pain intensity.

## Data availability statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable ethical and institutional requirements.

## Sampling method and participant recruitment

Participants were recruited using a non-probability convenience sampling method from selected community areas, residential areas, old-age homes, and the physiotherapy outpatient department of Krishna College of Physiotherapy, Karad. Eligible individuals aged 60 years and older who were willing to participate were invited to take part in the study. Written informed consent was obtained before data collection. A total of 94 participants were included in the final analysis. The numbers of individuals initially screened, excluded, or declining participation were not prospectively documented; therefore, a complete participant recruitment flow could not be established. Individuals with a recent shoulder fracture or shoulder surgery, neurological disorders affecting the upper limb, inflammatory joint diseases such as rheumatoid arthritis, or severe cognitive impairment, as well as those unwilling to participate, were excluded. The inclusion and exclusion criteria used to determine participant eligibility are shown in Table *1*.

| Inclusion criteria | Exclusion criteria |
|---|---|
| Individuals aged 60 years and older | Recent shoulder fracture |
| Participants of either sex | Recent shoulder surgery |
| Willingness to participate in the study | Neurological disorders affecting the upper limb |
| Provision of written informed consent | Inflammatory joint diseases, such as rheumatoid arthritis |
| - | Severe cognitive impairment |
| - | Unwillingness to participate in the study |

**TABLE 1: Inclusion and exclusion criteria.**

## Sample size calculation

The sample size was estimated using the formula:

$$n = \frac{4pq}{L^2}$$

Where p represents the expected prevalence (31%), q represents 100 - p (69%), and L represents the absolute precision. Based on an absolute precision of approximately 9.5%, a sample size of 94 participants was determined by the institutional research department during the study planning process. All 94 participants were included in the final analysis.

## Ethical approval

The study was conducted after obtaining approval from the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad (Approval No. 540/2025-2026). Written informed consent was obtained from each participant before data collection. Demographic information and relevant study data were collected from the participants.

## Statistical analysis

Pearson's correlation analysis was used to assess the relationship between awareness scores and pain intensity. Pain intensity was measured using the NPRS [20].

The cross-tabulation of awareness categories and shoulder movement restriction was examined descriptively because of potential overlap between questionnaire items assessing knowledge of shoulder stiffness and its clinical manifestations. Statistical significance was set at $p < 0.05$, with a 95% confidence level.

### Assessment of awareness of home exercises

Awareness of home exercises and shoulder health was assessed using a 15-item self-developed questionnaire designed specifically for the present study. The questionnaire assessed participants' knowledge of sedentary lifestyles, shoulder health, shoulder mobility exercises, home exercise programmes, and the role of physiotherapy.

The questionnaire was reviewed by five subject matter experts in physiotherapy to assess the relevance, clarity, and appropriateness of the questions. Their suggestions were considered during the finalisation of the questionnaire to improve its content relevance. However, the questionnaire was not subjected to formal psychometric validation. Cognitive pretesting, a formal readability assessment, and reliability testing were not performed. Therefore, the questionnaire should be considered a self-developed, expert-reviewed assessment tool rather than a validated instrument.

Each question contained four response options, including a "Do not know" option. Each correct response received one mark, whereas incorrect and "Do not know" responses received zero marks. The total awareness score ranged from 0 to 15. Scores were categorised as poor awareness (0-5), moderate awareness (6-10), and good awareness (11-15). Higher scores indicated greater awareness of home exercises and shoulder health.

### Assessment and classification of sedentary lifestyle

Information regarding sedentary behaviour was collected using the study's data collection questionnaire. The classification of participants into sedentary and non-sedentary groups was based on the lifestyle information recorded during the original data collection. As no predefined numerical cut-off or standardised instrument was used, the classification reflects the study-specific categorisation applied during the investigation and should not be interpreted as a standardised measure of sedentary behaviour.

### Assessment and operational definition of shoulder movement restriction

Shoulder ROM was assessed bilaterally using a universal goniometer. Both active range of motion (AROM) and passive range of motion (PROM) were evaluated with participants in the supine position. The movements assessed included shoulder flexion, extension, abduction, adduction, internal rotation, and external rotation. Measurements were recorded separately for the right and left shoulders.

For the purposes of this study, shoulder movement restriction was identified through clinical assessment and comparison of bilateral shoulder ROM measurements. The assessment included active and passive movements in six directions: flexion, extension, abduction, adduction, internal rotation, and external rotation. The classification was based on the clinical observations recorded during the original assessment. However, a predefined numerical threshold for absolute ROM restriction or side-to-side differences was not established before data collection. Therefore, this classification should be interpreted as a study-specific clinical observation rather than a standardised diagnostic criterion.

### Radiological assessment

No radiological investigations, including X-rays, USG, or MRI, were performed as part of this study. Shoulder stiffness was assessed clinically using participants' reported symptoms and shoulder ROM measured with a universal goniometer. Radiological imaging was not used to classify shoulder stiffness. This approach was considered appropriate for the clinical assessment undertaken in this study, as structural abnormalities may be present in both symptomatic and asymptomatic older adults, and imaging findings do not necessarily correspond with clinical symptoms [21].

## Results

A total of 94 participants aged 60-85 years were included in the study. The mean age was 72.79 ± 8.31 years, and the median age was 73 years. The descriptive statistics for age are presented in Table 2.

| Variable | Mean ± SD | Median | Minimum | Maximum |
|---|---|---|---|---|
| Age (years) | 72.79 ± 8.31 | 73 | 60 | 85 |

**TABLE 2: Descriptive statistics for participant age.**

Regarding gender distribution, 60 participants (63.8%) were male and 34 (36.2%) were female. The gender distribution is presented in Table *3*.

| Gender | Frequency (n) | Percentage (%) |
|---|---|---|
| Male | 60 | 63.8 |
| Female | 34 | 36.2 |
| Total | 94 | 100 |

**TABLE 3: Gender distribution of participants.**

Among the 94 participants included in the study, 59 (62.8%) were classified as having a sedentary lifestyle, whereas 35 (37.2%) were classified as non-sedentary. Thus, sedentary behaviour was common in the study sample. The distribution of participants according to sedentary lifestyle status is presented in Table *4*.

| Sedentary lifestyle | Frequency (n) | Percentage (%) |
|---|---|---|
| Yes | 59 | 62.8 |
| No | 35 | 37.2 |
| Total | 94 | 100 |

**TABLE 4: Distribution of participants according to sedentary lifestyle status.**

Regarding awareness of home exercises, 45 participants (47.9%) had moderate awareness, 27 (28.7%) had good awareness, and 22 (23.4%) had poor awareness. Moderate awareness was the most frequent category. The distribution is shown in Table *5*.

| Awareness level | Frequency (n) | Percentage (%) |
|---|---|---|
| Poor | 22 | 23.4 |
| Moderate | 45 | 47.9 |
| Good | 27 | 28.7 |
| Total | 94 | 100 |

**TABLE 5: Awareness levels regarding home exercises.**

The proportion of participants with shoulder stiffness was 55.3% (52/94; 95% CI: 45.3%-65.0%). Similarly, 62.8% (59/94; 95% CI: 52.7%-71.9%) of participants were classified as having a sedentary lifestyle. These CIs provide estimates of the precision of the observed proportions. The proportion of participants with shoulder stiffness in the study sample is presented in Table *6*.

| Study-defined shoulder movement restriction | Frequency (n) | Percentage (%) |
|---|---|---|
| Yes | 52 | 55.3 |
| No | 42 | 44.7 |
| Total | 94 | 100 |

**TABLE 6: Distribution of participants according to study-defined shoulder movement restriction.**

The mean awareness score was 8.27 ± 3.61, with a median of 8.5 and a range of 3-15. The mean score fell within the moderate-awareness category. These descriptive statistics are presented in Table 7.

| Variable | Mean ± SD | Median | Minimum | Maximum |
|---|---|---|---|---|
| Awareness score | 8.27 ± 3.61 | 8.5 | 3 | 15 |

**TABLE 7: Descriptive statistics for awareness scores.**

The mean NPRS pain score was 3.30 ± 3.13, with a median of 4 and a range of 0-8. This indicates variation in pain intensity among participants. The descriptive statistics for NPRS scores are presented in Table 8.

| Variable | Mean ± SD | Median | Minimum | Maximum |
|---|---|---|---|---|
| NPRS score | 3.30 ± 3.13 | 4 | 0 | 8 |

**TABLE 8: Descriptive statistics for Numeric Pain Rating Scale (NPRS) scores.**

Pearson's chi-square test of independence without Yates' continuity correction showed a statistically significant association between a sedentary lifestyle and shoulder stiffness ($\chi^2(1, N = 94) = 9.98$, $p = 0.002$), with a phi coefficient ($\phi$) of 0.326. Shoulder stiffness was observed in 40 of 59 sedentary participants (67.8%), compared with 12 of 35 non-sedentary participants (34.3%). These findings indicate a statistically significant association between a sedentary lifestyle and shoulder stiffness; however, the cross-sectional study design does not establish a causal relationship. The distribution of shoulder stiffness according to sedentary lifestyle status is presented in Table 9.

| Sedentary lifestyle | No movement restriction, n (%) | Movement restriction, n (%) | Total, n |
|---|---|---|---|
| Non-sedentary | 23 (65.7) | 12 (34.3) | 35 |
| Sedentary | 19 (32.2) | 40 (67.8) | 59 |
| Total | 42 (44.7) | 52 (55.3) | 94 |

**TABLE 9: Association between a sedentary lifestyle and shoulder movement restriction.**

The distribution of study-defined shoulder movement restriction across awareness categories was examined descriptively. Among participants with good awareness, all 27 had no recorded shoulder movement restriction. In the moderate-awareness category, 30 participants had movement restriction, and 15 had no recorded restriction. Among participants with poor awareness, all 22 had recorded movement restriction. However, the observed distribution demonstrated complete separation between the good- and poor-awareness categories. Considering the potential overlap between questionnaire items addressing shoulder symptoms and functional limitations, these findings were not subjected to inferential association testing and should be interpreted descriptively rather than as evidence of an independent relationship between awareness and shoulder stiffness. The distribution of shoulder stiffness across the different awareness

categories is presented in Table 10.

| Awareness level | No stiffness, n | Stiffness, n | Total, n |
|---|---|---|---|
| Good | 27 | 0 | 27 |
| Moderate | 15 | 30 | 45 |
| Poor | 0 | 22 | 22 |
| Total | 42 | 52 | 94 |

**TABLE 10: Descriptive distribution of shoulder movement restriction across awareness categories.**

Pearson's correlation analysis demonstrated a statistically significant negative correlation between awareness scores and pain intensity measured using the NPRS ($r = -0.641$, 95% CI: -0.747 to -0.504, $p < 0.001$). Higher awareness scores were associated with lower reported pain intensity in this sample. However, this relationship should be interpreted cautiously because of the cross-sectional design and potential overlap between knowledge-related questionnaire items and shoulder-related clinical manifestations. The correlation results are presented in Table 11.

| Variables | Pearson's r | 95% CI | p-value |
|---|---|---|---|
| Awareness score vs. NPRS score | -0.641 | -0.747 to -0.504 | <0.001 |

**TABLE 11: Correlation between awareness scores and NPRS pain intensity scores.**

NPRS: Numeric Pain Rating Scale.

# Discussion

## Participant characteristics and sedentary lifestyle

The present study included 94 older adults, with a mean age of 72.79 ± 8.31 years. The age profile is relevant because maintaining physical activity and functional capacity becomes increasingly important with advancing age. Current international guidance recommends regular aerobic activity, together with muscle-strengthening and multicomponent physical activities, for older adults. The present findings, therefore, need to be considered within the broader framework of active and healthy ageing [1].

Physical activity in later life is also important for preserving function among older adults who are vulnerable to frailty. Previous evidence indicates that appropriately prescribed exercise can improve functional performance and help maintain independence. This supports the physiotherapy focus of the present study on movement, shoulder mobility, and awareness of home exercises [2].

In the present sample, 59 participants (62.8%) were classified as sedentary. This finding is consistent with evidence showing that older adults can spend a considerable proportion of their waking time engaging in sedentary activities. High levels of sedentary behaviour are clinically relevant because they may coexist with low levels of purposeful physical activity and reduced opportunities for regular movement [3].

The observed level of sedentary behaviour is also consistent with evidence from reviews linking prolonged sedentary time in older adults with adverse health and functional outcomes. Although sedentary behaviour is not equivalent to physical inactivity, reducing prolonged sitting and encouraging frequent movement breaks are practical targets for community physiotherapy [4].

## Shoulder stiffness in the study sample

Shoulder stiffness was identified in 52 of the 94 participants (55.3%) included in the present study. This proportion is higher than the 21% prevalence of identifiable symptomatic shoulder disorders reported by Chard MD et al. in a community survey of 644 individuals aged over 70 years [6]. Similarly, Hill CL et al. reported that 22.3% of 3,206 participants in the North West Adelaide Health Study experienced pain, aching, or stiffness in either shoulder on most days [7]. However, these findings should be interpreted cautiously

because the studies involved different populations and used different case definitions. The present study included participants recruited from community settings, residential areas, old-age homes, and a physiotherapy OPD and assessed shoulder movement clinically using goniometry. The inclusion of outpatient attendees and differences in assessment methods may have contributed to the higher proportion observed in the present sample. Therefore, direct comparisons between these estimates are limited.

Shoulder stiffness is a clinical finding that may arise from several underlying conditions, including soft tissue changes, degenerative disorders, reduced joint mobility, and other musculoskeletal or neurological conditions. In the present study, shoulder stiffness was considered a clinical finding based on participants' reported symptoms and the clinical assessment of shoulder movement using a universal goniometer. The assessment was not intended to establish a specific diagnosis, such as adhesive capsulitis. Therefore, the findings should be interpreted as observed shoulder symptoms and movement restriction rather than as a confirmed diagnosis of a particular shoulder disorder [8].

Age-related changes may reduce tissue elasticity and physical capacity, while periods of reduced movement may further affect joint mobility. The literature on risk factors for shoulder stiffness supports the consideration of both individual and mechanical factors. The association observed in the present study is, therefore, clinically plausible, although it should not be interpreted as proof of causation [9].

## Association between a sedentary lifestyle and shoulder stiffness

The present study identified a statistically significant association between a sedentary lifestyle and clinically assessed shoulder stiffness among older adults. This study contributes sample-based evidence regarding the relationship between sedentary behaviour and shoulder movement restriction in this age group. However, the findings should be considered preliminary and hypothesis-generating because of the relatively small sample size, convenience sampling, and cross-sectional design. Further studies involving larger, representative populations and clearly defined criteria for shoulder movement restriction are required to confirm this association.

Shoulder pain and movement restriction in older adults may arise from different musculoskeletal conditions. In the present study, shoulder movement was assessed using bilateral goniometric measurements, and pain intensity was recorded using the NPRS. However, a specific underlying pathological diagnosis was not established. Therefore, the findings should be interpreted as study-defined shoulder movement restriction rather than as evidence of a particular shoulder disorder.

## Awareness of home exercises

The mean awareness score in the present study was 8.27 ± 3.61, which fell within the moderate-awareness category. Exercise has been shown to improve quality of life and physical outcomes in healthy older adults, supporting the importance of helping older adults understand the role of regular physical activity. Although awareness and knowledge are important for encouraging physical activity, education alone may not be sufficient to produce sustained behavioural change. Behaviour change strategies such as goal setting, self-monitoring, feedback, social support, and regular follow-up may help older adults translate exercise knowledge into consistent home exercise practices [17].

Evidence from exercise research in older adults further supports the use of structured physical activity to maintain or improve physical function. The present study did not test an exercise intervention, but its findings suggest a need for preventive education that encourages appropriate movement before functional limitations become more pronounced [12].

Home exercise is particularly relevant because it enables therapeutic activity to continue outside supervised physiotherapy sessions. Previous work has highlighted the importance of theory-based strategies for helping older adults sustain exercise after rehabilitation. This supports the inclusion of education, goal setting, reinforcement, and follow-up when home exercises are prescribed [13].

The present study found that 47.9% of participants had moderate awareness, 28.7% had good awareness, and 23.4% had poor awareness. Previous evidence from systematic reviews indicates that adherence to exercise programmes is influenced by both programme characteristics and personal factors. Therefore, efforts to improve awareness should be accompanied by practical and individualised exercise planning [14].

Adherence is particularly important when physiotherapy programmes depend on regular activity at home. Evidence on exercise for falls prevention indicates that adherence can be influenced by behavioural and supportive strategies. For shoulder care in older adults, repeated education, encouragement, and monitoring may, therefore, be useful in translating knowledge into regular exercise behaviour [15].

The manner in which exercises are explained may also influence adherence. Research in older adults has shown that the method of exercise instruction can affect adherence to home exercise programmes. This supports the use of clear demonstrations and simple written or visual instructions when teaching shoulder

exercises in community settings [16].

Behaviour change techniques such as goal setting, feedback, self-monitoring, and social support have been examined in relation to exercise adherence among older adults. The present findings, therefore, support a broader approach to home exercise education rather than the provision of instructions without reinforcement. Physiotherapists can use these strategies to make home exercise programmes more understandable and sustainable [17].

Evidence from systematic reviews on home-based exercise after hospitalisation also suggests potential benefits for physical activity, quality of life, and functional outcomes in older adults. Although the present study was not an intervention study, these findings strengthen the rationale for accessible exercise programmes that can be continued in the home environment [18].

The quality of a home exercise programme is another important consideration. Recent evidence suggests that the manner in which home-based interventions are delivered can influence the physical benefits obtained from them. In the present context, this means that awareness should ideally be accompanied by correct exercise technique, appropriate exercise selection, progression, and follow-up rather than reliance on general advice alone.

## Relationship between awareness and clinical findings

The present study assessed awareness of home exercises and shoulder health among older adults. The mean awareness score was 8.27 ± 3.61, indicating moderate awareness within the study sample. Awareness scores demonstrated a negative correlation with pain intensity measured using the NPRS ($r = -0.641$, $p < 0.001$).

However, this correlation should be interpreted cautiously. The awareness questionnaire included items addressing the symptoms and functional consequences of shoulder stiffness, including difficulty lifting the arm, difficulty performing daily activities, and the effects of stiffness on sleep. This may have introduced construct overlap between the measurement of awareness and participants' clinical experiences.

Furthermore, the cross-sectional design does not establish the direction of the observed relationship. Participants experiencing shoulder pain or movement restriction may have acquired greater knowledge through personal experience or healthcare consultations. Similarly, factors such as education, previous exposure to physiotherapy, age, and health literacy may influence both awareness and pain-related outcomes.

Therefore, the observed correlation should be considered exploratory rather than evidence that increased awareness directly reduces shoulder pain. Future studies should assess awareness using an independently validated instrument that clearly distinguishes knowledge of home exercises from personal symptoms and functional limitations.

However, because awareness, stiffness, and pain were measured cross-sectionally, these findings demonstrate associations and cannot establish that increasing awareness would directly reduce stiffness or pain [19].

## Strengths

This study addresses a clinically relevant and relatively underexplored research question concerning awareness of home exercises and shoulder movement restriction among older adults. One of its strengths is the assessment of multiple related factors, including a sedentary lifestyle, awareness of home exercises, shoulder ROM, and pain intensity, within the same study population. Bilateral active and passive shoulder ROM was assessed using a universal goniometer, providing clinical measurements alongside questionnaire-based information. The study also reports participant counts, proportions, and measures of association, including effect size estimates. Furthermore, the association between a sedentary lifestyle and shoulder movement restriction was analysed using Pearson's chi-square test without Yates' continuity correction. The observed association ($\chi^2 = 9.98$, $\phi = 0.326$) provides preliminary evidence supporting further investigation of this relationship in larger, representative community-based populations.

## Limitations

This study has several limitations that should be considered when interpreting the findings.

First, the cross-sectional design does not establish temporal or causal relationships between a sedentary lifestyle, shoulder movement restriction, awareness, and pain intensity.

Second, the relatively small sample size of 94 participants and the use of non-probability convenience sampling may limit the precision and generalisability of the findings.

Third, participants were recruited from multiple settings, including community areas, residential areas, old-age homes, and a physiotherapy OPD. Recruitment from a clinical setting may have introduced selection bias because individuals attending physiotherapy services may have existing musculoskeletal complaints. The study sample included a higher proportion of male participants than female participants. This unequal sex distribution may limit the representativeness of the findings and their applicability to older adult populations with different sex distributions.

Fourth, shoulder movement restriction was classified based on a comparative assessment of bilateral active and passive ROM using a universal goniometer. However, a predefined numerical threshold for absolute ROM restriction or side-to-side differences was not established before data collection. Therefore, the classification represents a study-specific clinical assessment rather than a standardised diagnostic definition. Additionally, the inter-rater and intra-rater reliability of the shoulder ROM measurements was not formally established. Therefore, potential measurement variability between repeated assessments or assessors cannot be excluded.

Fifth, sedentary lifestyle classification was based on recorded daily sitting duration and participation in regular physical activity. A standardised assessment instrument and a predefined numerical cut-off were not established. Consequently, the findings may not be directly comparable with those of studies using standardised classifications of sedentary behaviour.

Sixth, the awareness questionnaire was self-developed and reviewed by five subject matter experts in physiotherapy. However, formal psychometric validation and reliability testing were not performed. Some questionnaire items addressed shoulder symptoms and their functional consequences, potentially introducing construct overlap between awareness scores and participants' clinical experiences. Therefore, the distribution of awareness categories across shoulder movement restriction groups was interpreted descriptively and should not be considered evidence of an independent association.

Seventh, the study did not include multivariable analysis to adjust for potential confounding factors such as age, sex, comorbidities, physical activity, and previous exposure to physiotherapy. The observed associations should, therefore, be interpreted as unadjusted findings.

Eighth, the numbers of individuals screened, excluded, and declining participation were not prospectively documented. Consequently, a complete participant recruitment flow could not be established.

Finally, the findings are based on a relatively small convenience sample recruited from selected settings in Karad, Maharashtra. Larger community-based studies using prospectively defined operational criteria, standardised measures of sedentary behaviour, independently validated awareness instruments, and complete recruitment documentation are required to investigate these relationships further.

## Conclusions

In this cross-sectional study of 94 older adults recruited from selected community settings and a physiotherapy outpatient department in Karad, shoulder stiffness was identified in 52 participants (55.3%). A higher proportion of participants classified as having a sedentary lifestyle had shoulder stiffness than those classified as non-sedentary. This association was statistically significant ($\chi^2(1, N = 94) = 9.98$, $p = 0.002$), suggesting a relationship between a sedentary lifestyle and shoulder stiffness within the study sample.

Awareness scores were negatively correlated with pain intensity measured using the NPRS ($r = -0.641$, $p < 0.001$). However, this relationship should be interpreted cautiously because of the cross-sectional design and potential construct overlap between awareness questionnaire items and shoulder-related clinical manifestations. The study does not establish that greater awareness leads to reduced pain or prevents shoulder stiffness. These findings provide preliminary, hypothesis-generating evidence regarding a sedentary lifestyle, shoulder movement restriction, awareness of home exercises, and pain among the participants studied. The results should be interpreted cautiously because of the relatively small sample size, convenience-based recruitment, lack of multivariable adjustment, and limitations in the measurement instruments and operational definitions. Further adequately powered community-based studies using clearly defined clinical assessment criteria and independently validated awareness instruments are required.

## Additional Information

### Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

**Concept and design:** Jaydip P. Patil, Tejashree Kumbhar

**Acquisition, analysis, or interpretation of data:** Jaydip P. Patil, Tejashree Kumbhar

**Drafting of the manuscript:** Jaydip P. Patil, Tejashree Kumbhar

**Critical review of the manuscript for important intellectual content:** Jaydip P. Patil, Tejashree Kumbhar

**Supervision:** Jaydip P. Patil, Tejashree Kumbhar

## Disclosures

**Human subjects:** Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethics Committee, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad issued approval 540/2025-2026. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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# References

1. Bull FC, Al-Ansari SS, Biddle S, et al.: World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020, 54:1451-1462. 10.1136/bjsports-2020-102955
2. Chin A Paw MJ, van Uffelen JG, Riphagen I, van Mechelen W: The functional effects of physical exercise training in frail older people: a systematic review. Sports Med. 2008, 38:781-793. 10.2165/00007256-200838090-00006
3. Harvey JA, Chastin SF, Skelton DA: How sedentary are older people? A systematic review of the amount of sedentary behavior. J Aging Phys Act. 2015, 23:471-487. 10.1123/japa.2014-0164
4. Copeland JL, Ashe MC, Biddle SJ, et al.: Sedentary time in older adults: a critical review of measurement, associations with health, and interventions. Br J Sports Med. 2017, 51:1539. 10.1136/bjsports-2016-097210
5. de Rezende LF, Rey-López JP, Matsudo VK, do Carmo LO: Sedentary behavior and health outcomes among older adults: a systematic review. BMC Public Health. 2014, 14:333. 10.1186/1471-2458-14-333
6. Chard MD, Hazleman R, Hazleman BL, King RH, Reiss BB: Shoulder disorders in the elderly: a community survey. Arthritis Rheum. 1991, 34:766-769. 10.1002/art.1780340619
7. Hill CL, Gill TK, Shanahan EM, et al.: Prevalence and correlates of shoulder pain and stiffness in a population-based study: the North West Adelaide Health Study. Int J Rheum Dis. 2010, 13:215-222. 10.1111/j.1756-185X.2010.01475
8. Itoi E, Arce G, Bain GI, et al.: Shoulder stiffness: current concepts and concerns . Arthroscopy. 2016, 32:1402-1414. 10.1016/j.arthro.2016.03.024
9. Cucchi D, Marmotti A, De Giorgi S, et al.: Risk factors for shoulder stiffness: current concepts . Joints. 2017, 5:217-223. 10.1055/s-0037-1608951
10. Stubbs B, Patchay S, Soundy A, Schofield P: The avoidance of activities due to fear of falling contributes to sedentary behavior among community-dwelling older adults with chronic musculoskeletal pain: a multisite observational study. Pain Med. 2014, 15:1861-1871. 10.1111/pme.12570
11. Raafs BM, Karssemeijer EG, Van der Horst L, Aaronson JA, Olde Rikkert MG, Kessels RP: Physical exercise training improves quality of life in healthy older adults: a meta-analysis. J Aging Phys Act. 2020, 28:81-93. 10.1123/japa.2018-0436
12. Valenzuela PL, Saco-Ledo G, Morales JS, et al.: Effects of physical exercise on physical function in older adults in residential care: a systematic review and network meta-analysis of randomised controlled trials. Lancet Healthy Longev. 2023, 4:247-256. 10.1016/S2666-7568(23)00057-0
13. Gallagher KM: Helping older adults sustain their physical therapy gains: a theory-based intervention to promote adherence to home exercise following rehabilitation. J Geriatr Phys Ther. 2016, 39:20-29. 10.1519/JPT.0000000000000040
14. Picorelli AM, Pereira LS, Pereira DS, Felício D, Sherrington C: Adherence to exercise programs for older people is influenced by program characteristics and personal factors: a systematic review. J Physiother. 2014, 60:151-156. 10.1016/j.jphys.2014.06.012
15. Hughes KJ, Salmon N, Galvin R, Casey B, Clifford AM: Interventions to improve adherence to exercise therapy for falls prevention in community-dwelling older adults: systematic review and meta-analysis. Age Ageing. 2019, 48:185-195. 10.1093/ageing/afy164
16. Schoo AM, Morris ME, Bui Q: The effects of mode of exercise instruction on compliance with a home exercise program in older adults with osteoarthritis. Physiotherapy. 2005, 91:79-86. 10.1016/j.physio.2004.09.019
17. Room J, Hannink E, Dawes H, Barker K: What interventions are used to improve exercise adherence in older people and what behavioural techniques are they based on? A systematic review. BMJ Open. 2017, 7:e019221. 10.1136/bmjopen-2017-019221
18. Lin I, Glinsky J, Dean C, Graham P, Scrivener K: Effectiveness of home-based exercise for improving physical

activity, quality of life and function in older adults after hospitalisation: a systematic review and meta-analysis. Clin Rehabil. 2022, 36:1170-1185. 10.1177/02692155221095936

19. Lim ML, van Schooten KS, Radford KA, Delbaere K: Association between health literacy and physical activity in older people: a systematic review and meta-analysis. Health Promot Int. 2021, 36:1482-1497. 10.1093/heapro/daaa072
20. Hawker GA, Mian S, Kendzerska T, French M: Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). Arthritis Care Res (Hoboken). 2011, 63:S240-S252. 10.1002/acr.20543
21. Gill TK, Shanahan EM, Allison D, Alcorn D, Hill CL: Prevalence of abnormalities on shoulder MRI in symptomatic and asymptomatic older adults. Int J Rheum Dis. 2014, 17:863-871. 10.1111/1756-185X.12476