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Prevalence of Scapular Dyskinesia in Generation Z A Cross-sectional Observational Study

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ABSTRACT

Background: Scapular dyskinesia is an observable alteration in scapular position or movement during shoulder activity. It is frequently asymptomatic and increasingly observed in young, non-athletic populations. Generation Z individuals are characterized by sedentary lifestyles, prolonged academic sitting, and extensive digital device usage, which may predispose them to early movement dysfunction.

Objective: To determine the prevalence of scapular dyskinesia among apparently healthy Generation Z individuals using the Lateral Scapular Slide Test (LSST) and Scapular Dyskinesia Test (SDT).

Methods: A cross-sectional observational study was conducted on 50 apparently healthy Generation Z individuals (25 males, 25 females; age range 16–27 years; mean age 20.72 ± 1.94 years) recruited by convenience sampling. Scapular asymmetry was assessed using LSST at three arm positions (0°, 45°, 90° abduction). Dynamic scapular movement was assessed using SDT based on Kibler's classification.

Results: Scapular dyskinesia was detected in 78.0% (39/50) of participants on at least one side; right-side prevalence was 62.0% (31/50) and left-side prevalence was 72.0% (36/50). Type I dyskinesia was the most frequent pattern. Mean LSST asymmetry ranged from 0.90 ± 0.75 cm to 1.10 ± 0.71 cm across positions. Male LSST asymmetry was significantly greater than female at 90° abduction (1.46 ± 0.92 vs 0.70 ± 0.66 cm; $p = 0.002$), but not at 0° or 45° ($p = 0.115$, 0.351). Right- versus left-side measurements differed significantly (paired t-test, $p < 0.001$). Prevalence did not differ between males (80.0%) and females (76.0%; Fisher's exact $p = 1.000$).

Conclusion: Scapular dyskinesia is highly prevalent among apparently healthy Generation Z individuals, confirming its subclinical nature. The SDT identified a higher number of cases than the LSST. These findings support the need for early movement-based screening and preventive physiotherapy in young non-clinical populations.

Keywords: Scapula; Shoulder Joint; Biomechanical Phenomena; Cross-Sectional Studies; Prevalence; Young Adult

1. INTRODUCTION

In recent decades, musculoskeletal disorders have emerged as a major public health concern worldwide, affecting individuals across all age groups. Rapid urbanisation, increasing academic demands, reduced levels of physical activity, and extensive use of digital technology have contributed to early alterations in

movement behaviour, particularly among young populations.[1] Musculoskeletal complaints are no longer restricted to older adults but are increasingly observed among adolescents and young adults.[2]

The shoulder complex is one of the most mobile and biomechanically demanding regions of the human body, consisting of four interrelated articulations: the glenohumeral, acromioclavicular, sternoclavicular, and scapulothoracic joints.[4] Ludewig and Braman (2011) emphasised that normal scapulothoracic motions during arm elevation including upward rotation, posterior tilting, and external rotation are essential for maintaining glenohumeral alignment and preventing impingement.[3] The scapula acts as a dynamic link between the upper limb and the trunk, providing a stable yet mobile base for humeral movement, with neuromuscular dysfunction of stabilisers such as the serratus anterior and trapezius contributing to movement impairment.[5] Mottram (1997) highlighted that dynamic scapular stability depends on coordinated activation of multiple muscles, including the trapezius, serratus anterior, rhomboids, and levator scapulae, with neuromuscular timing playing a critical role in maintaining normal movement patterns.[9]

Normal shoulder elevation involves a coordinated interaction between the glenohumeral joint and scapulothoracic movement, commonly described as scapulohumeral rhythm. Any disruption in this rhythm can alter movement efficiency and load distribution across the shoulder complex.[11] Importantly, many individuals adapt to modified movement patterns while remaining functionally active, contributing to the under-recognition of movement dysfunctions in young populations.[12]

Scapular dyskinesia refers to an observable alteration in scapular position or movement during shoulder activity and is considered a clinical sign rather than a disease entity. It is commonly categorised into three observable patterns based on Kibler's classification: inferior angle prominence (Type I), medial border prominence (Type II), and superior border elevation (Type III).[13] A defining characteristic is its frequent asymptomatic presentation, creating a gap between actual occurrence and clinically reported cases.[15] A systematic review by Salamh et al. (2023) reported a prevalence of approximately 81% in symptomatic athletes, 57% in symptomatic orthopaedic patients, 42% in asymptomatic athletes, 59% in asymptomatic non-athletes, and approximately 48% in the asymptomatic general population.[15]

Although scapular dyskinesia has been widely studied in symptomatic and athletic populations, limited attention has been directed toward its occurrence in general, non-athletic young adults.[18] Kibler et al. (2012) noted that scapular dyskinesia is a common finding across both athletic and non-athletic populations, with contributing factors including muscular weakness, altered neuromuscular control, and postural adaptation.[6] Javdaneh et al. (2025) further highlighted the clinical importance of screening for scapular dysfunction in populations with postural and movement-related risk factors.[17] Generation Z, comprising individuals born approximately between 1995 and 2012, is characterised by increased sedentary behaviour, prolonged academic sitting, and extensive digital device usage.[19] In the Indian context, these patterns are intensified by academic competition, prolonged study hours, and increased reliance on online learning. The extent to which these factors translate into measurable movement dysfunction remains unclear due to the lack of structured prevalence-based studies in this population.[18]

Screening for conditions with a high asymptomatic burden before symptoms arise is a fundamental principle of preventive health practice established by Wilson and Jungner (1968).[16] Prevalence studies play a crucial role in quantifying the occurrence and distribution of a condition within a defined population, rather than establishing causation.[20] Currently, limited data exist regarding the prevalence of scapular dyskinesia among Generation Z, particularly within the Indian population.

Aim: The aim of this study was to determine the prevalence of scapular dyskinesia among apparently healthy Generation Z individuals using the LSST and SDT, and to generate baseline epidemiological data to support early screening and preventive physiotherapy planning.

2. MATERIALS AND METHODS

2.1 Design and Setting

A cross-sectional observational study was conducted in the Physiotherapy Department and community settings associated with Career Point University, Kota, Rajasthan, India, over a period of approximately 2 months. Data collection was carried out in a quiet, well-ventilated area with adequate space for performing dynamic shoulder movements and scapular assessment procedures.

2.2 Participants

Fifty apparently healthy Generation Z individuals (25 males, 25 females; age range 16–27 years; mean age 20.72 ± 1.94 years) were recruited by convenience sampling. All participants were right-hand dominant.

Inclusion Criteria: Generation Z individuals aged 16–27 years; both sexes; apparently healthy and asymptomatic; willingness to provide informed consent.

Exclusion Criteria: History of shoulder or cervical surgery, fracture, or major trauma; diagnosed neurological or musculoskeletal disorders affecting the upper limb or shoulder; current acute shoulder or neck pain; severe postural deformities such as scoliosis or kyphosis; unwillingness to consent.

2.3 Sample Size

A sample of 50 participants was determined based on an expected prevalence of approximately 48% derived from prior systematic review data on asymptomatic populations,[15] a 95% confidence level, and a margin of error of ±14%, yielding a minimum required sample of 49 ($n = Z^2P(1-P)/d^2$), rounded to 50 for practical purposes.

2.4 Intervention

No intervention was applied. This was a purely observational cross-sectional prevalence study. Participants were not subjected to any therapeutic procedure, exercise, or treatment protocol. Assessment was limited to clinical measurement using the LSST and observation using the SDT.

2.5 Outcome Measures

Lateral Scapular Slide Test (LSST): The LSST was used to assess bilateral scapular asymmetry. The distance between the inferior angle of the scapula and the corresponding spinal spinous process was measured bilaterally using a measuring tape in three standardised arm positions: 0° (arms at rest), 45° (hands on hips), and 90° abduction. A side-to-side difference greater than 1.5 cm was considered indicative of abnormal scapular asymmetry and possible dyskinesia.[5]

Scapular Dyskinesis Test (SDT): The SDT was used to assess dynamic scapular movement patterns during active shoulder motion. Participants performed repeated shoulder flexion and abduction movements with or without light dumbbells (1–3 kg) while the examiner visually observed scapular motion. Movement was classified according to Kibler's classification[7]: Type I (inferior medial border prominence), Type II (entire medial border prominence), Type III (superior border elevation), and Type IV (symmetrical and normal motion). Types I, II, and III were classified as dyskinesia-positive; Type IV as normal.[13]

2.6 Procedure

Participants were briefed on the study purpose and written informed consent was obtained. Demographic

information including age, sex, height, weight, dominant hand, screen time, and physical activity level was recorded. Participants were assessed standing in comfortable clothing allowing clear visualisation of the scapular region. LSST measurements were taken first, followed by SDT evaluation. Findings including presence or absence of dyskinesia, Kibler type, and LSST measurements were documented immediately. Participants demonstrating significant abnormalities were advised to seek further physiotherapy evaluation.

2.7 Statistical Analysis

Data were coded and entered into Microsoft Excel and analysed using Python (SciPy v1.x). Descriptive statistics (frequency, proportion, percentage, mean ± SD) were used to summarise prevalence and LSST asymmetry. An independent samples t-test (Welch's) was used to compare mean LSST asymmetry between male and female participants at each arm position. A paired-samples t-test was used to compare right- and left-side LSST measurements across all positions within participants. Fisher's exact test was used to compare overall dyskinesia prevalence between males and females. Statistical significance was set at $p < 0.05$.

3. RESULTS

A total of 50 Generation Z individuals (25 males, 25 females; age range 16–27 years; mean age 20.72 ± 1.94 years) were assessed. All participants were right-hand dominant.

3.1 Overall Prevalence

Scapular dyskinesia was detected in 78.0% (39/50) of participants on at least one side. Right-side prevalence was 62.0% (31/50) and left-side prevalence was 72.0% (36/50). A paired-samples t-test comparing right- and left-side LSST measurements across all three arm positions (n = 150 paired observations) showed a statistically significant difference (mean right = 8.72 cm, mean left = 8.32 cm; t = 4.02, $p < 0.001$), confirming the presence of measurable bilateral scapular asymmetry in this population.

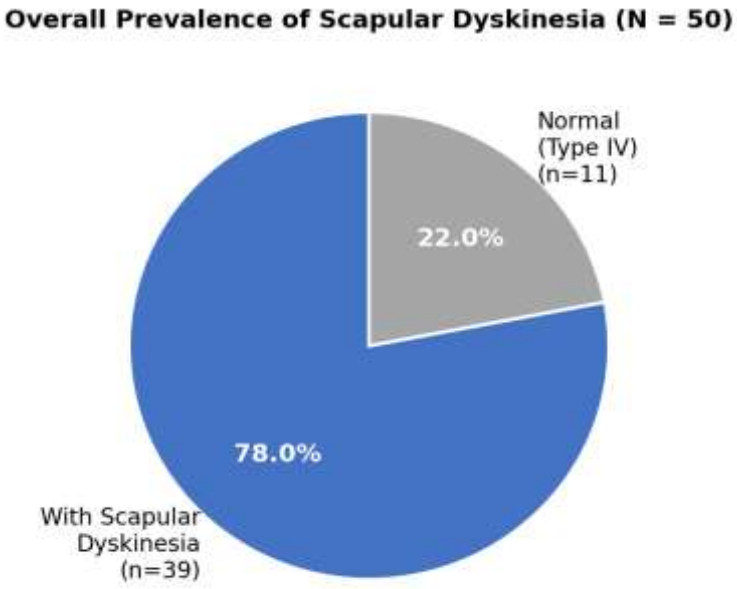


Figure 1. Overall Prevalence of Scapular Dyskinesia (N = 50)

3.2 Gender-wise Prevalence

Gender-wise prevalence data are presented in Table 1. Fisher's exact test showed no statistically significant difference in overall prevalence between males and females (p = 1.000).

Table 1. Gender-wise Prevalence of Scapular Dyskinesia (N = 50)

Gender	SD Positive (n)	Total (n)	Prevalence (%)
Male	20	25	80.0
Female	19	25	76.0
Total	39	50	78.0

Male prevalence: 80.0% (20/25). Female prevalence: 76.0% (19/25). Difference: 4.0% (Fisher's exact p = 1.000).

3.3 Type Distribution (SDT — Kibler Classification)

Table 2 presents the SDT classification (Type IV/normal vs. dyskinesia-present) by side; totals sum to N = 50 for each side.

Table 2. SDT Classification by Side (N = 50)

Classification	Right Side n (%)	Left Side n (%)
Type IV (Normal)	19 (38.0)	14 (28.0)
Dyskinesia present (Type I/II/III)	31 (62.0)	36 (72.0)
Total	50 (100.0)	50 (100.0)

Among right-side dyskinesia-positive cases (n = 31), Type I (inferior medial border prominence) was the most frequent pattern: Type I alone in 14 cases, Type II alone in 3, Type III alone in 2, Type I+II in 3, Type I+III in 4, Type II+III in 1, and Type I+II+III in 4 cases. On the left side, Type I was similarly the most frequent pattern, with Type I+II combinations observed in 8 cases and Type III in 4 cases.

3.4 Prevalence by Age Group

Table 3 presents prevalence of scapular dyskinesia by age group.

Table 3. Prevalence of Scapular Dyskinesia by Age Group

Age Group (years)	n	Prevalence (%)
16–18	4	100.0
19–21	32	71.9
22–25	13	92.3
26+	1	0.0*

**n = 1; result statistically inconclusive.*

3.5 LSST Mean Asymmetry (cm)

Table 4 presents mean ± SD of bilateral scapular asymmetry at three LSST positions, with independent samples t-test results comparing male and female participants at each position.

Table 4. LSST Mean Side-to-Side Asymmetry (cm) by Arm Position and Gender

Arm Position	Male Mean ± SD	Female Mean ± SD	Overall	p-value
0° Abduction	1.26 ± 0.79	0.94 ± 0.60	1.10 ± 0.71	0.115
45° Abduction	1.00 ± 0.88	0.80 ± 0.60	0.90 ± 0.75	0.351
90° Abduction	1.46 ± 0.92	0.70 ± 0.66	1.08 ± 0.88	0.002*

**Statistically significant (p < 0.05); independent samples t-test (Welch's).*

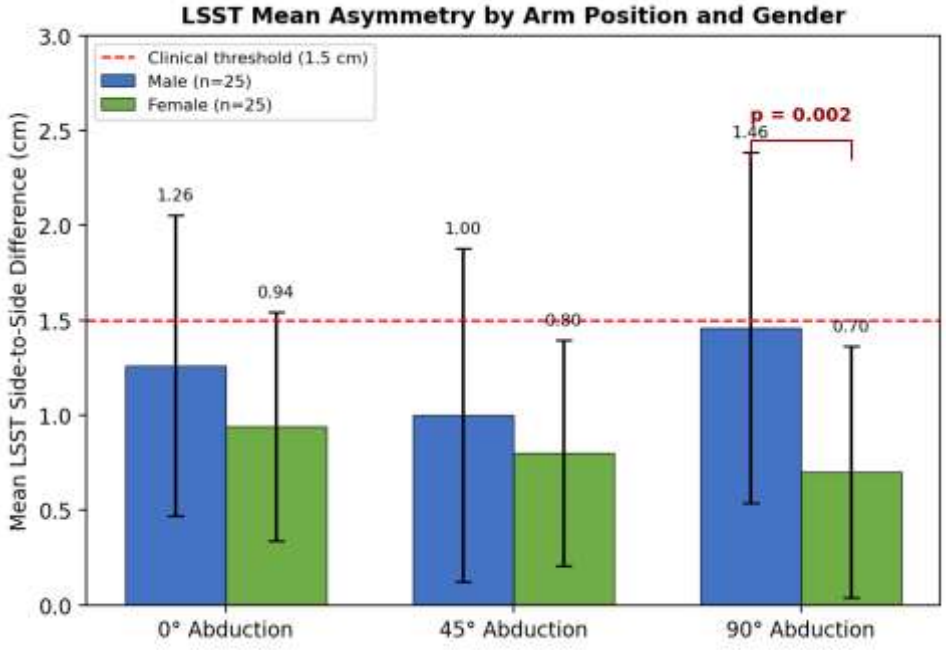


Figure 2. LSST Mean Side-to-Side Asymmetry by Arm Position and Gender

4. DISCUSSION

The present study determined the prevalence of scapular dyskinesia among apparently healthy Generation Z individuals, with a high overall prevalence of 78.0% (39/50) observed on at least one side. This indicates that scapular dyskinesia is common in this population and may exist as a subclinical movement dysfunction rather than an exclusively pathological condition.[15]

These findings are supported by Salamh et al. (2023), who reported a pooled prevalence of approximately 48% in asymptomatic non-athletic populations across 34 studies.[15] The higher prevalence observed in the present study may be attributed to the specific characteristics of the Generation Z cohort, including prolonged screen exposure, sedentary behaviour, reduced physical activity, and suboptimal postural habits.[19] Day et al. (2021) similarly observed altered scapular kinematics in asymptomatic college students, supporting the view that abnormal scapular movement patterns may represent common

movement variations in young adults rather than pathological findings.[12]

The SDT identified a higher number of cases of dyskinesia than the LSST, indicating that scapular dyskinesia is primarily a movement-related dysfunction rather than a static positional abnormality. This is consistent with Kibler and Sciascia (2010), who emphasised that scapular dyskinesia should be considered an impairment of movement rather than a structural diagnosis.[13] Uhl et al. (2009) also supported the clinical utility of visual assessment methods for identifying dynamic scapular abnormalities.[14] McClure et al. (2006) demonstrated differences in scapular kinematics between individuals with and without shoulder impingement syndrome, highlighting the clinical importance of detecting altered movement patterns.[10]

Gender-wise analysis showed a prevalence of 80.0% in males and 76.0% in females, with no statistically significant difference (Fisher's exact $p = 1.000$). The independent t-test revealed significantly greater LSST asymmetry in males than females at 90° abduction (1.46 ± 0.92 vs 0.70 ± 0.66 cm; $p = 0.002$), but no significant difference at 0° ($p = 0.115$) or 45° ($p = 0.351$), which may reflect differences in muscle mass, loading patterns, or activity levels at higher ranges of motion.[4] The predominance of Type I dyskinesia may indicate weakness or altered activation of stabilising muscles such as the serratus anterior and lower trapezius, as described by Cools et al. (2007).[8] Mean LSST asymmetry values remained below the 1.5 cm pathological threshold at 0° and 45°, with the male mean at 90° (1.46 cm) approaching but not exceeding this threshold, consistent with findings from Kibler and McMullen (2003).[5]

The higher left-side prevalence (72.0%) compared to the right side (62.0%) is consistent with the significant paired t-test result for right- versus left-side LSST measurements ($p < 0.001$), and may be associated with compensatory stabilisation demands placed on the non-dominant upper limb. Overall, the findings highlight the importance of early movement-based screening in Generation Z. Since many participants were asymptomatic, reliance solely on pain-based assessment may lead to under-recognition of early movement dysfunction. Incorporation of screening tools such as the SDT and LSST in routine physiotherapy assessment may contribute to preventive musculoskeletal healthcare.[17]

Limitations and Future Directions

The study was limited by a relatively small sample size ($n = 50$) and the use of convenience sampling, which may restrict generalisability to the wider Generation Z population. The cross-sectional design prevents causal interpretation. A formal paired comparison of right- versus left-side dyskinesia prevalence (e.g., McNemar's test) was not performed and is recommended for future work. Advanced biomechanical assessment techniques such as electromyography and three-dimensional motion analysis were not utilised, and inter-rater reliability of visual assessment was not formally evaluated. Future studies should employ larger, randomly selected samples, longitudinal designs, and advanced biomechanical techniques to better understand the natural progression and clinical implications of asymptomatic scapular dyskinesia in Generation Z.

5. CONCLUSION

Scapular dyskinesia was prevalent in 78.0% of apparently healthy Generation Z individuals, confirming that it commonly exists as a subclinical movement dysfunction in the absence of pain or functional limitation. The SDT identified a higher number of cases of dyskinesia than the LSST, underscoring the importance of dynamic over static assessment. Right- and left-side LSST measurements differed significantly ($p < 0.001$), and males showed significantly greater asymmetry than females at 90°

abduction (p = 0.002), while overall prevalence did not differ by gender (p = 1.000). These findings support the integration of movement-based screening tools into preventive physiotherapy practice for young non-clinical populations.

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