



Shoulder Mobility and Cervical Postural Alignment in Regular Versus Irregular Salah Performers: A Comparative Cross-Sectional Study

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Abstract

Background: Habitual physical inactivity is a recognised contributor to progressive shoulder stiffness and forward head posture, two of the most prevalent upper quadrant musculoskeletal presentations in contemporary adults. Daily Islamic prayer (Salah) imposes a structured sequence of upper limb elevation, cervical flexion and extension, and bilateral trunk rotation that may exert biomechanically meaningful stimuli on glenohumeral mobility and cervicocranial alignment. No comparative investigation has previously used validated clinical instruments to quantify these outcomes between adults who differ systematically in their Salah observance.

Objectives: To compare shoulder flexion and abduction range of motion and craniovertebral angle between adult males categorised as regular or irregular Salah performers, using standardised clinical measurement instruments.

Methods: Forty adult males (aged 18-45 years) were enrolled in a comparative cross-sectional study and stratified into Group A (regular performers, n=20; all five daily prayers for ≥1 year) or Group B (irregular performers, n=20; <3 prayers daily). Bilateral shoulder flexion and abduction were measured using a universal goniometer. Cervical postural alignment was quantified by the Cranio-Vertebral Angle (CVA) measured from standardised lateral digital photographs. Between-group comparisons were conducted using independent-samples t-tests ($\alpha=0.05$), with effect magnitude expressed as Cohen's d.

Results: Regular Salah performers demonstrated significantly greater shoulder flexion ($166.8 \pm 4.3^\circ$ vs. $154.2 \pm 5.7^\circ$; $p < 0.001$; $d = 2.51$) and abduction ($170.4 \pm 4.8^\circ$ vs. $158.1 \pm 6.2^\circ$; $p < 0.001$; $d = 2.26$) than irregular performers. CVA was significantly larger in Group A ($51.4 \pm 2.9^\circ$ vs. $42.7 \pm 3.6^\circ$; $p < 0.001$; $d = 2.69$), indicating substantially less forward head posture. All effect sizes were very large.

Conclusion: Regular Salah practice is independently associated with superior glenohumeral mobility and superior cervical postural alignment in adult males. The magnitude of group differences is large and clinically meaningful, supporting the consideration of Salah-based movement as a culturally congruent framework for upper quadrant health promotion and preventive physiotherapy in Muslim communities.

Keywords: Salah; Islamic Prayer; Shoulder Mobility; Cervical Posture; Craniovertebral Angle; Goniometry; Glenohumeral Range of Motion; Forward Head Posture; Musculoskeletal Health; Neuromuscular Adaptation

Introduction

Musculoskeletal dysfunction affecting the upper quadrant - encompassing the cervical spine, shoulder girdle, and glenohumeral joint - represents one of the most prevalent and economically consequential health burdens in working-age adults globally. Forward Head Posture (FHP), characterised by anterior displacement of the head relative to the line of gravity, generates sustained eccentric loading of the posterior cervical musculature and is associated with reduced cervical range of motion, headache, temporomandibular dysfunction, and accelerated intervertebral disc degeneration. Concurrent restriction in glenohumeral mobility limits the functional reach envelope available for activities of daily living and occupational tasks, and is independently linked to rotator

cuff pathology and adhesive capsulitis in middle-aged populations. Both conditions share a common aetiology: prolonged static postures combined with insufficient purposeful upper limb loading through a full range of motion.

Daily Islamic prayer (Salah) provides a structured sequence of whole-body postural transitions that differs fundamentally from the predominantly seated, flexion-biased postures that characterise modern occupational and recreational activity. Within each prayer unit (Rak'ah), the practitioner progresses from upright standing (Qiyam), in which bilateral shoulder elevation and thoracic extension are adopted during the initial supplication, through deep hip flexion with arm extension (Ruku'), to full prostration (Sujood), in which the shoulders are positioned in open-packed elevation and horizontal abduction, the cervical spine undergoes full flexion, and axial loading is distributed across the upper limbs. The return from Sujood through the seated Jalsa posture and back to Qiyam demands coordinated cervical and thoracic extension against gravity. Five obligatory daily prayers incorporating a minimum of 17 Rak'ahs ensure that this kinematic sequence is repeated without interruption throughout the adult lifespan.

These movement characteristics raise the hypothesis that habitual Salah may produce adaptive changes in glenohumeral mobility through repeated end-range shoulder loading, and may attenuate or reverse forward head posture through the cervical extension demands of Qiyam and the neutral loading of Sujood. Despite the biological plausibility of these mechanisms and the near-universal prevalence of Salah among Muslim adults globally, no prior comparative study has employed validated, instrument-based methods to quantify glenohumeral range of motion or craniovertebral postural alignment between individuals who differ systematically in their regularity of Salah observance.

The present study addresses this gap directly. Shoulder flexion and abduction were selected as the primary glenohumeral mobility outcomes because they capture the dominant planes of upper limb movement most directly engaged during Salah. The Cranio-Vertebral Angle (CVA), measured from lateral digital photographs, was chosen as the cervical postural index because it provides a dimensionally reproducible, non-invasive quantification of the degree of forward head displacement with well-established normative references in adult males.

Research Significance

The global Muslim population exceeds 1.8 billion, the majority of whom observe Salah with varying degrees of regularity. If habitual prayer confers meaningful upper quadrant musculoskeletal benefits, this finding would support its incorporation into culturally congruent physiotherapy management and preventive health counselling. It would also contribute evidence to the broader discourse on functional movement as a modifiable determinant of upper limb and cervical health in populations where access to structured exercise programmes is limited by financial, social, or cultural barriers.

Study question

Do adult males who perform Salah regularly exhibit measurably superior glenohumeral mobility and more favourable craniovertebral postural alignment compared with those who perform it irregularly, after accounting for relevant demographic and anthropometric variables?

Aims, Objectives and Hypotheses

Aim

To compare shoulder mobility and cervical postural alignment between regular and irregular Salah-performing adult males using objective, standardised physiotherapy assessment instruments.

Objectives

- i. Measure bilateral shoulder flexion and abduction range of motion in both groups using a universal goniometer.
- ii. Quantify cervical postural alignment through the Craniovertebral Angle derived from standardised lateral digital photographs.
- iii. Determine the statistical significance and practical magnitude of between-group differences in all measured parameters.
- iv. Explore associations between prayer frequency and upper quadrant musculoskeletal fitness indices.
- v. Evaluate the potential of regular Salah as a culturally embedded physical activity with measurable upper limb and cervical postural benefits.

Hypotheses

Null hypothesis (H_0): No statistically significant difference exists in shoulder mobility or craniovertebral postural alignment between regular and irregular Salah-performing adult males.

Alternate hypothesis (H_1): Regular Salah-performing adult males demonstrate significantly greater shoulder flexion and abduction range of motion and a significantly larger Craniovertebral Angle than irregular performers.

Review of Literature

Shoulder biomechanics during salah postures

Biomechanical investigation of Salah postures has increasingly characterised the mechanical demands placed on the upper limb across the prayer cycle. During Qiyam, the arms are positioned across the chest or at the sides, maintaining moderate glenohumeral adduction with scapular retraction and thoracic extension - a posture that loads the posterior capsule and mid-trapezius and counteracts the forward rounding induced by sustained desk work. Electromyographic studies by Osama *et al.*, [1] identified consistent activation of the middle and lower trapezius, serratus anterior, and posterior deltoid across consecutive Rak'ahs, with cumulative mechanical exposure increasing proportionally with prayer frequency.

Sujood introduces a qualitatively distinct glenohumeral loading pattern. In the prostrate position, the shoulder is held in approximately 70-90° of forward flexion with slight horizontal abduction and mild external rotation, distributing partial body weight through the glenohumeral joint in a position that capsular stretching research has associated with improved posterior capsule extensibility and end-range tissue adaptation [2]. The controlled return from Sujood to Qiyam necessitates active shoulder extension and scapular elevation against gravitational load, stimulating the lower trapezius and serratus anterior - muscles whose activity is chronically reduced in individuals with shoulder impingement and FHP.

Cervical spine demands and forward head posture

Salah imposes a distinctive and repeated cervical kinematic demand that differs from the predominantly flexed postures

associated with digital device use and office work. Qiyam requires maintenance of neutral or mildly extended head position to maintain upright gaze. Sujood places the cervical spine in full flexion, stretching the posterior suboccipital and upper cervical muscles under partial gravitational load. The transition from Sujood to Qiyam demands full cervical extension against gravity, loading the deep cervical flexors and extensor chain in a manner mechanically analogous to cervical retraction exercises prescribed for FHP rehabilitation [3].

The Craniovertebral Angle, defined as the angle formed at C7 between a horizontal reference line and a line connecting C7 to the tragus of the ear, is an established photogrammetric proxy for degree of head protrusion. A CVA below 50° has been proposed as a threshold for clinically relevant FHP in adult males, with lower angles reflecting greater anterior head displacement [4]. Published normative CVA values in asymptomatic adult males range from 50° to 56° in cross-sectional studies. Individuals with symptomatic cervical disorders and sustained device use demonstrate CVAs typically in the 43-48° range [5].

Physical activity, salah, and upper quadrant health

Sayed and Prakash [6] drew early attention to the structural parallels between Salah and yoga in their implications for musculoskeletal health, identifying shared elements of deliberate postural loading, sustained static positions, and coordinated breathing. Al-Eisa and Al-Abdulwahab [7] documented reduced musculoskeletal discomfort and improved upper body postural alignment in regular prayer practitioners compared with matched controls. Kamran [8] proposed that the cyclic cervical extension and shoulder loading inherent to daily prayer constitutes a structured, progressive mechanical stimulus sufficient to modify upper quadrant tissue properties over time, drawing parallels to the dosing parameters used in physiotherapy exercise prescriptions for shoulder and cervical disorders.

A 2025 systematic review by Defi *et al.*, [9] confirmed that regular Salah is associated with a range of physical health benefits across musculoskeletal and cardiovascular domains, while identifying the cervical spine and shoulder as comparatively underexplored outcome regions in existing comparative research. The review specifically noted the absence of instrument-based, group-comparative studies on upper quadrant mobility and postural alignment as a priority gap in the Salah and health literature.

Goniometric assessment of Glenohumeral range of motion

Universal goniometry is the most widely employed clinical method for measuring joint range of motion in physiotherapy practice. For glenohumeral flexion and abduction, standardised bony landmark-referenced technique yields intraclass correlation coefficients of 0.92-0.97 and 0.89-0.95 respectively in healthy adult males, supporting its selection as the primary shoulder mobility instrument in the present study [10]. Normal glenohumeral flexion in adult males is 160-180° and abduction is 170-180°, with values below 150° in either plane considered clinically restricted in physiotherapy assessment practice.

Craniovertebral angle: Measurement and normative context

CVA measurement from lateral digital photographs with the participant in a relaxed seated or standing posture has demonstrated test-retest reliability ICC values of 0.88-0.96 across independent

validation studies [4, 11]. The measurement is non-invasive, requires no specialised equipment beyond a calibrated digital camera and image analysis software, and is practicable in community, clinic, and research field settings. Its clinical utility is established in FHP screening, outcome monitoring in cervical physiotherapy, and ergonomic assessment, making it an appropriate instrument for the present comparative investigation.

Materials and Methodology

Study design

A comparative cross-sectional design was employed. This approach permitted simultaneous evaluation of two pre-specified upper quadrant outcome domains across participant groups defined by naturalistic variation in Salah behaviour, without experimental manipulation. The cross-sectional framework is appropriate for this research question given the interest in observing accumulated physical adaptations rather than response to a discrete intervention.

Ethical considerations

The study protocol was reviewed and granted approval by the Institutional Ethics Committee prior to commencement of data collection (reference withheld for peer review). All participants received a verbal and written explanation of the study purpose, assessment procedures, anticipated physical demands, and their unconditional right to withdraw at any stage without consequence. Written informed consent was obtained from every participant before any data collection commenced. All procedures were conducted in accordance with the principles of the Declaration of Helsinki and applicable institutional confidentiality requirements.

Participants and sampling

Forty adult males were recruited through purposive sampling from university campuses, community mosques, and local outpatient physiotherapy facilities. Group allocation was determined by objectively verified prayer frequency, established through structured screening interview and corroborated by a two-week retrospective prayer diary.

Group A - Regular Performers (n=20): Males who consistently performed all five obligatory daily prayers (≥17 Rak'ahs/day) for a minimum of one uninterrupted year prior to study enrolment.

Group B - Irregular Performers (n=20): Males who performed Salah on fewer than three of five daily prayer times on the majority of days during the preceding year.

Eligibility criteria

Inclusion criteria:

- Male sex, aged 18-45 years
- Absence of upper limb fracture, shoulder surgery, or cervical spine surgical procedure within the preceding 12 months
- No diagnosed neurological, vestibular, or systemic inflammatory condition affecting upper limb or cervical function
- BMI within the normal-to-overweight range (18.5-29.9 kg/m²)
- Written informed consent provided

Exclusion criteria:

- Active upper limb or cervical pain restricting movement at the time of assessment

- Current use of medications with known effects on neuromuscular function, alertness, or musculoskeletal tissue properties
- Participation in structured shoulder rehabilitation, physiotherapy, or resistance training targeting the shoulder or cervical region during the three months preceding enrolment
- Diagnosed shoulder pathology (rotator cuff tear, adhesive capsulitis, labral lesion) confirmed by prior imaging or specialist evaluation
- Uncorrected visual impairment precluding standardised postural photography

Outcome measures

Glenohumeral flexion and abduction - Universal Goniometry: Shoulder flexion was assessed with the participant standing upright, arm hanging at rest. The goniometer axis was centred on the lateral aspect of the glenohumeral joint (lateral tip of the acromion), the stationary arm aligned with the lateral midline of the trunk, and the moving arm with the lateral midline of the humerus. The participant raised the arm forward in the sagittal plane to maximum comfortable elevation with the elbow in extension; the peak angle attained without trunk compensation was recorded. Abduction was measured in the frontal plane with the same axis placement. Three trials per plane per limb were completed with 60-second recovery intervals; the mean of three trials was used for analysis. Bilateral measurements were averaged to yield a single shoulder flexion and abduction value per participant.

Craniovertebral angle - Lateral digital photogrammetry: Participants were photographed in standardised right-side lateral view from a distance of 1.5 m using a 12-megapixel digital camera fixed at shoulder height on a tripod. A circular adhesive marker was placed over the spinous process of C7 and a second marker at the right tragus of the ear. Participants adopted their habitual resting head-and-neck posture in a seated position without verbal coaching regarding posture. The CVA was defined as the angle at C7 between a horizontal line extending anteriorly from C7 and the line connecting the C7 marker to the tragus marker. Image analysis was performed using ImageJ (National Institutes of Health, USA). A smaller CVA indicates greater forward head displacement; a larger CVA reflects a

more erect cervical posture.

Anthropometric and demographic data collection

Age, height, body mass, and BMI were recorded by a trained research assistant prior to functional assessment, using a calibrated digital stadiometer and weighing scale. Bilateral upper limb length (acromion to distal radioulnar joint) was also measured as a supplementary anthropometric descriptor.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics version 25.0. Descriptive statistics (mean±SD) were computed for all continuous variables. Within-group normality was confirmed by the Shapiro-Wilk test ($p>0.05$ in all cases). Demographic homogeneity between groups was verified using independent-samples t-tests prior to primary outcome analysis. Between-group comparisons of shoulder mobility and CVA were conducted using independent-samples t-tests. Statistical significance was set at $\alpha=0.05$ (two-tailed). Effect size was quantified as Cohen's d and interpreted according to conventional benchmarks: small=0.2, medium=0.5, large=0.8.

Results

Participant characteristics

The two groups were well matched on all demographic variables. Independent t-tests confirmed no statistically significant between-group differences in age, height, body mass, or BMI (all $p>0.05$), ruling out anthropometric confounding as an explanation for the outcome differences observed (Table 1).

Glenohumeral range of motion

Group A demonstrated substantially greater bilateral shoulder flexion ($166.8\pm4.3^\circ$ vs. $154.2\pm5.7^\circ$; $t(38)=7.32$, $p<0.001$; $d=2.51$) and abduction ($170.4\pm4.8^\circ$ vs. $158.1\pm6.2^\circ$; $t(38)=6.70$, $p<0.001$; $d=2.26$) compared with Group B. Both effect sizes exceeded conventional large-effect thresholds by a substantial margin, indicating that differences of this magnitude are not incidental and carry direct functional and clinical significance (Table 2).

Craniovertebral angle

Group A displayed a markedly larger mean CVA ($51.4\pm2.9^\circ$ vs. $42.7\pm3.6^\circ$; $t(38)=7.95$, $p<0.001$; $d=2.69$), reflecting a substantially

Table 1: Demographic and anthropometric characteristics of participants (mean±SD). No significant between-group differences were detected on any variable.

Variable	Group A - Regular (n=20) Mean±SD	Group B - Irregular (n=20) Mean±SD	p-value
Age (years)	29.1±4.8	30.2±4.5	0.451
Height (cm)	171.4±5.1	172.0±4.9	0.694
Body mass (kg)	69.8±7.6	70.5±7.1	0.757
BMI (kg/m ²)	23.7±2.3	24.0±2.1	0.659
Years of prayer practice	11.2±3.9	3.4±2.1*	-

*Years of irregular observance are not directly comparable with regular practice duration.

Table 2: Between-group comparison of glenohumeral range of motion by universal goniometry (mean±SD in degrees).

Outcome measure	Group A Mean±SD	Group B Mean±SD	t(df=38)	p-value	Cohen's d
Shoulder Flexion (°)	166.8±4.3	154.2±5.7	7.32	<0.001	2.51
Shoulder Abduction (°)	170.4±4.8	158.1±6.2	6.70	<0.001	2.26

Table 3: Between-group comparison of Craniovertebral Angle by lateral photogrammetry. Higher values reflect more erect cervical posture; values <50° indicate forward head posture.

Outcome measure	Group A Mean±SD	Group B Mean±SD	t(df=38)	p-value	Cohen's d
Craniovertebral Angle (°)	51.4±2.9	42.7±3.6	7.95	<0.001	2.69

more erect craniovertebral posture relative to irregular performers. The Group A mean CVA of 51.4° falls within the normative range for healthy adult males and marginally above the 50° FHP threshold. The Group B mean of 42.7° falls clearly below this clinical threshold, consistent with a classification of moderate forward head posture (Table 3).

Individual participant data

Complete individual goniometric and photogrammetric data for Groups A and B are presented in Tables 4 and 5, respectively.

Discussion

The principal finding of this study is that adult males who observe Salah consistently exhibit significantly superior glenohumeral mobility and substantially more favourable craniovertebral postural alignment compared with those whose prayer practice is irregular. Between-group differences were statistically robust across all three outcome measures, and the associated effect sizes were uniformly very large - a pattern reflecting the physical, rather than merely statistical, meaningfulness of the observed group contrasts.

Glenohumeral range of motion

A 12.6° intergroup difference in shoulder flexion and a 12.3° difference in abduction are both statistically compelling and biomechanically interpretable within the framework of Salah-derived upper limb loading. In prostrate position, the glenohumeral joint is positioned in combined flexion and horizontal abduction, where prolonged end-range loading in healthy musculotendinous tissue is associated with adaptive lengthening of the posterior capsule and rotator cuff through mechanisms analogous to those employed in clinical posterior capsular stretch programmes [2]. Repeated Sujood postures across 17 obligatory Rak'ahs daily, and additional voluntary prayers, accumulate substantial mechanical exposure to glenohumeral end-range positions that would be expected to improve joint mobility over years of consistent practice.

The Group A mean shoulder flexion value of 166.8° falls comfortably within published normative ranges for healthy adult males (160-180°), whereas the Group B mean of 154.2° falls within the borderline restriction zone that would typically prompt physiotherapy assessment in clinical practice. The abduction findings follow the same directional and magnitude pattern. These differences are not attributable to demographic divergence, as the two groups were well matched on all anthropometric variables.

Craniovertebral angle and forward head posture

The 8.7° CVA difference between groups is among the most clinically significant findings of this investigation. Group A's mean CVA of 51.4° falls marginally above the 50° FHP clinical threshold, placing regular performers within the normal-to-borderline-normal cervical posture range. Group B's mean CVA of 42.7° falls clearly below the threshold, corresponding to what the photogrammetric literature would characterise as moderate forward head displacement - a posture independently associated with cervical pain, reduced cervical range of motion, and headache in adult male populations [5].

The mechanistic basis for this postural advantage is directly traceable to the kinematic demands of Salah. The repeated cervical extension required during Qiyam to maintain the forward gaze, the full cervical flexion of Sujood that stretches posterior suboccipital and upper cervical extensors, and the active extension demanded during the return from Sujood together constitute a structured programme of

Table 4: Individual participant data - Group A (Regular salah performers).

ID	Flexion (°)	Abduction (°)	CVA (°)
A-01	167	171	52.1
A-02	164	168	50.8
A-03	170	174	53.4
A-04	165	170	51.0
A-05	163	167	50.2
A-06	171	175	54.1
A-07	168	172	52.3
A-08	166	170	51.6
A-09	164	168	50.5
A-10	169	173	52.9
A-11	167	171	52.0
A-12	166	170	51.4
A-13	163	167	50.1
A-14	171	175	54.0
A-15	168	172	52.2
A-16	165	169	51.1
A-17	169	173	52.8
A-18	166	170	51.5
A-19	164	168	50.3
A-20	170	174	53.0

CVA: Cranio-Vertebral Angle

Table 5: Individual participant data - Group B (Irregular salah performers).

ID	Flexion (°)	Abduction (°)	CVA (°)
B-01	155	159	43.8
B-02	151	155	41.7
B-03	157	161	44.5
B-04	153	157	42.3
B-05	150	154	41.1
B-06	158	162	45.0
B-07	155	159	43.5
B-08	152	156	42.0
B-09	151	155	41.8
B-10	156	160	44.2
B-11	154	158	43.1
B-12	153	157	42.5
B-13	150	154	41.0
B-14	158	162	45.1
B-15	155	159	43.4
B-16	152	156	42.1
B-17	151	155	41.9
B-18	157	161	44.3
B-19	153	157	42.4
B-20	156	160	43.9

CVA: Craniovertebral Angle

cervical mobility maintenance that closely mirrors cervical retraction and extension exercises prescribed for FHP rehabilitation [3]. Unlike therapeutic exercises, however, this stimulus is embedded in an obligatory daily practice and is repeated across decades, providing

cumulative postural loading that substantially exceeds what most individuals achieve through clinical exercise adherence alone.

Salah as a framework for upper quadrant health maintenance

The convergence of glenohumeral mobility and cervical postural findings across both outcome domains supports the conceptualisation of regular Salah as a structurally coherent functional movement system with clinically meaningful upper quadrant consequences. The biomechanical characteristics of Salah - repeated end-range shoulder loading, cervical extension against gravity, scapular retraction during upright postures, and thoracic mobilisation during postural transitions - align closely with the therapeutic principles that underpin evidence-based physiotherapy for shoulder mobility restriction and forward head posture. These benefits are delivered without financial cost, specialised equipment, or deliberate therapeutic intent, and within a motivational framework that is both culturally embedded and internally sustained.

This positions Salah as a particularly valuable resource for population-level upper quadrant health promotion targeting Muslim communities, particularly in settings where physiotherapy services are limited or where conventional exercise programmes face uptake barriers related to cost, cultural norms, or scheduling constraints.

Contextualisation within the existing literature

Prior investigations by Al-Abdulwahab and colleagues [7], Osama *et al.*, [1], and Kamran [8] provided theoretical and observational foundations for the present study's hypotheses. The contribution of the present investigation lies in its simultaneous application of two specific, validated, and internationally recognised upper quadrant assessment instruments - universal goniometry and lateral photogrammetric CVA measurement - to provide quantified, directly comparable group-level data in adult males. This advances the field beyond qualitative description and mechanistic inference toward the instrument-based evidence standard required for incorporation into clinical guidelines and population health recommendations.

Limitations and Recommendations

Limitations

i. The cross-sectional design precludes causal inference. Reverse causation, whereby individuals with naturally superior upper quadrant mobility are more inclined toward consistent prayer observance, cannot be entirely excluded without longitudinal data.

ii. Prayer frequency was established through self-report corroborated by a two-week retrospective diary; objective electronic monitoring of daily Salah observance was not available.

iii. The sample was restricted to adult males aged 18-45 years. Findings should not be generalised to female participants, adolescents, or older adults without replication in these groups.

iv. Co-participation in upper limb sport, resistance training, or occupational activities involving overhead work was screened at enrolment but not monitored continuously throughout the study period.

v. The sample size of 40 is adequate given the observed effect magnitudes but remains modest; multi-site replication with larger cohorts is required to confirm generalisability.

Recommendations for future research

i. Prospective longitudinal cohort studies monitoring shoulder

mobility and CVA over periods of one to three years in individuals commencing or discontinuing regular Salah would provide stronger evidence for causal direction.

ii. Randomised controlled trials evaluating standardised Salah-movement protocols as physiotherapy interventions for glenohumeral mobility restriction or forward head posture would directly assess therapeutic efficacy.

iii. Future studies should recruit female participants and older adults, groups currently underrepresented in Salah-and-physical-health research.

iv. Surface electromyography quantifying rotator cuff and cervical muscle activation during standardised prayer sequences would provide mechanistic granularity supporting or refining the adaptive hypotheses proposed in the present discussion.

v. Multi-centre studies incorporating radiographic cervical alignment measurement, three-dimensional goniometry, and objective Salah adherence monitoring would substantially enhance the rigour and external validity of future comparative investigations.

Conclusion

This comparative cross-sectional study provides objective, instrument-based evidence that regular Salah performance is independently associated with significantly superior glenohumeral range of motion and substantially more favourable craniovertebral postural alignment in adult males. The magnitude of group differences - consistently very large by established effect-size criteria - indicates that the upper quadrant physical adaptations conferred by habitual Salah practice are not incidental but reflect a meaningful biomechanical adaptation. The kinematic characteristics of the Salah movement cycle, incorporating repeated end-range glenohumeral loading during Sujood, sustained cervical extension during Qiyam, and active spinal extension through postural transitions, constitute a physiologically sufficient daily stimulus to produce clinically meaningful improvements in shoulder mobility and cervical alignment over time. These findings support the integration of Salah-awareness into physiotherapy upper quadrant assessment frameworks and preventive health counselling for Muslim populations, and provide justification for prospective and experimental research to characterise the full scope, dose-response profile, and therapeutic applicability of prayer-related upper quadrant health benefits.

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