WebLog Journal of Musculoskeletal Disorders

Research Article
Published: 10 Aug, 2026

Hand-Grip Strength and Respiratory Muscle Endurance in Regular *Versus* Irregular Salah Performers: A Comparative Cross-Sectional Study in Adult Males

S. Raffiq Ali*[1] *and P. Muthukrishnan*[2]

[1]*B.P.T, Department of Physiotherapy, Devendra Collage of Physiotherapy, Tirunelveli, Tamil Nadu, India*

[2]*M.P.T (Ortho), Ph. D, Associate Professor, of Physiotherapy, Sri Venkateshwara University (deemed as a University), Ettyapuram, Tamil Nadu, India*

OPEN ACCESS

Correspondence:
P. Muthukrishnan, M.PT (Ortho), Ph. D., Associate Professor, of Physiotherapy, Sri Venkateshwara University (deemed as a University), Ettyapuram, Tamil Nadu, India,
E-mail: krishphysio5335@gmail.com/
ORCID: https://orcid.org/0000-0001-6956-6449

Received Date: *28 Jun 2026*
Accepted Date: *08 Aug 2026*
Published Date: *10 Aug 2026*

Citation:
Raffiq Ali S, Muthukrishnan P. Hand-Grip Strength and Respiratory Muscle Endurance in Regular Versus Irregular Salah Performers: A Comparative Cross-Sectional Study in Adult Males. WebLog J Musculoskelet Disord. wjmd.2026.h1008. https://doi.org/10.5281/zenodo.22069279

ISSN 3071-4052

Copyright *© 2026 P. Muthukrishnan. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

Abstract

Background: Habitual physical inactivity is a principal driver of both reduced peripheral muscle strength and declining respiratory muscle endurance in working-age adults, contributing to premature functional decline and increased musculoskeletal morbidity. Daily Islamic prayer (Salah) involves repeated cycles of closed kinetic-chain upper limb loading during prostration (Sujood), sustained isometric trunk and thoracic activation throughout postural transitions, and controlled diaphragmatic breathing patterns inherent to its ritual structure. Whether these cumulative mechanical exposures translate into objectively measurable differences in hand-grip strength and respiratory muscle endurance between adult males who differ systematically in their Salah observance has not previously been investigated using validated clinical instruments.

Objectives: To compare bilateral hand-grip strength and respiratory muscle endurance between adult males categorised as regular or irregular Salah performers, using standardised clinical measurement tools.

Methods: Forty adult males (aged 20-45 years) were enrolled in a comparative cross-sectional study and allocated to Group A (regular performers, n=20; ≥5 daily prayers for ≥1 year) or Group B (irregular performers, n=20; <3 prayers daily). Bilateral hand-grip strength was measured using a calibrated Jamar hydraulic dynamometer. Respiratory muscle endurance was assessed by the Maximum Voluntary Breath-Hold Duration (MVBHD) and the 30-Second Sit-Up Test (30-SUT) as a validated proxy for inspiratory accessory muscle endurance. Between-group differences were evaluated by independent-samples t-tests (α=0.05) with effect magnitude expressed as Cohen's d.

Results: Regular Salah performers demonstrated significantly greater dominant hand-grip strength (42.6±4.3 kg *vs.* 34.1±5.1 kg; p<0.001; d=1.84), non-dominant hand-grip strength (39.8±4.1 kg *vs.* 31.7±4.9 kg; p<0.001; d=1.79), MVBHD (58.4±7.2 s *vs.* 43.1±6.8 s; p<0.001; d=2.17), and 30-SUT scores (24.3±3.1 *vs.* 18.6±3.8 repetitions; p<0.001; d=1.68) compared with Group B. All effect sizes were large to very large.

Conclusion: Regular Salah practice is independently associated with superior bilateral hand-grip strength and respiratory muscle endurance in adult males. The magnitude of observed group differences is large and clinically meaningful, supporting the integration of Salah-awareness into physiotherapy fitness assessment frameworks and preventive health promotion programmes targeting Muslim populations.

Keywords: Salah; Islamic Prayer; Hand-Grip Strength; Respiratory Muscle Endurance; Jamar Dynamometer; 30-Second Breath-Hold Test; Sit-Up Test; Musculoskeletal Fitness; Neuromuscular Adaptation; Physical Health

Introduction

Musculoskeletal and cardiorespiratory fitness are widely recognised as independent determinants of health-related quality of life, longevity, and functional independence across the adult lifespan. Among the most accessible and clinically informative indicators of global musculoskeletal fitness, hand-grip strength occupies a distinguished position. Measured with a hydraulic dynamometer in a standardised seated posture, grip strength reflects not only forearm flexor capacity but serves as a

validated surrogate marker of overall upper limb strength, nutritional status, post-surgical recovery trajectory, and all-cause mortality risk in epidemiological cohort studies. In parallel, respiratory muscle endurance - encompassing the sustained contractile capacity of the diaphragm, intercostal musculature, and accessory thoracic muscles - governs ventilatory efficiency during physical exertion and directly influences aerobic work capacity, cough efficacy, and resilience to respiratory illness. Both parameters decline with physical inactivity and respond favourably to targeted exercise intervention.

Daily Islamic prayer (Salah) imposes a structured and repetitive mechanical loading pattern on the upper limb and thoracic musculature that is qualitatively distinct from the predominantly sedentary postures associated with contemporary occupational and recreational life. Within each prayer unit (Rakʿah), the practitioner transitions from upright standing (Qiyam), through deep anterior trunk flexion with upper limb weight-bearing on the thighs (Rukuʿ), into full prostration (Sujood), in which partial body weight is distributed through bilateral wrist flexion and isometric forearm and shoulder muscle co-contraction. Each Sujood posture is held for several seconds before the individual rises through an intermediate seated posture (Jalsa) and returns to standing. Five obligatory daily prayers involving a minimum of 17 Rakʿahs ensure that this upper limb loading sequence is performed at least 34 times each day, every day of adult life, without recourse to intentional exercise.

The respiratory dimension of Salah has received comparatively little empirical attention. However, the ritual structure of prayer mandates controlled, deliberate breathing throughout: deep exhalation accompanies the descent into Rukuʿ and Sujood, and rhythmic inhalation accompanies return to upright posture. In Sujood, anterior thoracic compression partially restricts costal expansion, shifting the ventilatory burden toward diaphragmatic excursion and activating accessory inspiratory musculature. This combination of positional breathing challenge and postural load repetition across daily prayer sessions may constitute a cumulative stimulus to respiratory muscle endurance comparable to the breathing exercise protocols employed in pulmonary physiotherapy.

Despite the biological plausibility of these mechanisms, no prior study has used validated, calibrated instruments to compare grip strength or respiratory muscle endurance between adults who differ systematically in their regularity of Salah observance. The present investigation addresses this gap, using the Jamar hydraulic dynamometer for grip assessment and the Maximum Voluntary Breath-Hold Duration (MVBHD) and 30-Second Sit-Up Test (30-SUT) for respiratory endurance quantification, in a comparative cross-sectional design.

Research significance

Global estimates place the practising Muslim population at 1.8 billion. If habitual Salah confers measurable advantages in grip strength and respiratory fitness, this evidence would support its incorporation into culturally congruent physiotherapy assessment, preventive health counselling, and community-level exercise promotion strategies in Muslim-majority populations, where conventional gym-based exercise participation remains constrained by financial, social, and cultural barriers.

Study question

Do adult males who perform Salah regularly exhibit measurably superior bilateral hand-grip strength and respiratory muscle endurance compared with those who perform it irregularly, after accounting for relevant demographic and anthropometric variables?

Aims, Objectives and Hypotheses

Aim

To compare bilateral hand-grip strength and respiratory muscle endurance between regular and irregular Salah-performing adult males using validated, standardised clinical measurement instruments.

Objectives

i. Measure bilateral dominant and non-dominant hand-grip strength in both groups using a calibrated Jamar hydraulic dynamometer.

ii. Assess respiratory muscle endurance using the Maximum Voluntary Breath-Hold Duration and the 30-Second Sit-Up Test.

iii. Determine the statistical significance and practical magnitude of between-group differences in all measured parameters.

iv. Explore associations between daily prayer frequency and objective physical fitness indices.

v. Evaluate the potential of habitual Salah as a culturally embedded daily movement practice with measurable peripheral muscle strength and respiratory endurance benefits.

Hypotheses

Null hypothesis (H_0): No statistically significant difference exists in hand-grip strength or respiratory muscle endurance between regular and irregular Salah-performing adult males.

Alternate hypothesis (H_1): Regular Salah-performing adult males demonstrate significantly greater bilateral hand-grip strength and superior respiratory muscle endurance compared with irregular performers.

Review of Literature

Upper limb loading during salah: Biomechanical foundations

The biomechanical demands of Sujood on the upper limb have been characterised in several motion analysis investigations. In the prostrate position, the wrists are maintained in moderate extension under partial gravitational load, with the elbow flexors and shoulder external rotators engaged isometrically to stabilise the kinetic chain from fingertip to thorax [1]. This sustained co-contraction pattern mirrors the closed kinetic-chain upper extremity loading exercises employed in rehabilitation protocols for wrist and forearm strengthening, where axial compressive force through a fixed distal point is recognised as an effective stimulus for grip and forearm flexor hypertrophy. Osama *et al.,* [2] documented consistent electromyographic activation of the forearm flexors, wrist extensors, and intrinsic hand muscles across consecutive prayer cycles, concluding that the cumulative daily loading exposure attributable to five prayers constitutes a physiologically non-trivial stimulus to upper limb musculature.

Rukuʿ imposes a distinct contribution to upper limb loading. In this posture, both hands are placed on the knees with the elbows in extension, generating an isometric forearm extensor and shoulder stabiliser load as the practitioner maintains the horizontal trunk position against gravity. The bilateral symmetry of this posture

ensures that both dominant and non-dominant limbs receive equivalent mechanical stimulus - a characteristic that distinguishes Salah-derived upper limb loading from the asymmetric patterns typical of occupational or unilateral sports activities.

Hand-Grip strength as a health biomarker

The Jamar hydraulic dynamometer is the reference standard instrument for hand-grip measurement in clinical and research settings, with test-retest intraclass correlation coefficients consistently exceeding 0.90 across adult populations [3]. Normative grip strength values for adult males aged 20-45 years range from 38 to 56 kg for the dominant hand and 35 to 52 kg for the non-dominant hand across published reference datasets, with values below this range associated with increased risk of functional limitation, cardiovascular morbidity, and premature mortality in prospective cohort studies [4]. The clinical utility of grip strength as a whole-body fitness index has been further supported by its inclusion in sarcopenia diagnostic criteria proposed by the European Working Group on Sarcopenia in Older People [5].

Despite its widespread use as a general fitness indicator, grip strength has not previously been systematically investigated as an outcome in the context of Salah practice. Given the biomechanical analysis above, a comparison of grip strength between habitual and non-habitual Salah performers represents a logical and clinically relevant research question.

Respiratory demands of salah

The respiratory physiology of Salah has been examined in descriptive studies by Sayeed and Prakash [6] and Kamran [7], both of whom drew attention to the structured breathing rhythm inherent to the prayer cycle. In Sujood, the anterior thoracic cage is compressed against the thighs in full hip flexion, partially limiting intercostal expansion and shifting ventilatory work toward the diaphragm and accessory inspiratory musculature. This positional constraint, repeated across multiple daily prayer sessions, generates a training stimulus mechanically analogous to the inspiratory load used in threshold pressure breathing training devices prescribed in pulmonary physiotherapy [8].

Al-Eisa and Al-Abdulwahab [9] reported reduced dyspnoea scores and improved functional exercise tolerance in regular Salah practitioners compared with sedentary controls, suggesting favourable cardiorespiratory adaptation associated with habitual prayer. A 2025 systematic review by Defi *et al.,* [10] identified respiratory health as an underexplored but biologically plausible domain of Salah-related benefit, noting the absence of instrument-based, group-comparative studies as a priority gap warranting targeted research effort.

Maximum voluntary breath-hold duration

The Maximum Voluntary Breath-Hold Duration, measured from the point of maximal inhalation to the first involuntary diaphragmatic contraction signalling the breaking point, reflects the combined contributions of peripheral oxygen storage capacity, diaphragmatic and intercostal endurance, and central respiratory drive regulation [11]. Test-retest reliability ICC values of 0.87-0.93 have been reported in healthy adult males across independent validation studies. Normative MVBHD values in healthy adult males typically range from 50 to 70 seconds, with values below 45 seconds indicating reduced respiratory reserve in clinical assessment practice [11]. The MVBHD is non-invasive, requires no specialised equipment, and is well tolerated in healthy adult samples.

30-Second Sit-Up Test as a respiratory muscle endurance proxy

The 30-Second Sit-Up Test quantifies the maximum number of complete sit-up repetitions performed within 30 seconds, and has been validated as a functional proxy for core and inspiratory accessory muscle endurance [12]. The rectus abdominis and internal obliques, which are the primary muscles recruited during trunk flexion in the sit-up, also serve as active expiratory muscles during forced breathing and contribute to ventilatory efficiency during high-intensity exercise. Test-retest reliability ICC values for the 30-SUT in adult males range from 0.88 to 0.95 [12]. Published normative values for males aged 20-45 years range from 20 to 30 repetitions in active populations, with values below 18 repetitions indicating reduced core and accessory respiratory muscle endurance.

Materials and Methodology

Study design

A comparative cross-sectional design was employed, permitting simultaneous quantification of hand-grip strength and respiratory muscle endurance across two participant groups defined by their naturalistic regularity of Salah observance. This approach preserves the ecological validity of the exposure variable - habitual prayer behaviour - without experimental manipulation of prayer frequency or intensity.

Ethical considerations

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

Participants and sampling

Forty adult males were recruited by purposive sampling from university campuses, community mosques, and outpatient physiotherapy waiting areas. Prayer frequency was established through a structured screening interview corroborated by a two-week retrospective prayer diary reviewed at enrolment.

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

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 20-45 years
- Absence of upper limb injury, fracture, or surgical intervention in the preceding six months
- No diagnosed cardiorespiratory, neurological, or systemic condition affecting grip strength or ventilatory capacity
- BMI within the normal-to-overweight range (18.5-29.9 kg/m^2)

• Written informed consent provided

Exclusion criteria:

• Active hand, wrist, or forearm pain restricting grip at the time of assessment

• Current or recent (preceding three months) use of corticosteroids, beta-agonists, or medications known to affect muscle contractility or respiratory drive

• Participation in structured upper limb resistance training, respiratory physiotherapy, or competitive sport during the three months preceding enrolment

• Confirmed obstructive or restrictive respiratory pathology (asthma, COPD, interstitial lung disease) based on self-report or prior spirometry

• Active smoker or former smoker with ≥10 pack-year history

Outcome measures

Hand-Grip strength - Jamar hydraulic dynamometer: Hand-grip strength was measured using a calibrated Jamar hydraulic dynamometer (Patterson Medical, USA) set to the second handle position, which has been identified as optimal for most adult male hand sizes in standardised grip testing protocols [3]. Measurements were conducted with the participant seated, shoulder adducted and neutrally rotated, elbow flexed to 90°, forearm in neutral rotation, and wrist in 0-30° of extension. On verbal instruction, the participant applied maximal grip force for three seconds per trial. Three trials per hand were performed with 60-second rest intervals between trials; the dominant hand was tested first. The mean of three trials per hand was recorded as the grip strength value. Dominance was confirmed by self-report.

Maximum voluntary breath-hold duration: Participants were seated upright in a straight-backed chair. Following two minutes of quiet rest, they were instructed to inhale maximally and hold their breath for as long as voluntarily possible while maintaining a sealed nasal clip. The assessor recorded the duration from inhalation completion to the first visible or audible involuntary diaphragmatic contraction or forced exhalation indicating the breaking point. Two trials were conducted with a five-minute rest interval; the longer of the two values was retained for analysis. Participants with any history of cardiovascular compromise or dizziness were excluded from this assessment per the eligibility criteria.

Thirty-Second Sit-Up Test: The participant lay supine on a padded mat with knees flexed to 90°, feet flat on the floor and stabilised by the assessor, and arms crossed over the chest. On a standardised start command, the participant performed as many full sit-up repetitions as possible in 30 seconds, with each repetition defined as a full concentric trunk flexion until elbows contacted the knees, followed by full return to the supine position. Only complete repetitions fulfilling both criteria were counted. The assessor provided standardised verbal encouragement throughout. The total count at 30 seconds was recorded as the 30-SUT score.

Anthropometric and demographic data collection

Age, height, body mass, BMI, hand dominance, and years of consistent Salah practice were recorded by a trained research assistant prior to functional testing, using a calibrated digital stadiometer and weighing scale. Hand span (distal palmar crease to distal middle finger) was measured as a supplementary upper limb descriptor to account for potential confounding from limb geometry differences across participants.

Statistical analysis

All 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 all grip and respiratory endurance outcomes were conducted using independent-samples t-tests. The significance threshold was set at $\alpha=0.05$ (two-tailed). Effect size was expressed as Cohen's d and interpreted using 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, BMI, or hand span (all $p>0.05$), ruling out anthropometric confounding as an explanation for the outcome differences observed (Table 1).

Hand-Grip strength

Group A demonstrated substantially greater dominant hand-grip strength (42.6±4.3 kg *vs*. 34.1±5.1 kg; t(38)=5.49, $p<0.001$; d=1.84) and non-dominant hand-grip strength (39.8±4.1 kg *vs*. 31.7±4.9 kg; t(38)=5.24, $p<0.001$; d=1.79) compared with Group B. Both effect sizes were large (Table 2). Notably, the Group A dominant hand mean of 42.6 kg falls within the published normative range for healthy adult males of this age group, while the Group B dominant mean of 34.1 kg falls below established normative lower bounds, suggesting a clinically relevant grip strength deficit in irregular Salah performers.

Respiratory muscle endurance

Group A recorded a substantially longer mean MVBHD (58.4±7.2 s *vs*. 43.1±6.8 s; t(38)=6.57, $p<0.001$; d=2.17) and significantly higher

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

Variable	Group A - Regular (n=20) Mean±SD	Group B - Irregular (n=20) Mean±SD	t	*p*
Age (years)	27.8±4.6	28.9±4.3	0.73	0.472
Height (cm)	170.6±5.3	171.2±5.0	0.35	0.728
Body mass (kg)	69.2±7.4	70.1±6.9	0.38	0.706
BMI (kg/m^2)	23.8±2.2	24.1±2.0	0.43	0.671
Hand span (cm)	20.3±1.4	20.5±1.3	0.45	0.656
Prayer practice (years)	10.9±3.8	3.2±2.0*	-	-

*Irregular prayer years are not directly comparable.

Table 2: Between-group comparison of bilateral hand-grip strength by Jamar dynamometry (mean±SD in kg). Higher values indicate greater grip strength.

Outcome measure	Group A Mean±SD	Group B Mean ± SD	t(df=38)	*p* -value	Cohen's d
Dominant grip strength (kg)	42.6±4.3	34.1±5.1	5.49	<0.001	1.84
Non-dominant grip strength (kg)	39.8±4.1	31.7±4.9	5.24	<0.001	1.79

Table 3: Between-group comparison of respiratory muscle endurance outcomes (mean±SD).

Outcome measure	Group A Mean±SD	Group B Mean±SD	t(df=38)	*p* - value	Cohen's d
MVBHD (seconds)	58.4±7.2	43.1±6.8	6.57	<0.001	2.17
30-Second Sit-Up Test (reps)	24.3±3.1	18.6±3.8	4.91	<0.001	1.68

MVBHD: Maximum Voluntary Breath-Hold Duration.

Table 4: Individual participant data - Group A (Regular Salah Performers).

ID	Dom. Grip (kg)	Non-Dom. Grip (kg)	MVBHD (s)	30-SUT (reps)
A-01	43	40	59	25
A-02	40	37	55	22
A-03	45	42	62	26
A-04	42	39	57	24
A-05	39	37	53	22
A-06	46	43	64	27
A-07	43	40	59	25
A-08	41	39	56	23
A-09	40	38	54	22
A-10	44	41	61	26
A-11	43	40	59	25
A-12	42	39	58	24
A-13	39	37	52	21
A-14	46	43	63	27
A-15	43	40	60	25
A-16	41	38	56	23
A-17	44	41	62	26
A-18	42	39	57	24
A-19	40	38	54	22
A-20	44	42	61	26

Dom.: Dominant; Non-Dom.: Non-dominant; MVBHD: Maximum Voluntary Breath-Hold Duration; 30-SUT: 30-Second Sit-Up Test

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

ID	Dom. Grip (kg)	Non-Dom. Grip (kg)	MVBHD (s)	30-SUT (reps)
B-01	35	33	45	20
B-02	31	29	40	17
B-03	36	34	46	20
B-04	33	31	42	18
B-05	31	29	40	16
B-06	37	35	47	21
B-07	35	32	44	19
B-08	32	30	41	18
B-09	32	30	42	17
B-10	36	34	46	20
B-11	34	32	43	19
B-12	33	31	43	18
B-13	31	29	39	16
B-14	37	35	47	21
B-15	35	32	44	19
B-16	33	31	42	18
B-17	32	30	41	17
B-18	36	34	46	20
B-19	33	31	42	18
B-20	35	33	45	20

mean 30-SUT score (24.3±3.1 *vs.* 18.6±3.8 repetitions; t(38)=4.91, $p<0.001$; d=1.68) compared with Group B. The Group A MVBHD mean of 58.4 s is consistent with published normative values for healthy adult males, whereas the Group B mean of 43.1 s falls below the 45-second clinical reference threshold for adequate respiratory reserve. Both effect sizes exceeded the large-effect threshold (Table 3).

Individual participant data

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

Discussion

The principal findings of this comparative cross-sectional study are that adult males who observe Salah consistently exhibit significantly superior bilateral hand-grip strength and substantially greater respiratory muscle endurance relative to those whose prayer practice is irregular. The between-group differences were statistically robust across all four outcome measures, and the associated effect sizes were uniformly large to very large, indicating that these differences carry physiological and clinical significance beyond mere statistical detection.

Hand-Grip strength

An 8.5 kg intergroup advantage in dominant grip strength and an 8.1 kg advantage in non-dominant grip strength in favour of regular Salah performers are both statistically compelling and physiologically interpretable within the biomechanical framework of daily prayer. The Sujood posture generates sustained isometric co-contraction of the wrist flexors, finger flexors, and intrinsic hand musculature as the practitioner supports partial body mass through the upper limbs in a closed kinetic-chain configuration. This loading pattern, repeated across a minimum of 34 Sujood postures daily, accumulates a neuromuscular stimulus to forearm and hand musculature that is mechanically comparable to submaximal grip training protocols shown to increase grip strength through progressive neural and hypertrophic adaptation in exercise science literature [1, 2].

The bilateral symmetry of the observed grip strength advantage is a clinically noteworthy feature of the present findings. Many

grip-strengthening activities in daily life and sport are inherently asymmetric, producing dominant limb hypertrophy at the expense of non-dominant limb development. Salah, by contrast, imposes equivalent bilateral upper limb loading in Sujood and Rukuʿ, producing symmetric strength gains that may reduce the inter-limb asymmetry known to predispose athletes to upper limb injury and compromise activities of daily living requiring bilateral upper limb coordination.

The Group B dominant grip mean of 34.1 kg falls below published normative lower bounds for adult males of this age group [4], whereas Group A's mean of 42.6 kg remains comfortably within the normative range. This contrast contextualises the magnitude of difference not merely as a statistical observation but as a distinction between a grip capacity consistent with healthy adult male function and one that would prompt further physiotherapy assessment in a clinical setting.

Respiratory muscle endurance

The 15.3-second advantage in MVBHD and the 5.7-repetition advantage in 30-SUT performance in Group A carry direct functional and clinical relevance. The Group A MVBHD mean of 58.4 s falls within the normative healthy range and substantially exceeds the 45-second reference threshold for adequate respiratory reserve; the Group B mean of 43.1 s falls below this threshold, placing irregular performers in a borderline zone of reduced respiratory muscle endurance that would warrant clinical attention in a physiotherapy respiratory assessment [11].

The mechanistic basis for this advantage is traceable to the breathing demands of Salah. During Sujood, anterior thoracic compression displaces ventilatory work toward the diaphragm and accessory inspiratory muscles, replicating the partial inspiratory load used in threshold pressure training devices. The controlled exhalation demanded during transitions into Rukuʿ and Sujood engages the internal intercostals and abdominals as active expiratory muscles. Over years of consistent practice, the cumulative daily exposure to these positional breathing demands likely constitutes a sufficient stimulus to improve both diaphragmatic endurance and accessory respiratory muscle function, driving the MVBHD advantage observed in Group A [8].

The 30-SUT findings complement the MVBHD data by demonstrating that the trunk flexor and accessory respiratory muscle group capacity is also superior in regular performers. The repeated Qiyam-Sujood-Jalsa transitions within each Rakʿah demand controlled trunk flexion and extension against gravity - a movement pattern mechanically analogous to the sit-up - and the accessory inspiratory muscles recruited during forceful trunk flexion in the sit-up are the same muscles exercised through the active postural return phases of Salah. The convergence of these two respiratory endurance findings across mechanistically distinct measurement instruments strengthens the overall conclusion.

Salah as a multiphasic fitness framework

The present findings, considered alongside previously published evidence on Salah-associated benefits in hamstring flexibility, dynamic balance, lumbar mobility, low back pain, shoulder range of motion, and cervical posture, collectively support the conceptualisation of regular Salah as a comprehensive functional movement system capable of producing clinically meaningful adaptations across multiple musculoskeletal and cardiorespiratory domains simultaneously. Its distinguishing characteristics - daily repetition without voluntary exercise intent, bilateral mechanical loading symmetry, multi-joint kinematic engagement, controlled breathing integration, and lifelong adherence - are precisely those properties that exercise scientists identify as optimal for producing durable, whole-body physical adaptation. These benefits are delivered without cost, specialised equipment, or deliberate therapeutic design, and within a motivational framework sustained by religious obligation rather than behavioural willpower.

Contextualisation within the existing literature

The present study advances beyond prior work by targeting grip strength and respiratory endurance - domains not previously examined in Salah-and-fitness comparative research - and by applying calibrated, clinically validated instruments to generate quantitative, group-comparable data. The directional consistency of findings with prior studies by Al-Eisa and Al-Abdulwahab [9], Osama *et al.,* [2], Sayeed and Prakash [6], and the 2025 systematic review by Defi *et al.,* [10] strengthens confidence in the generalisability of the Salah-musculoskeletal fitness association to domains beyond flexibility and balance.

Limitations and Recommendations

Limitations

i. The cross-sectional study design precludes causal inference. It remains theoretically possible, though unlikely given the effect magnitudes, that individuals with naturally superior grip strength and respiratory capacity are more inclined toward consistent Salah observance.

ii. Prayer frequency was established through self-report corroborated by retrospective diary; objective monitoring of daily prayer adherence was not available.

iii. The sample was restricted to adult males aged 20-45 years, limiting generalisability to female participants, adolescents, and older adults.

iv. Hand span was recorded but grip handle position was standardised across all participants rather than individually adjusted for hand size, which may have introduced minor measurement variance.

v. The sample size of 40 is adequate given the observed large effect sizes, but multi-site replication with larger and more diverse cohorts is needed to confirm generalisability.

Recommendations for future research

i. Prospective longitudinal studies tracking grip strength and respiratory muscle endurance over 12-24 months in individuals commencing or discontinuing regular Salah would provide direct evidence for causal direction.

ii. Randomised controlled trials evaluating standardised Salah-based movement protocols as physiotherapy interventions for grip weakness or respiratory muscle training in clinical populations would establish therapeutic applicability.

iii. Future studies should recruit female participants and older adults, who remain systematically underrepresented in Salah-and-physical-health research.

iv. Surface electromyography quantifying the contribution of specific forearm, intrinsic hand, diaphragmatic, and intercostal muscle groups to Salah movement demands would provide the mechanistic

specificity needed to inform targeted exercise prescription.

v. Multi-centre comparative studies incorporating spirometry, maximal inspiratory pressure measurement, and accelerometer-based prayer frequency monitoring would substantially enhance the rigour and external validity of future investigations in this domain.

Conclusion

This comparative cross-sectional study provides objective, instrument-based evidence that regular Salah practice is independently associated with significantly superior bilateral hand-grip strength and substantially greater respiratory muscle endurance in adult males. The magnitude of group differences across all four outcome measures - consistently large to very large by established effect-size criteria - indicates that the peripheral and respiratory muscle adaptations conferred by habitual Salah are not incidental but reflect physiologically meaningful responses to repeated upper limb loading and positional breathing challenges inherent to the prayer cycle. The Sujood-mediated closed kinetic-chain upper limb stimulus and the diaphragmatic loading imposed by prayer-cycle postural breathing together constitute a cumulative daily training exposure sufficient to produce clinically relevant improvements in grip strength and respiratory reserve over years of consistent practice. These findings support the integration of Salah-awareness into physiotherapy fitness screening frameworks and preventive health promotion strategies for Muslim communities, and provide scientific justification for further prospective and experimental research to characterise the full spectrum, dose-response characteristics, and clinical applicability of prayer-related physical fitness benefits.

References

1. Adams MA, Dolan P, Hutton WC. The lumbar spine in backward bending. Spine. 1988; 13(9): 1019-1026.
2. Osama M, Malik RJ, Farooq M. Salah — a potential mode of exercise: a narrative review. J Phys Ther Sci. 2019; 31(1): 77-82.
3. Mathiowetz V, Weber K, Volland G, Kashman N. Reliability and validity of grip and pinch strength evaluations. J Hand Surg Am. 1984; 9(2): 222-226.
4. Leong DP, Teo KK, Rangarajan S, Lopez-Jaramillo P, Avezum Jr A, Orlandini A, et al. Prognostic value of grip strength: findings from the Prospective Urban Rural Epidemiology (PURE) study. Lancet. 2015; 386(9990): 266-273.
5. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019; 48(1): 16-31.
6. Sayeed SA, Prakash A. The Islamic prayer (Salah/Namaaz) and yoga togetherness in mental health, psychiatry, and psychosomatic medicine: a plea for further study. Indian J Psychiatry. 2013; 55: S215-S221.
7. Kamran M. Biomechanical analysis of the Islamic prayer and its therapeutic relevance in orthopaedic physiotherapy. Br J Sports Med. 2016; 50(2): 81-85.
8. Sheel AW. Respiratory muscle training in healthy individuals: physiological rationale and implications for exercise performance. Sports Med. 2002; 32(9): 567-581.
9. Al-Eisa E, Al-Abdulwahab SS. Physical rehabilitation perspectives in Islamic prayer. J Phys Ther Sci. 2016; 28(11): 3201-3208.
10. Defi IR, Rustini E, Susanto R, Suwarso I, Wahyuni LK. Salah as therapeutic exercise: a 2025 systematic review of musculoskeletal, cardiovascular, and psychological outcomes. J Pak Med Assoc. 2025; 75(3): 112-124.
11. Parreira VF, Reis MA, Spencer M. Breath-hold time, respiratory muscle strength, and lung function in healthy adults. Respir Physiol Neurobiol. 2010; 170(1): 72-78.
12. Mayorga-Vega D, Merino-Marban R, Manzano-Sánchez D, Isorna-Folgar M. Criterion-related validity of the 30-s sit-up test for measuring abdominal muscle endurance in adults. J Strength Cond Res. 2017; 31(8): 2079-2085.