

OCCUPATIONAL VARIATIONS IN HAND GRIP STRENGTH AND WRIST RANGE OF MOTION AMONG FEMALES: A COMPARATIVE STUDY

Mohammad Hammad Khan¹, Sakshi Arora^{2*}

¹U.G Student, Department of Physiotherapy, Galgotias University

²Assistant Professor, Department of Physiotherapy, Galgotias University India

*Corresponding Author: sakshiarora261099@gmail.com

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ABSTRACT

Background: Hand grip strength (HGS), wrist range of motion (ROM), and mean upper arm circumference (MUAC) are vital indicators of muscle strength, joint flexibility, and body composition, frequently utilized in assessing physical capabilities and health.

Aims: This study aimed to investigate disparities in HGS and wrist ROM among females in various occupations, and to explore the relationship between these variables, MUAC, and body mass index (BMI).

Settings and Design: The study involved 90 individuals from Bulandshahr, Dankaur, and nearby villages, employing a handheld dynamometer and goniometer for HGS and wrist ROM measurements, respectively. Anthropometric measurements including MUAC, height, weight, and BMI were also recorded.

Methods: Statistical analysis included comparisons of HGS, wrist ROM, MUAC, and BMI across different occupational groups, as well as correlation analyses between these variables.

Results: While HGS showed little variation among farmers, house-helps, and teachers, significant differences were observed in wrist ROM and MUAC. Positive correlations were found between HGS and BMI, as well as HGS and MUAC, particularly notable among farmers.

Conclusions: This study underscores the importance of HGS assessment in occupational health and rehabilitation programs, highlighting its relevance in evaluating physical fitness and overall well-being among female workers.

Keywords: Hand Grip Strength, Wrist ROM, MUAC, BMI

INTRODUCTION

Optimal hand function is a cornerstone of daily living, occupational performance, and autonomy in diverse domains of life. Two fundamental metrics of upper limb assessment—hand grip strength (HGS) and wrist range of motion (ROM)—are widely utilized in clinical and research settings to evaluate musculoskeletal health and functional capacity (Wei et al., 2023; Marshall et al., 1999; Chandrasekaran

et al., 2010). HGS not only serves as a proxy for upper limb strength; it is also recognized as an independent predictor of overall health, nutritional status, and risk for certain metabolic conditions (Wei et al., 2023; Chandrasekaran et al., 2010). The functional importance of wrist ROM, encompassing flexion, extension, radial deviation, and ulnar deviation, is evident in the performance of fine and

gross motor skills that are essential for specialized upper limb tasks (Marshall et al., 1999).

Distinct occupational demands exert unique biomechanical and physiological stresses, leading to significant variation in upper limb performance among working populations (Leyk et al., 2007). Professions requiring repetitive gripping, sustained static postures, or prolonged inactivity can affect grip strength, wrist mobility, and muscular endurance differently (Leyk et al., 2007). Importantly, previous research highlights that wrist ROM and grip strength can vary with forearm rotation and occupational activities, emphasizing the necessity of task-specific evaluations rather than relying solely on standardized positions (Marshall et al., 1999; Leyk et al., 2007).

Anthropometric parameters such as mean upper arm circumference (MUAC) and body mass index (BMI) play a critical role in determining muscle strength and joint mobility, offering a broader perspective on individual physical potential and adaptation (Chandrasekaran et al., 2010; Leyk et al., 2007). Integrating functional and anthropometric assessments provides a comprehensive picture of upper limb performance, potentially highlighting compensatory patterns or risks of overuse injuries (Chandrasekaran et al., 2010).

Despite the clinical and ergonomic implications of these metrics, comparative research focusing on HGS and wrist ROM among females in various professions—while also accounting for anthropometric factors—is limited. This knowledge gap is significant for guiding targeted interventions and ergonomic strategies to promote musculoskeletal health in working women (Leyk et al., 2007; Chandrasekaran et al., 2010).

This study aims to offer a comparative evaluation of HGS and wrist ROM in females across different professions, utilizing key measures such as HGS, wrist ROM, MUAC, and BMI. Such findings may inform profession-specific prevention and rehabilitation strategies, contributing to advancing occupational health and preventive care for women.

METHODOLOGY

Population

The study sampled 90 female participants from Bulandshahr, Dankaur, and neighboring villages in North India. Sample size was determined using Rao

software, ensuring statistical power for comparative occupational analysis. Ethical clearance and prior registration with the Clinical Trials Registry of India (CTRI) were obtained before the commencement of the study.

Inclusion Criteria

Participants were women aged 30–60 years engaged in farming, house-helping, or teaching for at least six years. This ensured professional comparability and minimization of confounding novice-level occupational exposure.

Exclusion Criteria

- The study excluded individuals with:
- Neurological disorders (e.g., Parkinson's disease, movement disorders)
- Musculoskeletal conditions (e.g., Rheumatoid Arthritis, Osteoarthritis, recent upper limb surgery or fractures, carpal tunnel syndrome)
- Diabetes mellitus

Study Design

A comparative cross-sectional design was utilized. Cluster type sampling was implemented to recruit participants from specified geographic locations, facilitating representativeness across occupational categories. All procedures were conducted after obtaining informed consent, maintaining participant confidentiality throughout.

Outcome Measures

1. Hand Grip Strength

Assessed using a handheld dynamometer (dominant hand), a method with established reliability and validity in musculoskeletal research.

Participants were seated with armrests; performed three maximal grip trials, and the average score was recorded. (Saremi et al., 2019)

2. Wrist Range of Motion (ROM)

Measured using a universal goniometer, recording flexion, extension, radial deviation, and ulnar deviation in the dominant hand amid standardized positioning: shoulder abducted 90°, elbow flexed 90°, wrist neutral. (Klum et al., 2012)

3. Anthropometric Parameters

- Height measured by stadiometer in meter
- Weight by digital scale in kilogram
- BMI calculated as:

BMI=Weight (kg)/Height (m)² BMI=Height (m)²/Weight (kg) (Dasgupta et al., 2010)

Mean upper arm circumference (MUAC): Measured at the midpoint between the acromion and olecranon process in centimeters. (Dasgupta et al., 2010)

Ethical Considerations

All participants provided informed consent. Data confidentiality was upheld, and no identifying information appears in analyses.

Data analysis

The collected data for the comparative study underwent rigorous analysis using SPSS Version

24. Initial data entry was done in Microsoft Excel 2010, followed by numerical coding before processing in SPSS. Descriptive analysis showcased socio-demographics and explored relationships among Hand Grip Strength (HGS), Body Mass Index (BMI), Mean Upper Arm Circumference (MUAC), and Wrist Range of Motion (Wrist ROM). Pearson's correlation was done between HGS and following variables: BMI, MUAC, and Wrist ROM, yielding insights into significance and correlation direction. These analytical methods enhance the study's comprehension and contribute to its objectives.

RESULTS

Out of 90 participants, 30 were farmers, 30 were house-helps and remaining 30 were teachers. All participants were evaluated for inclusion and exclusion criteria before being asked to sign an informed consent form. Following the completion of the data collection and analysis, the following observations were made. The individuals in this study were from various occupations, and their demographic information is shown in Tables 1.

Mean values and standard deviations (SD) of age, weight, height, and BMI are provided for the farmer

group. Age is represented in years, weight in kilograms (kg), height in centimetres (cm), and BMI as kg/m².

Table 1 –Demographic details of farmers

Parameters	Mean ± SD
Age(years)	41.53 ± 8.77
Weight (kg)	51.40 ± 7.63
Height (cm)	151.61 ± 9.40
BMI	18.56±2.97

Mean values and standard deviations (SD) of age, weight, height, and BMI are provided for the house-help group. Age is represented in years, weight in kilograms (kg), height in centimetres (cm), and BMI as kg/m² show in table 2.

Table 2 – Demographic details of House-helps

Parameters	Mean ± SD
Age (years)	49.23 ± 7.49
Weight (kg)	67.93 ± 11.40
Height (cm)	158.70 ± 7.46
BMI*	22.50±2.98

Mean values and standard deviations (SD) of age, weight, height, and BMI are provided for the teacher group. Age is represented in years, weight in kilograms (kg), height in centimetres (cm), and BMI as kg/m² show in detail in table 3.

Table 3 – Demographic details of Teachers

Parameters	Mean ± SD
Age(years)	41 ± 7.42
Weight (kg)	42.70 ± 7.14
Height (cm)	151.83 ± 9.19
BMI	26.98±4.35

The table presents the mean hand grip strength (HGS) with standard deviations (SD) among females from different professional categories, namely farmers, house-helps, and teachers. The p-value indicates the level of significance in the comparison of HGS between the professional

groups. When the mean difference in hand grip strength was compared by profession, it was found that there is no significant difference in the mean hand grip strength among farmers, house-helps and teachers because p was more than 0.05, as shown in table 4 .

Table 4- Comparison of mean Hand grip strength (HGS) among females of different professional categories (N=90).

OCCUPATION	MEAN ± SD	P VALUE
Farmers	22.42±4.60	0.373
House-helps	20.68±4.93	
Teachers	29.96±5.77	

The table presents the mean flexion range of motion (ROM) with standard deviations (SD) among females from different professional categories, namely farmers, house-helps, and teachers. The p-value indicates the level of significance in the comparison of flexion ROM between the professional groups. When the mean difference of flexion range of motion was compared by profession, it was found that there is a significant difference in the mean flexion range of motion among farmers, house-helps and teachers as p was <0.05, as shown in table 5.

Table 5 – Comparison of mean flexion range of motion (ROM) among females of different professional categories (N=90).

OCCUPATION	MEAN ± SD	P VALUE
Farmers	77.83 ± 8.78	<0.001
House-helps	68 ± 12.30	

The table presents the mean extension range of motion (ROM) with standard deviations (SD) among females from different professional categories, namely farmers, house-helps, and teachers. The p-value indicates the level of significance in the comparison of extension ROM between the professional group.

When the mean difference of extension range of motion was compared by occupation, it was found that there is a significant difference in the mean extension range of motion among farmers, house-

helps and teachers as p was <0.05, as shown in table 6.

Table 6 — Comparison of mean extension range of motion (ROM) among females of different professional categories (N=90).

Occupation	Mean ± SD	P value
Farmers	70.03 ± 12.68	0.035
house-helps	76.67 ± 9.77	
Teachers	71.17 ± 8.27	

Explanations: The table presents the mean radial deviation range of motion (ROM) with standard deviations (SD) among females from different professional categories, namely farmers, house-helps, and teachers. The p-value indicates the level of significance in the comparison of radial deviation ROM between the professional groups. When the mean difference of radial deviation was compared by profession, it was found that there is no difference in the mean radial deviation among farmers, house-helps and teachers, as shown in table 7.

Table 7 – Comparison of mean radial deviation range of motion (ROM) among females of different professional categories (N=90).

Occupation	Mean ±	P value
Farmers	37.17 ± 10.54	0.308
House-helps	35.50 ± 4.80	
Teachers	36.33 ± 8.30	

Explanations: The table presents the mean ulnar deviation range of motion (ROM) with standard deviations (SD) among females from different professional categories, namely farmers, house-helps, and teachers. The p-value indicates the level of significance in the comparison of ulnar deviation ROM between the professional groups. When the mean difference of ulnar deviation range of motion was compared by profession, it was found that there is no significant difference in mean ulnar deviation among farmers, house-helps and teachers because p was more than 0.05, as shown in table 8.

Table 8 – Comparison of mean ulnar deviation range of motion (ROM) among females of different professional categories (N=90).

Occupation	Mean ± SD	P value
Farmers	39.50 ± 8.02	0.965
House-helps	39.17 ± 6.44	
Teachers	39.00 ± 7.58	

The table presents the mean mid-upper arm circumference (MUAC) with standard deviations (SD) among females from different professional categories, namely farmers, house-helps, and teachers. The p-value indicates the level of significance in the comparison of MUAC between the professional groups.

When the mean difference in MUAC was compared by occupation, it was found that there is a significant difference in the mean MUAC among farmers, house-helps and teachers as p was

<0.05, as shown in table 9.

Table 9 – Comparison of mean MUAC among females of different professional categories (N=90).

Occupation	Mean ± SD	P value
Farmers	24.14 ± 2.50	<.001
House-helps	28.05 ± 3.72	
Teachers	24.93 ± 1.88	

The table presents the correlation coefficient and significance level between handgrip strength and body mass index (BMI). The p-value indicates the level of significance for the correlation. When the correlation between HGS and BMI was examined, it was found that there is a negligible positive correlation, as indicated by the correlation coefficient of 0.024 in table 10.

Table 10 – Correlation between handgrip strength and body mass index.

P value	0.024
Sig. (2 tailed)	0.826

The table presents the correlation coefficient and significance level between body mass index (BMI) and hand grip strength specifically among house-helps. The p-value indicates the level of significance for the correlation. When the correlation between BMI and HGS among house-helps was examined, it was found that there is a minimal positive correlation between hand grip strength and BMI among house-helps, as the correlation coefficient was more than zero, as shown in table 11.

Table 11 – Correlation between BMI and hand grip strength among house-helps.

P value	0.014
Sig.(2 tailed)	0.940

The table presents the correlation coefficient and significance level between body mass index (BMI) and hand grip strength specifically among teachers. The p-value indicates the level of significance for the correlation. When the correlation between BMI and HGS among teachers was examined, it was found that there is a very weak correlation between hand grip strength and BMI among teachers, as the correlation coefficient was more than zero, as shown in table 12.

Table 12- Correlation between BMI and hand grip strength among teachers.

P value	0.125
Sig.(2tailed)	0.504

The table presents the correlation coefficient and significance level between body mass index (BMI) and hand grip strength specifically among farmers. The p-value indicates the level of significance for the correlation. When the correlation between BMI and HGS among farmers was examined, it was found that there is a positive correlation between hand grip strength and BMI among farmers, as the correlation coefficient was >0, as shown in table 13.

Table 13 – Correlation between BMI and hand grip strength among farmers.

P value	0.374
Sig. (2 tailed)	0.038

Explanations: The table presents the correlation coefficients and significance levels between hand grip strength and different wrist motions, including flexion, extension, radial deviation, and ulnar deviation. The p-values indicate the levels of significance for the correlations. According to the findings of the correlation between HGS and wrist ROM, there is a very weak positive correlation between HGS and flexion, HGS and ulnar deviation, but a very weak negative correlation between HGS and extension and HGS and radial deviation, as shown in table 14.

Table 14 – Correlation between Hand grip strength and wrist range of motions.

	Flexion	Extension	Radial deviation	Ulnar deviation
P value	.110	-.001	-.084	.162
Sig.(2 tailed)	.304	.992	.429	.127

Explanations: The table presents the correlation coefficient and significance level between hand grip strength and mean upper arm circumference (MUAC). The p-value indicates the level of significance for the correlation. When the correlation between hand grip strength and MUAC was examined, it was found that there is a positive correlation since the correlation coefficient was more than zero, as shown in table 15.

Table 15- Correlation between hand grip strength and MUAC

P value	.296
Sig.(2 tailed)	.005

Explanations: The table presents the correlation coefficient and significance level between mean upper arm circumference (MUAC) and body mass index (BMI) category. The p-value indicates the level of significance for the correlation. On analyzing the correlation between MUAC and BMI category according to WHO it was observed that there is a positive correlation between MUAC and BMI category as correlation coefficient was >0 as mentioned in table 16.

TABLE 16- Correlation between MUAC and BMI category

P value	.591
Sig. (2 tailed)	<.001

DISCUSSION

The present study set out to examine whether women in different occupations differ in hand grip strength (HGS) and wrist range of motion (ROM), and to explore how these measures relate to mean upper arm circumference (MUAC) and body mass index (BMI).

Earlier studies have often suggested that women engaged in manual work, such as farming or domestic labor, are likely to develop stronger grip strength because of the physical demands of their daily activities (Lenardt et al., 2016; Saremi et al., 2019). In this study, however, no significant differences in HGS were observed across occupational groups. Interestingly, a larger proportion of teachers had a BMI above 25, supporting previous reports that higher BMI may sometimes be associated with greater grip strength, particularly among overweight or obese individuals (Prakash et al., 2022).

When assessing wrist mobility, the results were mixed. Radial and ulnar deviations were similar across professions, but differences emerged in wrist flexion and extension. MUAC also varied between groups, which may reflect underlying differences in nutrition and socioeconomic background (Gulati et al., 2022).

The relationship between BMI and grip strength proved more complex. Overall, the study found only a negligible correlation ($P = 0.826$, $r = 0.024$). This contrasts with earlier work, which has reported both positive and negative associations, as well as no clear relationship at all (Gulzar et al., 2022; Jafar et al., 2023). Subgroup analysis suggested that farmers showed a clearer positive association between BMI and HGS, while the relationship was much weaker among teachers and house-helps.

This regional context makes the findings particularly valuable. Although grip strength has been studied extensively in diverse populations worldwide—including in Canada, Brazil, Iran, Malaysia, South Africa, Nepal, and other Indian states (Zaccagni et al., 2020; Dhananjay et al., 2017; Wong et al., 2016; Amaral et al., 2019; Jaafar et al., 2023; Rostamzadeh et al., 2019)—there has been little attention to women in Uttar Pradesh. By focusing on this

population, the study provides evidence that is both context-specific and relevant to broader discussions of occupation, nutrition, and physical function.

The association between HGS and wrist movements was also examined. Results showed weak positive correlations with wrist flexion and weak negative correlations with wrist extension (Klum et al., 2012). More importantly, a significant positive association was found between HGS and MUAC ($P = 0.005$, $r = 0.296$), consistent with earlier findings (Akbar et al., 2017). MUAC also showed a strong correlation with BMI ($P = 0.001$, $r = 0.635$), reinforcing the usefulness of these measures in evaluating nutritional status (Dasgupta et al., 2010).

As with any research, certain limitations must be acknowledged. The relatively small sample size, restricted geographic scope, and absence of a control group limit the generalizability of the findings. Reliance on self-reported information and the exclusive focus on grip strength may also have introduced bias or overlooked other aspects of upper limb function. Furthermore, variability in anthropometric measurements and potential observer bias are important considerations.

Despite these limitations, the study contributes meaningful insights into the interplay between occupation, body composition, and functional capacity in women from Uttar Pradesh. Future research would benefit from larger and more diverse samples, a wider range of physical performance measures—including pinch grip—and consideration of additional social and lifestyle factors. Such work could help build a more comprehensive understanding of women's physical health in varied occupational and cultural contexts.

CONCLUSION

The study examined hand grip strength and wrist range of motion among females working in various occupation. It found no significant difference in grip strength among farmers, house- helps and teachers. However, there is a notable variation in flexion and extension range of motion. BMI and grip strength showed a negligible positive correlation overall, with a stronger correlation among farmers. MUAC positively correlated with grip strength, indicating better nutrition may contribute to stronger grip. The study highlights the importance of hand grip strength assessment and its association with occupation, BMI, and MUAC for rehabilitation

therapists in tailoring effective rehabilitation protocols.

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