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# Prevalence of Forward Head Posture among Cleaning Workers and Its Correlation to Physical Workload

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## ABSTRACT

**Background:** Cleaning workers often perform repeated activities in awkward postures, exposing them to postural malalignment and musculoskeletal disorders.

**Objective:** This study aimed to investigate the prevalence of forward head posture (FHP) among cleaning workers and to determine its associated risk factors with a correlational analysis to physical workload.

**Methods:** This cross-sectional observational research was conducted using Photogrammetry to determine the craniovertebral angle and a Rapid Upper Limb Assessment (RULA) working sheet to evaluate the physical workload and the risk level for developing musculoskeletal disorders (MSDs) in 104 cleaning workers.

**Results:** The prevalence of forward head posture among cleaning workers was 61.54% with 95% CI (51.94- 70.32%). FHP was significantly associated with higher weight status and working years ($p<0.05$). A Binary logistic regression determined that overweight and obese participants were 0.11 times more likely to have FHP compared to normal weight participants (Odds Ratio = 0.11, 95% CI 0.04-0.34). Participants with working 5-30 years were 0.23 times more likely to have FHP than participants with 1- 4 working years (Odds Ratio = 0.23, 95% CI 20.09-0.53). RULA score among them was 6.33 ± 0.73. There is a significant moderate positive correlation between the FHP and RULA score ($rpb = 0.49$ $p < 0.05$).

**Conclusion:** 61.54% of cleaning workers exhibited forward head posture. High BMI and long working years were the associated risk factors. High RULA scores emphasized the need for preventive actions to lower the risk of developing FHP and other MSDs.

**Keywords:** Musculoskeletal Disorders, Photogrammetry, Posture, Workload.

## INTRODUCTION

Assuming healthy postures is thought to be essential for overall health on both a musculoskeletal and psychological level [(1)]. Forward head posture (FHP) is a common abnormal posture in the sagittal plane that is described as a position whereby the head is anteriorly displaced from a vertical reference line that passes through the ear lobe to the tip of the shoulder [(2)]. Lower cervical spine flexion and hyperextension of the upper cervical spine are the defining characteristics of this particular postural abnormality [(3, 4)].

After handling or lifting large objects, individuals with improper postures are more likely to develop musculoskeletal disorders (MSDs) compared to those who maintain a proper posture [(5)]. Housekeeping involves frequent manual material handling tasks, including lifting, bending, pushing, carrying, and pulling, often in awkward positions [(6)]. As a result of performing lots of hazardous duties, cleaning workers are definitely among those most susceptible for developing work-related musculoskeletal disorders (WRMSDs) [(7)].

Photogrammetry is a method of quantifying body posture through the utilization of software specifically designed to measure angles and linear distances (formed between lines produced by body markers and horizontal or vertical lines) on digital photographs [(8,9)]. The Rapid Upper Limb Assessment (RULA) is a frequently used observational ergonomic tool. It evaluates deviations in joint angles in the shoulder, elbow, wrist, neck, and trunk regions relative to their neutral positions across a range of occupational situations [(10)].

Posture assessment is significantly important for clinicians and researchers investigating the impact of chronic incorrect postures on musculoskeletal disorders progression [(11)]. Therefore, this research was conducted to determine the prevalence of FHP in cleaning workers and to investigate its correlation to physical workload related to the musculoskeletal system.

## SUBJECTS AND METHODS

**Design:** The study was conducted from April to November 2023 using a cross-sectional observational research design.

**Participants:** Participants were recruited from the Housekeeping Department in 3 Universities in Cairo, Egypt. Sample size calculation was done by the G*power program 3.1.9 (version 3.1, Heinrich-Heine-University, Düsseldorf, Germany) for two-tailed tests (α balancing: α/2 on each side) based on $\chi^2$ tests - Variance: Difference from constant (one sample case), Ratio var1/var0 =1.5434598623, Type I error (α) = 0.05, power (1-β error probability) = 0.80.



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**Inclusion criteria:** Both genders aged from 18 to 50 years working for at least 6 months for the same work duties 5 days per week, 7 hours per day [12].

**Exclusion criteria:** Participants with physical disabilities, a history of accidents, and spine or neurological pathologies were excluded from the study [13].

**Procedures:** The research methodology has been divided into multiple stages:

**Stage I:** Survey Implementation: The survey comprised of participant characteristic data (gender, age, height, weight, BMI, dominant hand, educational level), presence of pain and its location and work characteristics details (work experience, duration of working hours, and the activities maximally involved).

**Stage II:** Photogrammetric evaluation of the forward head position. It is a digital imaging technique utilized to assess the head and neck in a standing position. The ear's tragus and C7 vertebrae are marked with fluorescent adhesive markers. To identify the C7 spinous process, the examiner requests that the subject perform cervical spine flexion and extension. The C7 spinous process becomes more projecting during extension, whereas the C6 spinous process is palpably absent [14].

A landmark was placed on the floor 30 cm from the wall to ensure that all participants were positioned identically in front of the camera. The subject was asked to stand in a relaxed position without instructions about his posture and look straight ahead. A sagittal plane photograph was then taken using an android mobile (Samsung A51) with a standard-wide camera: 48 P sensor and 26 mm-equivalent f/2.0, AF, at 1.5 m distance from the subject, at the shoulder level [14]. The image was then digitized and the cranio-vertebral angle (CVA) was calculated using the APECS application [13].

The term "craniovertebral angle" refers to the acute angle formed by a horizontal line that goes through the spinous process of the seventh cervical vertebra (C7) and the line that joins the ear tragus midway to the spinous process of C7. FHP has been defined in the sagittal plane when the craniovertebral angle (CVA) is fewer than 50 degrees [15].

**Stage III:** Evaluation of physical workload related to the musculoskeletal system using Rapid Upper Limb Assessment (RULA) working sheet. This diagnostic instrument evaluates postural and biomechanical load on the entire body, with specific emphasis on the neck, trunk, and upper extremities. The process is quick and the results are organized into an action list that specifies the necessary level of intervention [16].

RULA targets two groups of body regions: Group A: arm, forearm, wrist and wrist twist and group B: neck, trunk and leg. The two final scores for both groups are combined to get the final result.

After interviewing participants, floor-sweeping was the activity most performed by all the participants and it was the selected task to be evaluated. Several pictures and videos of each participant's dominant side while sweeping were taken then the pictures were displayed on the computer to measure the angles of each body region using AutoCAD [17].

**Ethical approval: The investigation was approved by The Research Ethical Committee of the Faculty of Physical Therapy, Cairo University (P.T.REC/012/004517). After explaining the study's objectives and methodologies, each participant was required to sign a consent form. The participants were adequately informed of their right to reject or discontinue participation at any time, and the confidentiality of the data was ensured. The Helsinki Declaration was followed throughout the study's conduct.**

***Statistical analysis***

All statistical analyses were conducted using version 25 of the Statistical Package for Social Studies (SPSS) for Windows. The mean ± standard Deviation, frequencies, and percentages were employed as descriptive statistics to show the characteristics of the participants and the data that was measured. Logistic regression and Chi-square statistics were employed to investigate the association among FHP and participant characteristics. The coefficient of Pearson correlation was applied to examine the correlation between the RULA score and FHP. For all statistical tests, the level of significance was established as $p \leq 0.05$.

**RESULTS**

One hundred and four cleaning workers participated in this study. Their gender distribution revealed that there were 70 (67.3%) females and 34 (32.7%) males. The mean of age of participants was 33.58 ± 11.67 years with a minimum of 18 years and a maximum of 50 years. The mean of BMI of participants was 24.43 ± 3.29 kg/m² with a minimum of 19 kg/m² and a maximum of 38.40 kg/m².

(Figure 1) showed that the prevalence of FHP among cleaning workers was 61.54% with a 95% CI of 51.94- 70.32%. FHP was present in 43 (61.4%) of females and 21 (61.8%) of males. The mean of NPRS among participants with pain was 6.08 ± 1.92 with minimum of 2 and maximum of 10. Out of the participants, 43 (41.35%) reported neck pain and 19 (18.27%) reported shoulder pain. The mean of RULA score among participants was 6.33 ± 0.73 with minimum of 5 and maximum of 7. There were 16 (15.4%) participants with a score of 5, 38 (36.5%) participants with a score of 6 and 50 (48.1%) participants with a score of 7 (Table 1).

**Table (1):** Characteristics of participants.

| | $\overline{X}$ ±SD | Median | Minimum | Maximum | Range |
|---|---|---|---|---|---|
| **Age (years)** | 33.58 ± 11.67 | 34 | 18 | 50 | 32 |
| **Weight (kg)** | 66.06 ± 9.13 | 65 | 42 | 90 | 48 |
| **Height (cm)** | 164.36 ± 6.31 | 165 | 145 | 183 | 38 |
| **BMI (kg/m²)** | 24.43 ± 3.29 | 23.60 | 19 | 38.40 | 19.40 |
| **Working years** | 6.47 ± 6.45 | 4 | 1 | 30 | 30 |
| **Working hours/day** | 9.15 ± 1.17 | 9 | 8 | 12 | 4 |
| **NPRS** | 6.08 ± 1.92 | 6 | 2 | 10 | 8 |
| **RULA score** | 6.33 ± 0.73 | 6 | 5 | 7 | 2 |
| **Age classes** | | | | | |
| | **Frequency** | | | | |
| **18-34 years** | 53 (50.96%) | | | | |
| **35-50 years** | 51 (49.04%) | | | | |
| **Weight classes** | | | | | |
| **Normal weight (18.5–24.9 kg/m²)** | 64 (61.5%) | | | | |
| **Overweight (25.0–29.9 kg/m²)** | 34 (32.7%) | | | | |
| **Obese (≥ 30 kg/m²)** | 6 (5.8%) | | | | |
| **Gender distribution** | | | | | |
| **Females** | 70 (67.3%) | | | | |
| **Males** | 34 (32.7%) | | | | |
| **Dominant hand distribution** | | | | | |
| **Right-handed** | 98 (94.2%) | | | | |
| **Left-handed** | 6 (5.8%) | | | | |
| **Educational level distribution** | | | | | |
| **Illiterate** | 26 (25%) | | | | |
| **Primary school** | 47 (45.2%) | | | | |
| **High school** | 31 (29.8%) | | | | |
| **Working Experience** | | | | | |
| **1- 4 years** | 53 (50.96%) | | | | |
| **5-30 years** | 51 (49.04%) | | | | |
| **Working hours/day** | | | | | |
| **8- 9 h/day** | 59 (56.73%) | | | | |
| **> 9 h/day** | 45 (43.27%) | | | | |
| **RULA score** | | | | | |
| **5** | 16 (15.4%) | | | | |
| **6** | 38 (36.5%) | | | | |
| **7** | 50 (48.1%) | | | | |

There was a significant association between FHP and weight status, overweight/obese subjects had a higher prevalence of FHP than normal weight subjects ($p<0.001$). There was a significant association between FHP and working years. There was a significant rise in the prevalence of FHP in participants with 5-30 working years compared to participants with 1- 4 working years ($p<0.001$). There was no significant association between FHP with age and gender ($p>0.05$) (Table 2).

**Table (2):** Association of FHP with age, weight status, gender and working years.

| | Prevalence of FHP | | $\chi^2$ value | p -value |
|---|---|---|---|---|
| | Yes | No | | |
| **Age classes** | | | | |
| 18-34 years | 32 (60.4%) | 21 (39.6%) | 0.06 | 0.80 |
| 35-50 years | 32 (62.7%) | 19 (37.3%) | | |
| **BMI classes** | | | | |
| Normal weight | 29 (45.3%) | 35 (54.7%) | 18.51 | 0.001 |
| Overweight/obese | 35 (87.5) | 5 (12.5%) | | |
| **Gender** | | | | |
| Females | 43 (61.4%) | 27 (38.6%) | 0.001 | 0.97 |
| Males | 21 (61.8%) | 13 (38.2%) | | |
| **Working Experience** | | | | |
| 1- 4 years | 24 (45.3%) | 29 (54.7%) | 12.07 | 0.001 |
| 5-30 years | 40 (78.4%) | 11 (21.6%) | | |

By utilizing binary logistic regression, the variables that can predict FHP among cleaning workers were identified. Univariate analysis revealed that weight status and working years had a significant association with FHP. Overweight/obese participants were 0.11 times more likely to have FHP compared to normal weight participants (Odds Ratio = 0.11, 95% CI 0.04-0.34, p = 0.001). Participants with working years 5-30 years were 0.23 times more likely to have FHP compared to participants with 1- 4 working years (Odds Ratio = 0.23, 95% CI 20.09-0.53, p = 0.001). Being overweight/obese and working 5-30 years were significant predictors for FHP ($p < 0.05$) (Table 3).

**Table (3):** Predictors of FHP among participants.

| | *Univariate analysis* | | | *Multivariate analysis* | | |
|---|---|---|---|---|---|---|
| ***Variables*** | ***Odds ratio*** | ***95% CI*** | ***p-value*** | ***Odds ratio*** | ***95% CI*** | ***p-value*** |
| **Weight status** | | | | | | |
| Overweight/obese | 0.11 | 0.04-0.34 | 0.001 | 0.29 | 0.11 -0.72 | 0.008 |
| **Working years** | | | | | | |
| 5-30 years | 0.23 | 0.09-0.53 | 0.001 | 0.14 | 0.05-0.42 | 0.001 |

CI: Confidence interval; p value: Probability value.

The correlation between FHP and RULA score showed significantly moderate positive correlation ($r_{pb} = 0.49$, $p< 0.05$) (Table 4).

**Table (4):** Correlation between FHP and RULA score

| **FHP** | | **$r_{pb}$ value** | **p value** |
|---|---|---|---|
| | **RULA score** | 0.49 | 0.001 |

$r_{pb}$: Point biserial correlation coefficient, p value: Probability value

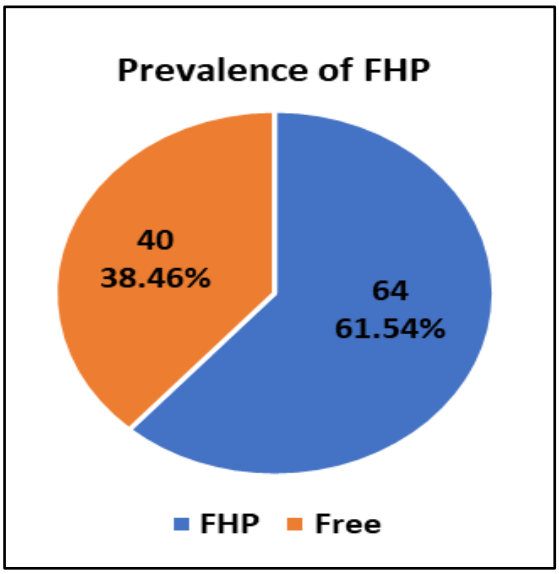


**Figure (1):** Prevalence of FHP among participants.

## DISCUSSION

The findings of the current study indicated that 61.54% of participants had a forward head posture.

The mean of NPRS among participants with pain was 6.08 ± 1.92 with a minimum of 2 and maximum of 10. There was a significant association between weight status (OR = 0.11, 95% CI 0.04-0.34, p<0.05) and working years (OR = 0.23, 95% CI 20.09-0.53, p<0.05) with FHP, while there was no significant association between FHP with age and gender (p>0.05). Additionally, the mean of RULA score among participants was 6.33 ± 0.73 with a minimum of 5 and maximum of 7. There was a moderate positive significant association among FHP and RULA score (r = 0.49, p<0.05).

In the current study, it was found that out of 104 participants, 64 individuals had forward head posture (FHP), which accounts for 61.54% of the total population. Previous studies have also shown a high prevalence of FHP in different groups such as sewing machine operators, computer users, dentists, and school-going students. For instance, 64.67% of sewing machine operators presented with FHP [18]. **Ashok *et al.*** [19] reported a prevalence of 60.63% of FHP among users of computer systems. Research by **Vakili *et al.*** [20] revealed that 85.5% of dentists have FHP. **Verma *et al.*** [21] found that there was a prevalence of 63% of FHP between 12 to 16 years old school-going students.

To assess the FHP of cleaning workers, we opted to utilize photogrammetry to measure the craniovertebral angle. This approach has good intrarater (ICC=0.75-0.89) and interrater (ICC=0.91-0.99) reliability [22]. Additionally, its correlation with the angles determined by Low-Density X-ray images (LODOX) was extremely robust (r = 0.84). Therefore, photogrammetry was a favored technique due to its clinical viability, cost-effectiveness, time efficiency, non-invasiveness, and absence of ionizing irradiation exposure [23].

Regarding pain, it was found that 43 (41.35%) participants experienced neck pain while 19 (18.27%) experienced shoulder pain with a mean intensity of 6.08 ± 1.92 reported using NPRS. These findings go parallel with **Zakaria *et al.*** [24] who reported that 15.90% and 22.7% of waste collectors complained of pain in the neck and shoulder regions respectively. A possible cause of pain is that cleaning workers were all subjected to physically high manual labor for extended periods throughout their employment.

Furthermore, individuals diagnosed with FHP can show symptoms including stiffness and tenderness in the neck and shoulder, as well as a diminished range of motion and muscle strength in those areas. As a result, they may develop cervicogenic headache, shoulder pain, craniofacial pain, or all of the above [25]. Furthermore, FHP results in muscular imbalance, which contributes to alterations in spinal curvature, round shoulder posture, and increased tension across multiple body regions [26].

Concerning the participants' characteristics, compared to those with normal weight, participants who were overweight or obese had a higher prevalence of FHP (OR=0.11, P<0.05). This finding is consistent with the research conducted by **Elhafez and Mahmoud** [27] who explained that obesity can negatively affect posture in Egyptian adolescents. Obesity causes a forward shift in the center of gravity (COG), which has an impact on torque (Torque = Force x Moment Arm). As a result, postural changes occur to compensate for this abnormality, which can reduce craniovertebral angle (CVA) and cause FHP. The current study's findings are in line with a prior investigation that compared the spinal characteristics of adult obese individuals with those of normal weight. The results showed that obese individuals had a more severe thoracic kyphosis [difference between groups (Δ) = 6.1°, 95% CI 3.3°–8.9°, p < 0.0001] [28]. Similarly, **Gulati *et al.*** [29] conducted an investigation to establish a correlation between clinicians' postural stress and obesity. According to their findings, three-quarters of clinicians in the higher BMI group had improper standing static posture and seventy- nine percent had improper dynamic work posture, whereas the normal BMI group had the fewest faulty postures. These results are consistent with our own, as participants that overweight or obese were 0.11 times more liable to have FHP than those with a normal weight.

The results of this investigation showed a statistically significant association (p<0.05) between years of service and FHP. This is consistent with the results obtained from an earlier investigation that aimed at determining the prevalence of FHP among male nurses in Tehran and examining its correlation with professional experience. There was a weak positive correlation between work experience and FHP (P<0.05, r=0.29) [30]. As per our findings, participants who had worked for 5-30 years were found to be 0.23 times more prone to have FHP as compared to those who had 1-4 years of work experience (OR=0.23).

This is in line with earlier research, which found that bank workers with more than six years of experience were 2.16 times more likely to encounter work related muscloskeletal disorders (WRMSDs) than those who served for less than six years [OR:2.16, 95% CI: 1.05-4.43] [(31)]. This could be explained by the repetitive strain, muscle fatigue over time, and performing the same tasks repeatedly. The above-mentioned factors lead to muscle imbalances and tightness in certain muscles while weakening of others. The imbalance can pull their body out of alignment, causing FHP.

Cleaning workers in this study included both genders with a distribution revealed that there were 70 (67.3%) females and 34 (32.7%) males. Their occupation involved performing similar tasks that exposed them to similar levels of awkward posture, repetitive motions, and forceful exertion. This clarified that there was no significant association between FHP and gender ($p>0.05$). Our results agree with a study by **Nejati *et al.*** [(32)] who stated that there was no significant variation found in both male and female Iranian office workers in terms of FHP. Unlike, the results of a previous study, which demonstrated that a greater percentage of female students (71.1%) displayed FHP when compared to male students (55.7%). This was attributable to psychosocial factors, specifically stress, which was found to be partially correlated with secondary sexual characteristics [(21)].

Although aging-related deterioration can have an impact on sagittal alignment [(33)], our results showed that there was no significant association between FHP and age ($p>0.05$). It had been observed that many young age cleaning workers spend time using mobile phones in awkward sitting positions during their rest periods, which may be a contributing factor that was not determined in this study.

The current study was concerned with physical workload and the risk of MSDs and their correlation to FHP. Concerning the RULA score, out of all participants, 48.1% had a score of 7, indicating a high physical workload and high risk of MSDs which require immediate action to implement changes. While, the remaining participants had a score of 5 or 6 showing that they were at medium risk, which requires further investigation and necessary changes. Our results are consistent with a previous study, which stated that based on RULA analysis, 43.20% of the garbage collectors received a score of 7, which suggests that postural adjustments need to be made right away. In the meantime, 45.5% of garbage collectors indicated that postural adjustments needed to be made quickly [(24)]. Additionally, the high RULA scores obtained in our study are consistent with the findings of **Lim *et al.*** [(7)], who found that none of the janitorial employees maintained appropriate working postures, 83.8% fell within the medium-risk category whereas 11.3% of them were at extremely high risk. This latter group needed an immediate intervention to mitigate the risk of upper limb musculoskeletal disorders (ULMSDs).

According to these results, cleaning workers were subjected to comparatively strenuous physical demands across various body regions. The results of this study are not shocking, given that the sweeping task under investigation necessitated regular forward flexion of the upper body, which places an excessive burden on the workers' posture. A moderately significant positive correlation was observed ($rpb = 0.49$, $p<0.05$) between the FHP and RULA scores. This is in line with **Kelly *et al.*** [(34)] who stated that the ergonomic risk of surgeons could be indicated by utilizing both the craniovertebral angle and the RULA score for the neck, trunk, and leg. The characteristics of posture and neck muscular flexibility that are evaluated by RULA are directly impacted by forward head position. RULA considers the amount of muscle used in a certain job as well as the angle at which the neck is bent. Repetitive tasks, like sweeping, can affect neck posture and put a constant strain on the muscles of the neck region, causing them to shorten and others to tighten. This further promotes FHP, which explains the moderate positive significant correlation between FHP and RULA score.

Improper posture could be improved by education, reviewing ergonomics of workstations, conservative management and managing the other etiologies associated with FHP to ensure proper posture, thereby decreasing the prevalence of musculoskeletal pain and improving the quality of life [(32)]. Our results provide further evidence that cleaning workers have one of the most demanding and stressful jobs. However, fortunately, several effective strategies can reduce the risk of developing MSDs and promote a healthier workforce. These strategies include the usage of ergonomic tools with long handles, adjustable heights, and powered-operated cleaning equipment. Additionally, adaptable workstations with adjustable shelves and countertops can minimize awkward reaching and bending. Providing mechanical assistance for moving heavy loads or objects can also be helpful. At work, it is highly important to offer practical ergonomic training that teaches the correct work techniques, while also stressing the significance of reporting any discomfort at an early stage.

Despite the unique findings of the study, this study focused on analyzing a single posture of the participant’s dominant side during the sweeping task. Comparative studies across different cleaning contexts using objective measures of posture and muscle activity such as cameras, sensors, or electromyography are required to identify the associated physical workload. In addition, further studies are encouraged to consider other factors including individual differences, physical fitness, anthropometric measures, and psychological factors such as job satisfaction to recognize the possible risk factors associated with postural malalignments.

## CONCLUSION

It has been observed that cleaning workers are commonly affected by forward head posture (FHP) with a prevalence of 61.54%. Additionally, long working years and high BMI were significant associated factors for developing FHP ($p < 0.05$). Cleaning workers had a relatively high physical demand while working, which resulted in high RULA scores. Research showed that FHP had a moderately positive significant correlation with RULA score ($p<0.05$), which highlights the need for preventive measures to reduce the risk of developing FHP and other MSDs among cleaning workers.

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