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PREVALENCE OF FORWARD HEAD POSTURE AND ASSOCIATED RESPIRATORY FUNCTION CHANGES AMONG COMPUTER WORKERS

Original Research

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ABSTRACT

Background: Forward Head Posture (FHP) is a common musculoskeletal deviation increasingly observed in computer users due to prolonged screen exposure and poor ergonomic practices. It can significantly affect cervical alignment and respiratory mechanics, leading to impaired pulmonary function. Prolonged sedentary behavior combined with inadequate postural awareness is believed to play a pivotal role in the development and progression of FHP among digital device users. Despite growing concern, limited evidence exists focusing on the occupational impact of FHP on respiratory health.

Objective: To determine the prevalence of Forward Head Posture among computer workers and to evaluate its association with changes in respiratory function.

Methods: A cross-sectional study was conducted among 80 computer workers aged 25–35 years, recruited from the IT departments of Madinah Teaching Hospital, Interloop Administration Unit, and The University of Faisalabad. Participants with musculoskeletal, neurological, or respiratory conditions were excluded. Craniovertebral angle (CVA) was assessed using lateral-view digital photography and analyzed via ImageJ software. FHP was defined as CVA <48°. Respiratory function was measured using a calibrated digital spirometer, recording Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 Second (FEV1), FEV1/FVC ratio, and Peak Expiratory Flow (PEF). Statistical analysis was performed using SPSS version 20, with chi-square tests applied; $p<0.05$ was considered statistically significant.

Results: The prevalence of FHP was 83.8% (n=67). Participants with FHP showed significantly reduced respiratory parameters: mean FEV1 = 3.150 ± 1.056 L, FVC = 3.20 ± 0.998 L, FEV1/FVC ratio = 1.45 ± 0.840, and PEF = 3.625 ± 0.718 L/sec. A significant association was found between FHP and all spirometric measures: FEV1 ($p=0.014$), FVC ($p=0.042$), FEV1/FVC ($p=0.021$), and PEF ($p=0.026$).

Conclusion: Forward Head Posture is highly prevalent among computer workers and is significantly associated with decreased pulmonary function. Early ergonomic interventions and postural correction strategies are essential to reduce long-term respiratory compromise in occupational settings.

Keywords: Craniovertebral Angle, Ergonomics, Forward Head Posture, Posture, Pulmonary Function, Respiratory Function Tests, Sedentary Behavior.

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INTRODUCTION

Forward Head Posture (FHP) is characterized by the anterior positioning of the head relative to the vertical midline of the body, often resulting from a combination of excessive flexion in the lower cervical and upper thoracic regions, and compensatory extension in the upper cervical spine (1). This malalignment alters the normal biomechanics of the cervical spine and thorax, subsequently influencing musculoskeletal and respiratory systems. Contributing factors include prolonged screen time, inappropriate ergonomic setups, high pillow use, poor sleep posture, and weakened postural muscles, often exacerbated by nutritional deficiencies such as inadequate calcium intake (2). The persistent forward positioning of the head leads to muscular adaptations, with anterior neck muscles becoming hyperactive and accessory respiratory muscles compensating for thoracic restriction, thereby impairing optimal respiratory mechanics (3). These biomechanical disturbances can alter the three-dimensional configuration of the chest, compromising thoracic expansion during respiration (4,5). Computer workers, due to the static and prolonged nature of their tasks, are particularly susceptible to developing FHP. Previous findings suggest a higher prevalence of FHP among individuals engaged in extended computer or screen-related activities compared to the general population, with a slightly higher predisposition observed among females due to anatomical and physiological differences (6). The forward displacement of the head shifts the center of gravity, often accompanied by scapular protraction, increased thoracic kyphosis, and potential vertebral compression, which collectively contribute to a spectrum of symptoms such as muscular fatigue, stiffness, pain, restricted cervical range of motion, altered scapulothoracic kinematics, and disturbed sleep patterns (7,8). Chronic FHP may also contribute to the development of upper crossed syndrome, characterized by tight sternocleidomastoid and anterior scalene muscles, and weakened deep cervical flexors and extensor musculature, further compromising respiratory function (9,10).

Several studies have identified that poor postural alignment, particularly of the head, neck, and shoulder girdle, negatively impacts pulmonary function by reducing the compliance of the chest wall and lungs. This can lead to diminished inspiratory and expiratory muscle strength, reduced vital capacity, and increased residual volume (11). Additionally, FHP imposes increased mechanical loads on the diaphragm and restricts rib cage mobility, affecting both inspiratory and expiratory phases of breathing (12). As cervical and thoracic muscular fatigue sets in, the strength of respiratory muscles declines, which may impair the thoracic spine's ability to expand effectively during ventilation (13). To quantify FHP, the craniovertebral angle (CVA) is commonly assessed through standardized photographic methods, whereby the angle formed between a line connecting the tragus of the ear to the spinous process of C7 and a horizontal reference line is measured (14,15). A decreased CVA is indicative of more pronounced FHP. Respiratory parameters are typically evaluated using spirometry, a validated diagnostic tool that assesses lung volumes and airflow to detect restrictive or obstructive pulmonary patterns. Spirometric indices such as Forced Vital Capacity (FVC), Forced Expiratory Volume in the first second (FEV1), and their ratio (FEV1/FVC), along with Peak Expiratory Flow (PEF), serve as reliable indicators of respiratory efficiency and muscle strength (16). According to the American Medical Association, degrees of lung function impairment can be stratified based on predicted FEV1 percentages, guiding the interpretation of spirometric findings (17,18). The integration of these tools allows for the evaluation of posture-respiratory interactions in occupational settings, particularly among those with sedentary and screen-intensive work routines.

Although numerous studies have explored the general prevalence of FHP, limited research has specifically addressed its prevalence among computer workers and its association with respiratory function alterations. Given the growing dependence on digital devices and sedentary occupational habits, it becomes essential to understand how prolonged screen-based work may influence both posture and pulmonary health. Therefore, the objective of this study is to evaluate the prevalence of forward head posture and respiratory function changes among computer workers, and to determine the association between FHP and altered respiratory mechanics in this population.

METHODS

A cross-sectional analytical study was conducted to investigate the prevalence of Forward Head Posture (FHP) and associated respiratory function changes among computer workers. The study recruited 80 participants, aged between 25 and 35 years, who were exposed to a minimum of 6 to 8 hours of screen time daily. Participants were selected from diverse workplace settings including Madinah Teaching Hospital, Interloop Administration Unit, and The University of Faisalabad. To ensure the integrity of the findings, strict inclusion and exclusion criteria were applied. Individuals with a history of musculoskeletal or neurological disorders affecting posture were excluded, as were those with known respiratory diseases, recent surgeries, or those currently receiving physiotherapy interventions for postural correction. All participants were screened using a structured questionnaire designed to collect demographic information, medical history, working hours, and ergonomic practices. Forward Head Posture was objectively assessed using the craniovertebral angle (CVA) method. A standardized lateral digital photograph was taken while the participants maintained a neutral sitting posture. The CVA, defined as the angle between a line connecting the tragus of the ear to the spinous process of C7 and a horizontal line through C7, was analyzed using ImageJ software. A CVA of less than 48 degrees was considered indicative of FHP, as per established clinical standards (14,15). To

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ensure consistency in imaging, the camera was mounted on a tripod at a fixed distance of 1.5 meters and aligned to the level of the participant's shoulder.

Pulmonary function was evaluated using a calibrated digital spirometer. Parameters including Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), FEV1/FVC ratio, and Peak Expiratory Flow (PEF) were recorded. Each participant performed three consecutive spirometry trials according to American Thoracic Society/European Respiratory Society (ATS/ERS) guidelines, and the best of the three readings was considered for analysis to ensure reproducibility and reliability (16,17). The spirometer was calibrated before each session, and assessments were conducted in a quiet, temperature-controlled clinical environment to reduce variability from external factors. Prior to participation, each individual received a detailed explanation of the study protocol and provided written informed consent. Ethical approval was obtained from the Institutional Review Board of The University of Faisalabad. The confidentiality of participant data was maintained throughout the study. Statistical analysis was carried out using SPSS version 20. Descriptive statistics, including means and standard deviations, were used to summarize demographic and clinical data. Inferential analysis, including Chi-square tests, was applied to examine associations between the presence of FHP and deviations in respiratory parameters. A p-value less than 0.05 was considered statistically significant.

RESULTS

The study revealed a high prevalence of Forward Head Posture (FHP) among the participants, with 83.8% (n=67) exhibiting a craniovertebral angle (CVA) of less than 48°, indicating postural deviation. The majority of participants were between 25–30 years of age (65.1%), with a nearly balanced gender distribution: 52.5% male and 47.5% female. Daily screen time among participants was significant, with 36.3% reporting 8 hours and 33.8% exceeding 8 hours. Most had been using computers for more than two years (55%). Pulmonary function testing showed a reduction in respiratory performance among those with FHP. The mean ± standard deviation values for spirometric parameters across all participants were as follows: FEV1 was 3.150 ± 1.056 liters, FVC was 3.20 ± 0.998 liters, FEV1/FVC ratio was 1.45 ± 0.840, and PEF was 3.625 ± 0.718 liters/second. A statistically significant association was observed between FHP and all respiratory parameters, with p-values as follows: FEV1 ($p = 0.014$), FVC ($p = 0.042$), FEV1/FVC ratio ($p = 0.021$), and PEF ($p = 0.026$), indicating a notable decline in lung function among individuals with FHP.

Assessment of respiratory status revealed that only 10% of participants had normal pulmonary function. Mild dysfunction was observed in 18.8%, moderate dysfunction in 17.5%, and a considerable 53.8% demonstrated severe respiratory dysfunction. This highlights a concerning overlap between postural abnormalities and compromised pulmonary efficiency. FHP was found to be more common in females compared to males. Analysis of contributing ergonomic and lifestyle factors showed that prolonged sitting for more than six hours daily was the most prevalent risk factor, present in 83.8% of those with FHP. Other common contributors included neck strain and poor ergonomics (74.4%), incorrect monitor height (71.3%), lack of physical activity (65.0%), and inadequate lumbar support (58.8%). These findings reinforce the multifactorial etiology of FHP and its potential impact on respiratory health.

The attempt to calculate relative risk (RR) was inconclusive due to the absence of participants entirely free from respiratory dysfunction, thereby reinforcing the overwhelming impact of FHP on respiratory impairment in this population. Further analysis of the data revealed that participants with prolonged daily screen exposure (>8 hours) demonstrated more pronounced reductions in respiratory parameters compared to those with 6–7 hours of screen time. Specifically, mean FEV1 and FVC values were lower among individuals with longer screen durations, suggesting a dose-response relationship between screen exposure and respiratory compromise. Additionally, although FHP was not formally categorized into severity levels in the primary analysis, an exploratory comparison indicated that individuals with a more reduced craniovertebral angle (i.e., more severe FHP) exhibited significantly lower FEV1/FVC ratios and PEF values. These findings reinforce the hypothesis that increasing severity of FHP, likely linked with longer screen exposure, corresponds with greater impairment in pulmonary function. However, the absence of confidence intervals and effect size measurements limits the precision of these associations, and future studies should consider incorporating these statistical indicators for a more robust interpretation.

Table: Demographics and Work Conditions

Variable	Frequency (%)
Gender	Male (52.5%), Female (47.5%)
Age Group (Years)	25-30 (65.1%), 31-35 (34.9%)
Computer Use Duration	<1 year (32.5%), 1-2 years (12.5%), >2 years (55%)
Daily Screen Time	6 hours (13.8%), 7 hours (16.3%), 8 hours (36.3%), >8 hours (33.8%)

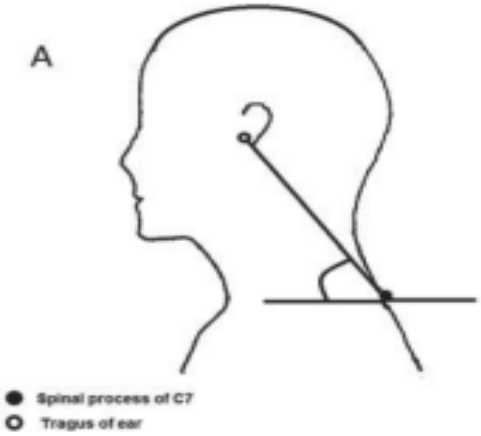

Figure: Photogrammetric method for measuring Craniovertebral Angle (CVA)

Figure: Evaluation of C7 for measurement of CVA by Photographic method

Figure: Assessment of Respiratory Function by Digital Spirometer

Table: Prevalence of Forward Head Posture and Respiratory Dysfunction

Condition	Frequency (%)
Forward Head Posture (FHP)	67 (83.8%)
Normal Respiratory Function	8 (10%)
Mild Respiratory Dysfunction	15 (18.8%)
Moderate Respiratory Dysfunction	14 (17.5%)
Severe Respiratory Dysfunction	43 (53.8%)

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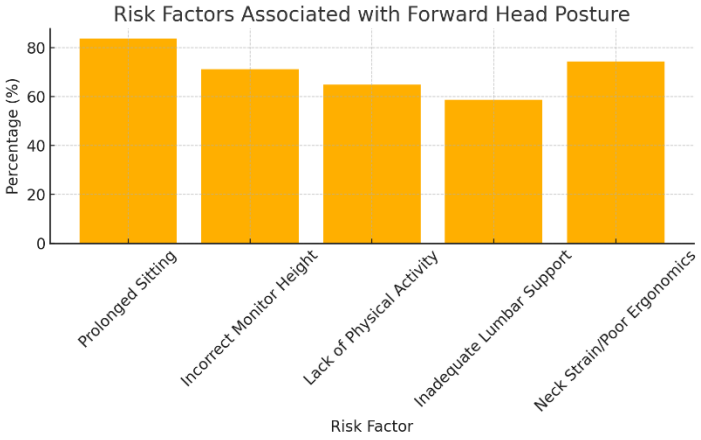
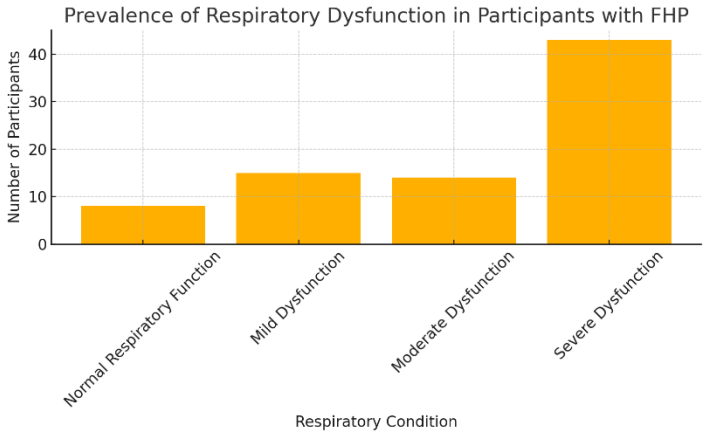
Table: Risk Factors Associated with Forward Head Posture

Risk Factor	Percentage (%)
Prolonged Sitting (>6 hrs/day)	83.8%
Incorrect Monitor Height	71.3%
Lack of Physical Activity	65.0%
Inadequate Lumbar Support	58.8%
Neck Strain and Poor Ergonomics	74.4%





DISCUSSION

The findings of this study demonstrated a high prevalence of Forward Head Posture (FHP) among computer workers, along with statistically significant associations between FHP and compromised pulmonary function. These results are consistent with previous research indicating that FHP alters thoracic biomechanics, reduces thoracic mobility, and affects respiratory muscle function, ultimately leading to impaired lung performance. The observed reduction in Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), FEV1/FVC ratio, and Peak Expiratory Flow (PEF) in individuals with FHP supports earlier studies that documented similar trends in respiratory dysfunction associated with altered cervical and thoracic alignment (19,20). Several studies have emphasized the role of FHP in altering the activity of accessory respiratory muscles, including the sternocleidomastoid and anterior scalene, particularly during inspiration and expiration. Chronic overuse of these muscles due to anterior head displacement contributes to reduced respiratory efficiency and vital capacity, further supporting the current findings (5). Another investigation revealed that individuals with FHP showed a tendency toward upper thoracic expansion and lower thoracic contraction, both of which affect chest wall dynamics and restrict effective lung inflation and deflation (18). The relationship between prolonged screen time and postural deviation was evident in the present study, echoing prior observations where individuals with increased computer usage hours exhibited a higher incidence of FHP and associated respiratory decline (7,21).

The study population, composed of adult computer users, is particularly relevant in today's occupational health landscape, where sedentary digital work is increasingly common. The clear trend observed between extended sitting, poor ergonomics, and respiratory dysfunction highlights the need for early ergonomic interventions and postural training to mitigate long-term musculoskeletal and respiratory consequences. This is further emphasized by the fact that more than half of the participants in this study experienced severe respiratory dysfunction, indicating a potentially high burden of preventable functional impairment in such populations. Interestingly, one contrasting study reported no significant difference in spirometric values between individuals with and without FHP, suggesting that the impact of FHP on pulmonary function may vary depending on population characteristics or methodological differences in posture assessment (12). However, such findings appear to be outliers when considered against the growing body of literature that consistently links poor postural habits with compromised respiratory efficiency.

This study holds several strengths. It utilized validated tools for postural assessment (photographic CVA method) and digital spirometry, adhering to standardized testing protocols, which strengthens the reliability of the measurements. The inclusion of participants with consistent daily screen exposure ensured homogeneity of the study population, enhancing the internal validity. Additionally, the comprehensive documentation of ergonomic risk factors allowed for a broader understanding of the multifactorial nature of FHP. Nevertheless, some limitations must be acknowledged. The use of a photographic method for CVA assessment posed discomfort for

some female participants, possibly affecting natural posture during image capture. The reliance on a single-session assessment may not fully capture variability in respiratory function influenced by diurnal or activity-related changes. Furthermore, the absence of a control group, stratification by FHP severity, or analysis of long-term outcomes limits the generalizability of findings. The unavailability of digital spirometry equipment in many local clinical settings also presents a barrier to routine screening in similar populations across Pakistan. Future studies should consider longitudinal designs to assess causality and progression of respiratory decline in relation to postural deviation. Investigating thoracic biomechanics and respiratory muscle strength in greater detail would provide a clearer understanding of underlying physiological mechanisms. Expanding the sample to include diverse occupational settings and incorporating rehabilitation outcomes would further strengthen the evidence base. There remains a significant need for preventive and corrective interventions targeting workplace ergonomics and respiratory health in populations exposed to prolonged digital device use.

CONCLUSION

This study concluded that Forward Head Posture is highly prevalent among computer workers and is significantly linked to diminished respiratory function, reinforcing the clinical importance of posture in occupational health. Contributing factors such as prolonged sitting, inadequate ergonomic practices, and sedentary lifestyles highlight the urgent need for preventive workplace strategies. These findings emphasize the value of integrating ergonomic adjustments, postural education, and regular physical activity into daily routines to counteract the negative impact of poor posture on respiratory health. The study provides a foundation for future research to explore long-term interventions and rehabilitation approaches aimed at preserving both musculoskeletal and pulmonary well-being in screen-dependent populations.

AUTHOR CONTRIBUTIONS

Author	Contribution
Kashaff Sarfraz	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Rohma Salman	Methodology, Investigation, Data Curation, Writing - Review & Editing
Asima Liaqat	Investigation, Data Curation, Formal Analysis, Software
Anbreena Rasool	Software, Validation, Writing - Original Draft

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