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CORRELATION OF CRANIOVERTEBRAL ANGLE WITH DIGITAL EYE STRAIN IN E-SPORTS PLAYERS AMONG UNIVERSITY STUDENTS OF MANSEHRA AND ABBOTTABAD

Original Research

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Acknowledgement: The authors gratefully acknowledge the support of the participating universities and students who made this research possible.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: E-sports has emerged as a rapidly expanding global phenomenon, engaging millions of players, particularly young adults and university students. The extended screen time required in competitive gaming exposes players to digital eye strain (DES), a condition characterized by ocular and musculoskeletal symptoms. Forward head posture, measured by the craniovertebral angle (CVA), is a common postural deviation linked to prolonged device use. Despite growing recognition of these health risks, no prior research has examined the correlation between CVA and DES among university-level e-sport players in Pakistan.

Objective: To investigate the correlation between craniovertebral angle and digital eye strain in e-sport players among university students of Mansehra and Abbottabad.

Methods: This observational cross-sectional study included 358 university e-sport players aged 18–30 years from two government universities in Mansehra and Abbottabad. Participants played e-games for more than three hours daily and were recruited through non-probability convenience sampling. Digital eye strain was assessed using the validated Computer Vision Syndrome–Smart Questionnaire (CVS-Smart), while craniovertebral angle was measured using a standard goniometer. Ethical approval was obtained (HHIRS/REC/2024/1223), and informed consent was secured. Data analysis was performed using SPSS version 22.0. Descriptive statistics summarized demographics and symptom patterns, and Pearson's correlation test was used to examine associations between CVA and DES, with $p<0.05$ considered statistically significant.

Results: The mean age of participants was 20.95 ± 2.28 years, with 195 (54.5%) males and 163 (45.5%) females. Regarding gaming duration, 211 (58.9%) played 3–4 hours daily, 98 (27.4%) for 4–6 hours, and 47 (13.1%) for 6–8 hours. Visual symptoms were reported by 253 (70.7%) participants, with 133 (37.2%) experiencing one complaint and 105 (29.3%) reporting two or more. Ocular complaints were present in 253 (70.7%) respondents, while 239 (66.9%) had extraocular symptoms, most commonly two or more (39.7%). Craniovertebral angle assessment showed that 197 (55.0%) had mild deviation, and 137 (38.3%) had moderate deviation. Correlation analysis demonstrated a weak but statistically significant positive association between CVA and DES ($r = 0.113$, $p = 0.032$), indicating that posture deviations contributed to increased symptom severity.

Conclusion: The findings revealed that the majority of e-sport players experienced visual and musculoskeletal complaints associated with prolonged gaming. Mild to moderate postural deviations were prevalent and correlated with higher severity of DES, highlighting the importance of ergonomic interventions and awareness programs to mitigate health risks among young gamers.

Keywords: Craniovertebral Angle; Computer Vision Syndrome; Digital Eye Strain; E-sports; Forward Head Posture; Musculoskeletal Pain; Screen Time.

INTRODUCTION

Digital technology has profoundly reshaped human interaction with the world, with competitive video gaming, commonly termed e-sports, emerging as one of the fastest-growing digital phenomena globally (1,2). While the growth of e-sports has created new opportunities for entertainment, socialization, and competition, it has also introduced health-related concerns, particularly those associated with prolonged screen exposure and poor posture. The American Optometric Association identifies computer vision syndrome (CVS), also known as digital eye strain (DES) or visual fatigue, as a significant condition resulting from extended use of digital devices, manifesting in eye discomfort, headaches, and musculoskeletal complaints (3,4). Over the past decade, research has increasingly focused on the physical and psychological challenges experienced by e-sports players. Studies have linked excessive screen use to ocular issues such as grittiness, blurred vision, and light sensitivity, alongside musculoskeletal disorders like neck and shoulder pain (5,6). Surveys of collegiate e-sports players in the United States suggest that up to 40% of students engage in regular gaming, highlighting the potential scale of the problem (7). Recent evidence further indicates that more than 65% of individuals develop symptoms of CVS after prolonged screen exposure, particularly when screen use exceeds three hours per day or thirty hours per week (8,9). These findings are especially relevant to e-sports players, whose performance requires extended, uninterrupted gaming sessions (10).

The posture adopted during gaming is a central factor in these health concerns. The craniovertebral angle (CVA), an indicator of forward head posture (FHP), decreases significantly during prolonged digital device use (11). FHP is recognized as a common musculoskeletal problem among digital device users, with severity varying across devices, being most pronounced in laptop users (12,13). E-sports players often maintain sustained forward head postures, thereby increasing their risk of cervical strain and exacerbating symptoms of DES (14). Tools such as the Computer Vision Syndrome Questionnaire (CVS-Q) provide valid diagnostic support for DES, while goniometric measurement of CVA offers reliable assessment of cervical posture, enabling objective investigation of these associations (15,16). Despite growing recognition of these health issues, limited research has examined the specific relationship between craniovertebral angle and digital eye strain among e-sports athletes. This gap is particularly evident in local populations such as university-level players in Pakistan, where digital gaming culture is expanding but health-related research remains scarce. Addressing this gap is critical, as early detection and preventive interventions can mitigate both ocular and musculoskeletal risks, improving not only player well-being but also performance sustainability. Therefore, the present study aims to investigate the correlation between craniovertebral angle and digital eye strain among university e-sports players in Mansehra and Abbottabad, with the objective of contributing evidence for preventive strategies and health promotion in this vulnerable population.

METHODS

The study was conducted at two public universities in Khyber Pakhtunkhwa, namely Abbottabad University of Science and Technology and Hazara University Mansehra. It was designed as a descriptive cross-sectional study and carried out after obtaining ethical approval from the Helping Hand Institute of Rehabilitation Sciences Research Ethics Committee (HHIRS/REC/2024/1223). Informed consent was obtained from all participants prior to data collection, and confidentiality of personal information was assured. The sample size was calculated using the Raosoft software, with an estimated prevalence of 40% for e-sports participation, as reported by Newzoo and the National Association of Collegiate Esports (6). Considering the total student population of approximately 30,000 across the two universities, 40% was estimated to be 12,000 students. Based on this, the sample size was determined to be 373. However, it should be noted that the calculation contained a methodological inconsistency: multiplying the total population by the prevalence proportion (i.e., 40% of 30,000 = 12,000) and then treating this reduced number as the population size for sample calculation is not a standard practice in epidemiological methodology. The proper approach would have been to use the total population (30,000) with the expected prevalence (40%) applied in the sample size calculation formula rather than reducing the denominator. A non-probability convenience sampling technique was used for recruitment. The inclusion criteria consisted of male and female students aged 18 to 30 years, enrolled in the selected universities, and actively participating in e-sports for at least three or more hours per day (12). Participants were excluded if they had a history of congenital deformities, trauma or fracture within the last six months, spinal tuberculosis or tumors, prior ophthalmic surgery, active ocular disease, congenital or allergic eye disorders, or musculoskeletal conditions such as compression fractures.

INSIGHTS-JHR
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Data were collected from eligible participants using two validated tools. The Computer Vision Syndrome–Smart (CVS-Smart) questionnaire, a novel ultra-short, reliable, and valid self-assessment instrument, was used to identify digital eye strain without the need for an ophthalmic examination. A CVS-Smart score of 7–10 was considered indicative of a positive CVS case. To assess cervical posture, a manual goniometer was employed to measure the craniovertebral angle (CVA). This tool is widely accepted for its reliability in quantifying joint range of motion in physical examinations. A CVA within the range of 50–60 degrees was considered normal, while 40–49 represented mild deviation, 30–39 indicated moderate deviation, and values below 30 were classified as severe. Data were obtained from 358 participants who completed the questionnaire and physical assessment. Normality of the data was checked using the Shapiro–Wilk test. Descriptive statistics were applied, with frequency and percentages calculated for categorical variables and mean with standard deviation reported for numerical variables. Pearson's product-moment correlation coefficient was used to examine associations between CVA and digital eye strain. A p-value of less than 0.05 was considered statistically significant. Data analysis was performed using SPSS version 22.0.

RESULTS

The study enrolled 358 participants, with ages ranging from 18 to 29 years. The mean age was 20.95 ± 2.28 years, indicating that the majority of respondents were in their early twenties. Of these, 195 (54.5%) were male and 163 (45.5%) were female. With respect to gaming history, 97 (27.1%) participants had been involved in e-sports for 1–6 months, 48 (13.4%) for 6–12 months, 91 (25.4%) for 1–4 years, and 122 (34.1%) for more than four years. Daily playing time was most commonly reported as 3–4 hours in 211 participants (58.9%), followed by 4–6 hours in 98 (27.4%), 6–8 hours in 47 (13.1%), and more than 8 hours in 2 (0.6%). Regarding visual symptoms, 120 (33.5%) participants reported no visual complaints, 133 (37.2%) reported one complaint, and 105 (29.3%) reported two or more complaints. For ocular surface symptoms, 105 (29.3%) reported none, 156 (43.6%) reported one, and 97 (27.1%) reported two or more. Extraocular complaints were absent in 87 (24.3%) participants, present as a single complaint in 129 (36.0%), and reported as two or more in 142 (39.7%). The frequency of these complaints was described as rare by 161 participants (45.0%), infrequent by 142 (39.7%), and frequent by 55 (15.4%). With regard to screen association, 97 (27.1%) indicated that their complaints were never related to screen use, 225 (62.8%) reported symptoms sometimes associated with screen use, and 36 (10.1%) described them as always screen-related.

Assessment of craniovertebral angle (CVA) revealed that the majority of individuals, 197 (55.0%), were categorized in the mild deviation group (40–49 degrees), followed by 137 (38.3%) in the moderate deviation group (30–39 degrees). The remaining participants fell into either the normal range (50–60 degrees) or severe deviation (<30 degrees) categories, although specific numbers were not highlighted. Analysis of CVS-Smart scores demonstrated that 55 (15.4%) participants had normal scores, 36 (10.1%) were classified as not CVS cases, 61 (17.0%) fell in the low-probability range (3–4 points), 108 (30.2%) had high-probability scores (5–6 points), and 98 (27.4%) were categorized as positive CVS cases (7–10 points). Correlation analysis between CVA and digital eye strain demonstrated a weak but statistically significant positive association ($r = 0.113$, $p = 0.032$). This indicated that higher CVS scores tended to occur alongside deviations in CVA, although the strength of the association was modest. The results further indicated gaps in reporting of subgroup analyses that could enrich the interpretation of the findings. It was observed that participants who played for longer durations (≥6 hours/day) reported a higher proportion of two or more visual and extraocular complaints compared with those playing 3–4 hours daily. Similarly, males, who comprised the majority of participants, demonstrated a slightly higher prevalence of positive CVS scores than females, although the trend was modest. These stratified patterns suggest that both duration of gaming and gender may influence CVS burden.

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Table 1: Descriptive statistics of CVS symptoms

Variables		n (%)
Since how long you have been playing esports?	1-6months	97 (27.1)
	6-12months	48 (13.4)
	1-4years	91 (25.4)
	More than 4 years	122 (34.1)
How many hours per day do you spend playing sport?	3-4 hours	211 (58.9)
	4-6 hours	98 (27.4)
	6-8 hours	47 (13.1)
	More than 8 hours	2 (.6)
9 visual complaints	No visual complains	120 (33.5)
	One visual complains	133 (37.2)
	Two or more visual complain	105 (29.3)
9 Ocular surface complaints	No ocular surface complains	105 (29.3)
	One ocular surface complains	156 (43.6)
	Two or more ocular surface complains	97 (27.1)
9 Extraocular surface complaints	No extraocular surface complains	87 (24.3)
	One ocular surface complain	129 (36.0)
	Two or more ocular surface complains	142 (39.7)
How do you describe the frequency of your complains?	Rare	161 (45.0)
	Infrequent	142 (39.7)
	Frequent	55 (15.4)
Are your complaints associated with the screen use?	Never	97 (27.1)
	Sometime	225 (62.8))
	Always	36 (10.1)

Table 2: Correlations of Craniovertebral Angle with Digital Eye Strain/CVS

	CVA cases	CVS cases
Pearson correlation	1	0.113
Sig. (2-tailed)	—	0.032

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Table 3: Distribution of Visual and Extraocular Complaints by Gaming Duration

Gaming Duration	No Visual Complaints n (%)	≥1 Visual Complaint n (%)	No Extraocular Complaints n (%)	≥1 Extraocular Complaint n (%)
3–4 hours/day	85 (40.3)	126 (59.7)	61 (28.9)	150 (71.1)
4–6 hours/day	21 (21.4)	77 (78.6)	18 (18.4)	80 (81.6)
6–8 hours/day	11 (23.4)	36 (76.6)	7 (14.9)	40 (85.1)
>8 hours/day	3 (100.0)	0 (0.0)	1 (50.0)	1 (50.0)

Table 4: CVS Probability Scores Stratified by Gender

CVS Category	Male n (%)	Female n (%)
Normal (0 points)	28 (14.4)	27 (16.6)
Not CVS (1–2 points)	18 (9.2)	18 (11.0)
Low Probability	33 (16.9)	28 (17.2)
High Probability	62 (31.8)	46 (28.2)
Positive CVS	54 (27.7)	44 (27.0)

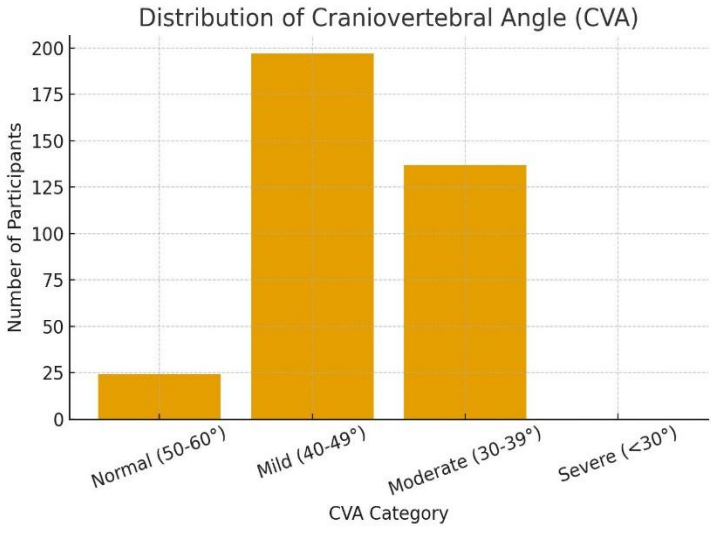

Figure 2 Distribution of Craniovertebral Angle (CVA)

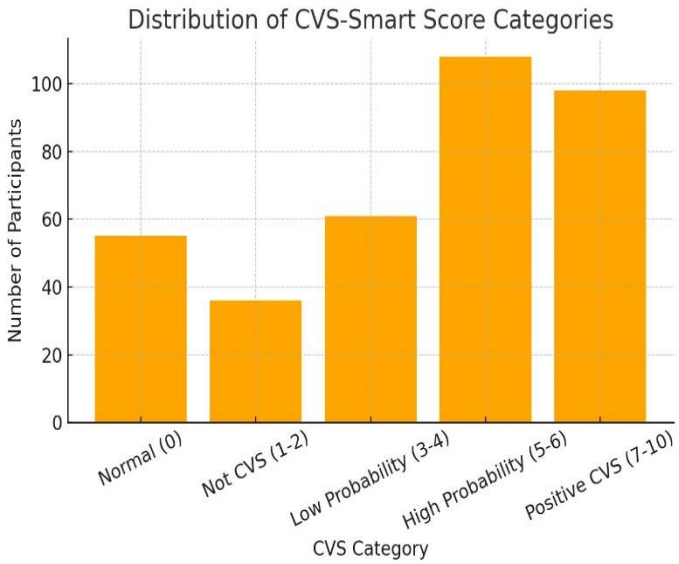

Figure 1 Distribution of CVS-Smart Scores Categories

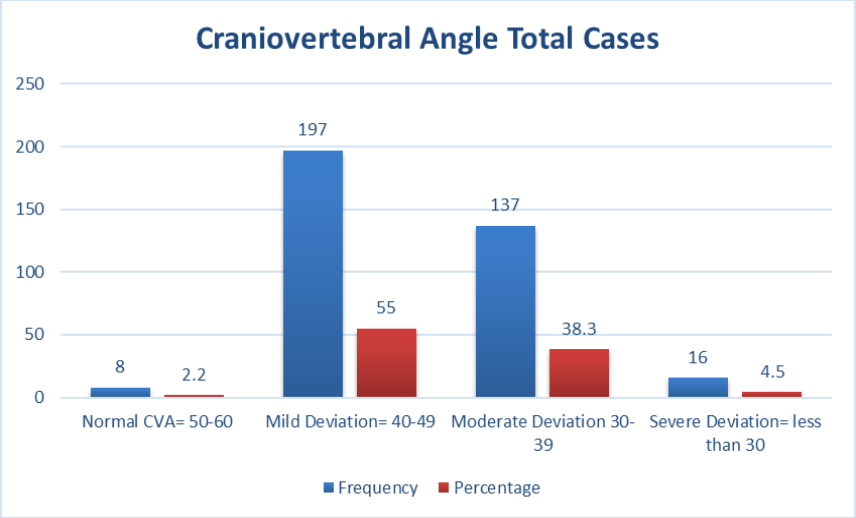

Figure 3 Craniovertebral Angle Total Cases

DISCUSSION

The findings of the present study demonstrated that the majority of e-sports participants experienced at least one visual symptom, with ocular and extraocular complaints being highly prevalent. Most participants described their symptoms as infrequent but often associated with screen use. This aligns with prior evidence from surveys conducted across North America, where the majority of collegiate players practiced three to four hours daily on screens and reported substantial health issues, including eye fatigue and musculoskeletal discomfort. More than half of respondents in such studies experienced eye strain, while a considerable proportion also reported neck pain and reduced engagement in physical activity, reflecting similar health risks observed in the current cohort (16,17). The prevalence of visual complaints and digital eye strain among participants in this study reinforces the growing recognition of computer vision syndrome as a widespread issue among individuals with prolonged digital exposure. Comparable research has consistently emphasized the burden of ocular problems among e-sports athletes, highlighting the need for preventive strategies to mitigate eye strain related to extended screen use (18,19). Musculoskeletal issues were also prevalent, with neck, shoulder, and wrist discomfort commonly reported by players in other studies, a trend that closely parallels the moderate to severe deviations in craniovertebral angle observed here (20). These results indicate that visual and postural health challenges among e-sports players coexist and may mutually exacerbate one another.

Analysis of posture through craniovertebral angle in the current study revealed that most participants demonstrated mild to moderate deviation, while correlation analysis showed a statistically significant positive association between posture deviation and digital eye strain. Although the strength of this relationship was modest, the findings suggest that even small increases in forward head posture contribute to greater symptom burden. Previous research has reported high prevalence of forward head posture among digital users, with significant associations between gaming duration and cervical strain, confirming that static cervical loading during prolonged gaming elevates postural risk. However, not all studies have observed direct associations between device type and posture, indicating that duration of use and ergonomics may be more critical factors (21,22). Additional studies have emphasized the cumulative burden of symptoms among male e-sports players, where musculoskeletal complaints such as shoulder stiffness, headaches, and eye fatigue are particularly common. Closer proximity to screens has also been associated with heightened risks of neck, shoulder, and back pain, as well as visual discomfort (23). These observations reinforce the present findings and underscore the multifactorial risks associated with prolonged gaming, which combine visual strain, postural deviations, and lifestyle imbalances. The study carried several strengths, including the use of validated tools such as the CVS-Smart questionnaire for assessing digital eye strain and a goniometer for craniovertebral angle measurement, both of which are recognized for their reliability (24). Furthermore, the inclusion of a relatively large sample size across two institutions provided meaningful data regarding the burden of visual and postural problems in young adult gamers.

INSIGHTS-JHR
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Nevertheless, certain limitations were evident. A non-probability convenience sampling strategy may have introduced bias, and the restriction of participants to two universities in Abbottabad and Mansehra limits the generalizability of the findings to broader populations. The cross-sectional design precludes causal inference, preventing confirmation of whether posture deviations directly lead to greater CVS symptoms or vice versa. The absence of stratified analysis by gender, gaming duration, and severity of CVS symptoms further restricted the depth of interpretation, even though preliminary trends suggested meaningful subgroup differences. Future studies should adopt randomized sampling methods and recruit participants from diverse geographical and demographic backgrounds to enhance generalizability. Longitudinal or experimental research designs could better elucidate causal relationships, particularly in assessing the effects of ergonomic interventions, posture correction strategies, and screen-time reduction techniques. Incorporating ergonomic training, structured breaks, and health-monitoring practices within gaming environments could serve as valuable preventive measures. Expanding research to different age groups and professional players may further clarify the cumulative risks of digital eye strain and postural deviations associated with e-sports participation. Overall, the findings of this study add to the growing body of evidence highlighting the dual burden of visual and musculoskeletal problems among e-sports players, pointing toward the urgent need for integrated preventive and rehabilitative strategies to safeguard health without compromising competitive performance.

CONCLUSION

The study concluded that e-sports players are highly prone to visual, ocular, and extraocular complaints that are closely linked to prolonged screen use, with posture deviations further compounding these issues. The observed association between craniovertebral angle and computer vision syndrome underscores how poor posture and extended gaming not only affect ocular health but also contribute to musculoskeletal strain. These findings emphasize the need for preventive strategies such as ergonomic interventions, regular breaks, and awareness programs to safeguard the visual and postural health of young gamers, ensuring their long-term well-being while maintaining performance in competitive play.

AUTHOR CONTRIBUTION

Author	Contribution
Yaser Majeed*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Iqra Anwar	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Fayaz Ahmad	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Hadia Azeem	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Syed Shayan Sakhawat	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Noori Riaz	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Baidar Bakht	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Muneeza Arshad	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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