

Gaming-Related Ergonomic Factors and Regional Musculoskeletal Symptoms among Professional and Amateur Video Gamers in Nigeria: An Analytical Cross-Sectional Study

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Abstract

Background

Musculoskeletal symptoms are common among video gamers, but evidence regarding their association with gaming-related ergonomic factors remains limited, particularly among Nigerian gamers. This study examined associations between gaming-related ergonomic factors and musculoskeletal symptoms among professional and amateur video gamers in Nigeria.

Methods

We conducted an analytical cross-sectional study of 120 adult Nigerian video gamers recruited between September and December 2024 in Enugu State, Nigeria. Participants comprised 60 professional and 60 amateur gamers. Gaming characteristics and ergonomic factors, including prolonged static sitting, sustained neck/trunk posture, repetitive upper-limb activity, upper-limb support, workstation configuration, and gaming breaks, were assessed using a structured questionnaire. Musculoskeletal symptoms across nine anatomical regions were assessed using the Nordic Musculoskeletal Questionnaire-Extended. Binary logistic regression examined crude and adjusted associations with musculoskeletal symptoms in any region during the preceding 12 months.

Results

Mean age was 24.8 ± 4.2 years, and 99 (82.5%) were male. Overall, 78 (65.0%) reported musculoskeletal symptoms in at least one region. Most affected regions were the neck (46.7%), lower back (40.8%), shoulders (35.8%), and wrists/hands (30.0%). Prolonged static sitting affected 77 (64.2%), sustained neck/trunk posture 69 (57.5%), repetitive upper-limb activity 73 (60.8%), and infrequent gaming breaks 64 (53.3%). Adjusted analysis showed higher odds with prolonged static sitting (aOR 2.12, 95% CI 1.01–4.46), sustained neck/trunk posture (aOR 2.28, 95% CI 1.05–4.94), infrequent gaming breaks (aOR 2.41, 95% CI 1.09–5.34), and longer gaming duration (aOR 1.07, 95% CI 1.01–1.14). Professional gaming status was not independently associated.

Conclusions

Musculoskeletal symptoms were common among Nigerian gamers. Prolonged static sitting, sustained neck/trunk posture, infrequent breaks, and longer gaming duration were associated with higher odds of symptoms. Prospective studies using objective exposure measures and validated gaming-specific ergonomic instruments are warranted.

Introduction

Video gaming has expanded beyond recreational participation to include increasingly organised forms of competitive play [1]. eSports refers to organised competitive video gaming in which individual players or teams participate in structured competitions [1, 2]. The professionalisation of competitive gaming has created environments characterised by structured training and repeated practice [3, 4]. These characteristics have increased interest in the physical health demands associated with intensive gaming participation [5, 6].

Although gaming is predominantly sedentary, it requires sustained interaction with computers, consoles, mobile devices and other gaming equipment [7]. Prolonged sitting, static postures and repetitive upper-limb movements may expose gamers to physical demands involving the neck, shoulders, back, elbows, wrists and hands [7, 8]. Evidence from professional eSports populations indicates that musculoskeletal disorders are common, with symptoms reported in the lower back, shoulders, neck and wrists among other anatomical regions [9]. In a systematic review of 10 studies involving 789 eSports athletes, [9] reported substantial variation in musculoskeletal disorder prevalence and identified longer training duration and inadequate ergonomic arrangements among factors associated with musculoskeletal symptoms.

The distribution of symptoms across anatomical regions is particularly relevant when considering the physical characteristics of gaming [7]. Gaming requires sustained positioning of the head, trunk and upper limbs, while the type and position of gaming equipment may influence the posture adopted during play [10]. Studies of elite mobile eSports players have examined spinal posture, mobility and stability, while other research has investigated upper-limb neuropathies among eSports athletes [10, 11]. These findings indicate that physical problems associated with gaming may involve multiple anatomical regions rather than being restricted to the hand or wrist [7, 10, 11].

Gaming-related ergonomic factors encompass characteristics of the gaming workstation, equipment positioning, seating arrangement, posture and upper-limb support during play [5, 10]. These factors may be particularly relevant during prolonged gaming sessions because the physical conditions in which gaming is performed determine how sustained postural and upper-limb exposure is experienced [5]. [9] identified inadequate ergonomic setup among factors associated with musculoskeletal symptoms in eSports athletes, including findings concerning the availability of arm support. However, much of the available evidence has focused on professional eSports populations [9].

Differences in gaming status may therefore be important when examining musculoskeletal outcomes. Professional and amateur gamers may differ in training volume, duration of gaming, competitive exposure, equipment use and gaming routines [4, 12]. Research comparing professional and casual mobile eSports players has specifically examined differences in health risks and musculoskeletal problems according to gaming status [13]. Musculoskeletal complaints and injuries have also been documented among professional and collegiate eSports populations exposed to organised competitive gaming [14, 15]. These findings support the relevance of examining gaming status alongside the ergonomic conditions under which gaming occurs [13].

The Nigerian context provides an important setting for investigating these relationships because musculoskeletal symptoms associated with technology use have previously been reported among Nigerian computer users [16, 17]. Reported complaints have included symptoms involving the neck, low back, shoulders, wrists and fingers [16]. Longer daily and accumulated computer exposure has also been associated with increased reporting of musculoskeletal symptoms among Nigerian computer users [17]. Poor computer-use posture has additionally been associated with musculoskeletal discomfort among Nigerian students [18].

However, occupational and educational computer use represents a different exposure pattern from video gaming [7, 19]. Recent Nigerian research has examined gaming behaviour and compulsive gaming among young people [20], but this evidence does not specifically characterise gaming-related ergonomic factors together with region-specific musculoskeletal symptoms among professional and amateur gamers. Consequently, evidence remains limited regarding whether professional and amateur gamers differ in their gaming-related ergonomic characteristics and regional musculoskeletal symptom profiles. Evidence is also limited regarding the association between specific gaming-related ergonomic characteristics and musculoskeletal symptoms reported during the preceding 12 months among Nigerian gamers.

An analytical cross-sectional design is appropriate for examining the distribution of ergonomic exposures and musculoskeletal symptoms and their associations within a defined population. Such a design can also be used to compare professional and amateur gamers with respect to ergonomic characteristics and regional musculoskeletal symptoms. However, because exposure and outcome are assessed concurrently, associations identified in a cross-sectional study cannot establish temporal precedence or causality [7, 9].

Therefore, this study aims to determine the association between gaming-related ergonomic factors and regional musculoskeletal symptoms among professional and amateur video gamers in Nigeria. Specifically, the study will determine the prevalence and anatomical distribution of musculoskeletal symptoms, characterise gaming-related ergonomic factors, compare ergonomic characteristics between professional and amateur gamers, compare regional musculoskeletal symptoms between the two groups, and examine ergonomic and gaming-related factors associated with overall and region-specific musculoskeletal symptoms.

Methods

Study Design

An analytical cross-sectional study was conducted to investigate the association between gaming-related ergonomic factors and musculoskeletal symptoms among professional and amateur video gamers in Nigeria. The study was reported in accordance with the STROBE recommendations for cross-

sectional studies [21]. As exposure and outcome were assessed concurrently, observed associations were interpreted as non-causal.

Study Setting and Period

The study was conducted among video gamers residing in Nigeria. Recruitment was undertaken through gaming centres in Enugu State and online gaming communities, including Telegram, WhatsApp, and Facebook groups. Participants were recruited between September 2024 and December 2024. The same eligibility criteria and questionnaire were used across all recruitment sources.

Participants

The study population comprised Nigerian adults aged ≥ 18 years who actively participated in video gaming. Participants were eligible if they resided in Nigeria, had actively engaged in video gaming, used a seated gaming setup involving a computer, console, or comparable device, met the predefined criteria for professional or amateur gaming status, and provided informed consent. Mobile gamers whose primary gaming exposure involved handheld devices and participants who primarily played virtual-reality games while standing were excluded because their gaming postures and ergonomic exposures differed from the seated gaming conditions investigated in the study.

Operational Definition of Gaming Status

Gaming status was defined a priori based on participation and occupational/competitive characteristics rather than gaming duration alone.

A professional gamer was defined as an adult who participated in organised competitive video gaming as a structured competitive activity, including participation in organised tournaments or teams and/or receipt of gaming-related income, sponsorship, or other professional remuneration.

An amateur gamer was defined as an adult who actively participated in video gaming but did not meet the predefined criteria for professional gaming, including individuals who participated competitively at a non-professional level or primarily played for recreation.

Participants who could not be confidently classified according to these criteria were excluded from the primary comparative analysis.

Sampling and Recruitment

Convenience sampling was used because a comprehensive sampling frame of professional and amateur video gamers in Nigeria was not available. Participants were recruited from gaming centres and online

gaming communities using social media platforms, including Telegram, WhatsApp, and Facebook. Recruitment was undertaken across both professional/competitive and amateur gaming communities to facilitate representation of both gaming-status groups.

Recruitment materials provided a brief description of the study and the eligibility criteria. Potential participants received the same study information and consent procedures irrespective of the recruitment source. Participants completed the questionnaire only once, and those recruited online were informed that duplicate submissions were not permitted.

Sample Size Determination

The primary objective was to examine the association between gaming-related ergonomic exposures and musculoskeletal symptoms; therefore, an association-based approach was used for sample-size planning [22]. The calculation assumed a two-sided significance level of 0.05, 80% power, a 35% prevalence of musculoskeletal symptoms among participants without the exposure, an anticipated odds ratio of 2.50, and an exposure prevalence of approximately 40%. Based on these assumptions, the planned sample size was 120 participants, comprising 60 professional and 60 amateur gamers. The final analytical sample comprised 120 participants and therefore met the planned sample size. Region-specific analyses were considered exploratory and were performed only where sufficient outcome events were available.

Study Variables

The primary exposure variables were gaming-related ergonomic characteristics, including awkward or sustained posture, prolonged static posture, repetitive upper-limb movements, seating characteristics, workstation configuration, upper-limb support, monitor and input-device positioning, and break practices. The primary outcome was the presence of musculoskeletal symptoms in at least one anatomical region during the preceding 12 months, assessed using the Extended Nordic Musculoskeletal Questionnaire (NMQ-E). Secondary outcomes were symptoms in specific anatomical regions.

Potential confounders considered a priori included age, sex, gaming status, gaming duration, gaming frequency, years of gaming, and physical activity. Variables were selected for adjustment based on their potential relationships with the exposure and outcome rather than solely on statistical significance in univariable analyses.

Assessment of Musculoskeletal Symptoms

Musculoskeletal symptoms were assessed using the Extended Nordic Musculoskeletal Questionnaire (NMQ-E). The NMQ-E assessed symptoms across nine anatomical regions: neck, shoulders, upper back, lower back, elbows, wrists/hands, hips, knees, and ankles/feet. Participants reported lifetime symptoms

and symptoms experienced during the preceding 12 months, together with the consequences of musculoskeletal symptoms [23, 24].

Assessment of Gaming-related Ergonomic Factors

Gaming-related ergonomic exposures were assessed using selected items adapted from the Dutch Musculoskeletal Questionnaire (DMQ), supplemented by investigator-developed questions addressing gaming-specific workstation, seating, upper-limb support, screen/device positioning, and break practices [25]. The adapted items were modified from their original occupational context to reflect participants' usual gaming activities.

The ergonomic assessment covered prolonged static sitting, sustained neck or trunk posture, repetitive upper-limb movements, seating and back support, foot support, upper-limb support, screen/device positioning, and break practices. Frequency-based ergonomic items were assessed using five response categories: never, rarely, sometimes, often, and always. Other ergonomic characteristics were assessed using appropriate categorical response options.

For the primary analysis, ergonomic variables were operationalised as binary exposure variables according to prespecified study criteria. The criteria used to classify participants as exposed or unexposed were applied consistently across professional and amateur gamers. Because the adapted DMQ items and additional gaming-specific questions were not validated as a single gaming-specific ergonomic instrument, the resulting measures were treated as self-reported indicators of gaming-related ergonomic exposure rather than as scores from a validated gaming-specific ergonomic scale.

The primary ergonomic exposures examined in the analysis were prolonged static sitting, sustained neck/trunk posture, repetitive upper-limb activity, upper-limb support, workstation configuration, and gaming break practices.

Assessment of Physical Activity and Other Characteristics

Demographic and gaming-related characteristics were collected using a structured study-specific questionnaire. Physical activity was assessed using self-reported information on participation in physical activity outside gaming, including frequency and duration. Participants were categorised as physically active or physically inactive according to the prespecified study criteria. Physical activity was considered as a potential covariate in the analysis of musculoskeletal symptoms.

Data collection procedure

Following ethical approval, the study questionnaire was administered electronically using Google Forms. The first section provided study information and electronic informed consent. Participants who consented completed questions on sociodemographic characteristics, gaming characteristics, ergonomic exposures, and musculoskeletal symptoms. Participants recruited through gaming centres completed the questionnaire independently, while those recruited online accessed the same

questionnaire through links distributed in gaming communities. Completed responses were exported to Microsoft Excel and subsequently imported into SPSS for analysis.

Measures to Minimise Bias

The same questionnaires, eligibility criteria, and operational definitions were used for professional and amateur gamers. Recruitment was conducted through both gaming centres and online gaming communities to facilitate access to participants from both gaming-status groups. Nevertheless, selection bias could not be completely excluded because convenience sampling was used. Self-reported ergonomic exposures and musculoskeletal symptoms were also susceptible to recall and reporting bias. Furthermore, because exposure and outcome were assessed concurrently, reverse causation was possible; participants experiencing musculoskeletal symptoms may have modified their gaming posture, equipment, or break practices in response to their symptoms.

Quantitative Variables

Continuous variables, including age, gaming duration, and years of gaming, were retained as continuous variables where appropriate. Their distributions were assessed before analysis. Where categorisation was necessary, category boundaries were defined a priori.

Statistical Analysis

Data were analysed using IBM SPSS Statistics version 29. Continuous variables were assessed for distribution and summarised using means and standard deviations for approximately normally distributed variables or medians and interquartile ranges for skewed variables. Categorical variables were presented as frequencies and percentages.

The prevalence of musculoskeletal symptoms was calculated overall and by anatomical region. Professional and amateur gamers were compared using independent-samples *t*-tests or Mann–Whitney *U* tests for continuous variables, as appropriate, and Pearson's chi-square test or Fisher's exact test for categorical variables.

The primary analytical outcome was the presence of musculoskeletal symptoms in at least one anatomical region during the preceding 12 months. Binary logistic regression was used to estimate crude and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for associations between selected gaming-related ergonomic exposures and overall musculoskeletal symptoms.

A parsimonious multivariable model was developed using the primary ergonomic exposures and prespecified potential confounders. Age, sex, gaming duration, and gaming status were considered a priori confounders. Given the sample size, the number of predictors in the final model was restricted to reduce the risk of overfitting. Region-specific regression analyses were considered exploratory and were performed only where sufficient outcome events were available.

Multicollinearity was assessed before fitting the final multivariable model, and model discrimination and calibration were assessed using appropriate diagnostic procedures. Missing data were examined for each variable, and complete-case analysis was used where missing data were minimal. All statistical tests were two-sided, with $p < 0.05$ considered statistically significant. Findings from exploratory region-specific analyses were interpreted cautiously.

Ethical Considerations

Ethical approval

was obtained from the University of Nigeria Teaching Hospital Health Research Ethics Committee (NHREC/05/01/2008B-FWA00002458-1RB00002323). All participants provided informed consent before enrolment. Participation was voluntary, and participants were informed that they could withdraw from the study. Study data were coded and handled confidentially.

Results

Participant Characteristics

A total of 138 individuals were assessed for eligibility, of whom 18 were excluded because they did not meet the eligibility criteria or did not complete the questionnaire. The final analytical sample comprised 120 participants, including 60 professional gamers and 60 amateur gamers.

The mean age of the participants was 24.8 ± 4.2 years, with no significant difference between professional gamers (25.1 ± 4.4 years) and amateur gamers (24.5 ± 4.0 years; $p = 0.43$). Most participants were male (99/120, 82.5%), with no significant difference in sex distribution between professional and amateur gamers (85.0% vs. 80.0%, respectively; $p = 0.46$).

Gaming-related characteristics differed significantly between the two groups. A greater proportion of professional gamers reported gaming on at least 5 days per week compared with amateur gamers (81.7% vs. 45.0%; $p < 0.001$). Similarly, a higher proportion of professional gamers reported gaming for at least 4 hours per day (78.3% vs. 40.0%; $p < 0.001$). Professional gamers also had a higher median duration of gaming experience than amateur gamers (8 [IQR: 6–11] vs. 6 [IQR: 4–9] years; $p = 0.01$).

Computer gaming was the predominant gaming mode overall, reported by 74 participants (61.7%), although the difference between professional and amateur gamers did not reach statistical significance (70.0% vs. 53.3%; $p = 0.06$). Regarding physical activity, 72 participants (60.0%) were classified as physically active and 48 (40.0%) as physically inactive. The proportion classified as physically active did not differ significantly between professional and amateur gamers (53.3% vs. 66.7%; $p = 0.139$). Detailed participant characteristics are presented in Table 1.

Table 1
Sociodemographic and Gaming Characteristics of Participants

Characteristic	Total (n = 120)	Professional (n = 60)	Amateur (n = 60)	p-value
Age, years, mean $\pm$ SD	24.8 $\pm$ 4.2	25.1 $\pm$ 4.4	24.5 $\pm$ 4.0	0.43
Male, n (%)	99 (82.5)	51 (85.0)	48 (80.0)	0.46
Gaming $\geq$ 5 days/week, n (%)	76 (63.3)	49 (81.7)	27 (45.0)	< 0.001
Gaming $\geq$ 4 h/day, n (%)	71 (59.2)	47 (78.3)	24 (40.0)	< 0.001
Years of gaming, median (IQR)	7 (5–10)	8 (6–11)	6 (4–9)	0.01
Mainly computer gaming, n (%)	74 (61.7)	42 (70.0)	32 (53.3)	0.06
Physical activity, n (%)	72 (60.0)	32 (53.3)	40 (66.7)	0.139
Physically inactive, n (%)	48 (40.0)	28 (46.7)	20 (33.3)	—
Note: SD = standard deviation; IQR = interquartile range. p-values compare professional and amateur gamers. Physical activity and physical inactivity represent complementary categories of the same variable.				

Gaming-related Ergonomic Characteristics

Prolonged static sitting was reported by 77 participants (64.2%), while 69 (57.5%) reported maintaining a sustained neck or trunk posture for prolonged periods. Repetitive upper-limb activity was reported by 73 participants (60.8%), and 64 (53.3%) reported infrequent gaming breaks.

Professional gamers reported a higher frequency of prolonged static sitting than amateur gamers (75.0% vs. 53.3%; $p = 0.014$). Repetitive upper-limb activity was also more frequently reported among professional gamers (70.0% vs. 51.7%; $p = 0.040$), as was inadequate upper-limb support (56.7% vs. 35.0%; $p = 0.020$) and infrequent gaming breaks (65.0% vs. 41.7%; $p = 0.010$). Differences in sustained neck/trunk posture (65.0% vs. 50.0%; $p = 0.090$) and inadequate workstation configuration (48.3% vs. 31.7%; $p = 0.070$) were not statistically significant. The distribution of gaming-related ergonomic exposures is presented in Table 2.

Table 2
Gaming-related Ergonomic Exposures

Ergonomic characteristic	Total n (%)	Professional n (%)	Amateur n (%)	p-value
Prolonged static sitting	77 (64.2)	45 (75.0)	32 (53.3)	0.014
Sustained neck/trunk posture	69 (57.5)	39 (65.0)	30 (50.0)	0.090
Repetitive upper-limb activity	73 (60.8)	42 (70.0)	31 (51.7)	0.040
Inadequate upper-limb support	55 (45.8)	34 (56.7)	21 (35.0)	0.020
Gaming without regular breaks	64 (53.3)	39 (65.0)	25 (41.7)	0.010
Inadequate workstation configuration	48 (40.0)	29 (48.3)	19 (31.7)	0.070
<i>Note: p-values compare professional and amateur gamers.</i>				

Prevalence and Anatomical Distribution of Musculoskeletal Symptoms

Seventy-eight of the 120 participants (65.0%) reported musculoskeletal symptoms in at least one anatomical region during the preceding 12 months. The most frequently reported anatomical regions were the neck (56, 46.7%), lower back (49, 40.8%), shoulders (43, 35.8%), and wrists/hands (36, 30.0%).

Neck symptoms were reported by 56 participants (46.7%), including 32 professional gamers (53.3%) and 24 amateur gamers (40.0%; $p = 0.143$). Lower-back symptoms were reported by 49 participants (40.8%), with a significantly higher proportion among professional gamers than amateur gamers (50.0% vs. 31.7%; $p = 0.044$). Shoulder symptoms were reported by 43 participants (35.8%), with no statistically significant difference between professional and amateur gamers (43.3% vs. 28.3%; $p = 0.089$). Wrist/hand symptoms were reported by 36 participants (30.0%), with no statistically significant difference between professional and amateur gamers (38.3% vs. 21.7%; $p = 0.052$).

Overall, musculoskeletal symptoms in at least one anatomical region were reported by 44 professional gamers (73.3%) and 34 amateur gamers (56.7%). The difference between the two groups was not statistically significant ($p = 0.055$). The remaining anatomical regions also showed no statistically significant differences between professional and amateur gamers ($p > 0.05$). The regional distribution of musculoskeletal symptoms is presented in Table 3.

Table 3
Regional distribution of musculoskeletal symptoms during the preceding 12 months

Anatomical region	Total n (%)	Professional n (%)	Amateur n (%)	p-value
Neck	56 (46.7)	32 (53.3)	24 (40.0)	0.143
Shoulders	43 (35.8)	26 (43.3)	17 (28.3)	0.089
Upper back	29 (24.2)	17 (28.3)	12 (20.0)	0.282
Lower back	49 (40.8)	30 (50.0)	19 (31.7)	0.044
Elbows	17 (14.2)	10 (16.7)	7 (11.7)	0.444
Wrists/hands	36 (30.0)	23 (38.3)	13 (21.7)	0.052
Hips	15 (12.5)	9 (15.0)	6 (10.0)	0.419
Knees	18 (15.0)	10 (16.7)	8 (13.3)	0.631
Ankles/feet	12 (10.0)	7 (11.7)	5 (8.3)	0.538
Any region	78 (65.0)	44 (73.3)	34 (56.7)	0.055
<i>Note: p-values compare professional and amateur gamers. Participants could report symptoms in more than one anatomical region; therefore, regional frequencies are not mutually exclusive.</i>				

Association Between Gaming-related Ergonomic Factors and Musculoskeletal Symptoms

In crude logistic regression analysis, prolonged static sitting, sustained neck/trunk posture, repetitive upper-limb activity, infrequent gaming breaks, and gaming for ≥ 4 hours per day were statistically associated with higher odds of reporting musculoskeletal symptoms. Participants who reported prolonged static sitting had more than twice the odds of reporting musculoskeletal symptoms compared with those who did not report prolonged static sitting (OR = 2.31, 95% CI: 1.08–4.95; $p = 0.031$). Sustained neck/trunk posture (OR = 2.44, 95% CI: 1.15–5.17; $p = 0.020$), repetitive upper-limb activity (OR = 2.17, 95% CI: 1.02–4.61; $p = 0.044$), infrequent gaming breaks (OR = 2.68, 95% CI: 1.25–5.75; $p = 0.011$), and gaming for ≥ 4 hours per day (OR = 2.21, 95% CI: 1.04–4.70; $p = 0.039$) were also statistically associated with higher odds of musculoskeletal symptoms. Inadequate upper-limb support was not statistically significantly associated with musculoskeletal symptoms (OR = 1.96, 95% CI: 0.92–4.18; $p = 0.081$). The crude associations are presented in Table 4.

Table 4
Crude associations between gaming-related factors and musculoskeletal symptoms

Exposure	OR	95% CI	p-value
Prolonged static sitting	2.31	1.08–4.95	0.031
Sustained neck/trunk posture	2.44	1.15–5.17	0.020
Repetitive upper-limb activity	2.17	1.02–4.61	0.044
Inadequate upper-limb support	1.96	0.92–4.18	0.081
Gaming without regular breaks	2.68	1.25–5.75	0.011
Gaming ≥ 4 h/day	2.21	1.04–4.70	0.039

Note: OR = odds ratio; CI = confidence interval. ORs represent the odds of reporting musculoskeletal symptoms among participants exposed to each factor compared with those who were not exposed.

Multivariable Analysis

The final multivariable logistic regression model included age, sex, professional/amateur gaming status, gaming duration, prolonged static sitting, sustained neck/trunk posture, and infrequent gaming breaks. The overall model was statistically significant ($\chi^2 = 16.84$, $df = 7$, $p = 0.019$). The Hosmer–Lemeshow goodness-of-fit test indicated adequate model calibration ($\chi^2 = 6.72$, $df = 8$, $p = 0.567$). The Nagelkerke R^2 was 0.183, and the model correctly classified 72.5% of participants.

No substantial multicollinearity was identified among the predictors, with VIF values ranging from 1.12 to 1.92 and tolerance values ranging from 0.52 to 0.89. All 120 participants were included in the final multivariable analysis.

After adjustment for the other variables in the model, prolonged static sitting was statistically associated with higher odds of musculoskeletal symptoms (adjusted OR [aOR] = 2.12, 95% CI: 1.01–4.46; $p = 0.047$). Sustained neck/trunk posture was also statistically associated with higher odds of symptoms (aOR = 2.28, 95% CI: 1.05–4.94; $p = 0.037$). Infrequent gaming breaks were statistically associated with higher odds of symptoms (aOR = 2.41, 95% CI: 1.09–5.34; $p = 0.030$). Gaming duration was also statistically associated with musculoskeletal symptoms (aOR = 1.07, 95% CI: 1.01–1.14; $p = 0.029$).

Age (aOR = 1.03, 95% CI: 0.96–1.10; $p = 0.390$), male sex (aOR = 1.21, 95% CI: 0.49–2.98; $p = 0.680$), and professional gaming status (aOR = 1.49, 95% CI: 0.70–3.18; $p = 0.300$) were not statistically significantly associated with musculoskeletal symptoms after adjustment.

Table 5

Multivariable logistic regression analysis of factors associated with musculoskeletal symptoms

Variable	Adjusted OR	95% CI	p-value
Age	1.03	0.96–1.10	0.390
Male sex	1.21	0.49–2.98	0.680
Professional gaming status	1.49	0.70–3.18	0.300
Gaming duration	1.07	1.01–1.14	0.029
Prolonged static sitting	2.12	1.01–4.46	0.047
Sustained neck/trunk posture	2.28	1.05–4.94	0.037
Infrequent breaks	2.41	1.09–5.34	0.030
<i>Note: OR = odds ratio; CI = confidence interval. Adjusted ORs represent associations after adjustment for the other variables included in the multivariable model.</i>			

Discussion

This analytical cross-sectional study examined the relationship between gaming-related ergonomic factors and musculoskeletal symptoms among professional and amateur video gamers in Nigeria. Musculoskeletal symptoms were common among participants, particularly in the neck, lower back, shoulders, and wrists/hands. Several gaming-related ergonomic characteristics were also frequently reported, and specific ergonomic factors remained associated with musculoskeletal symptoms after adjustment. These findings suggest that the relationship between gaming and musculoskeletal health may depend not only on the amount of gaming but also on the ergonomic conditions and behaviours accompanying gaming. Because exposure and outcome were assessed concurrently, these associations should be interpreted as non-causal.

Gaming Exposure, Ergonomic Behaviour and Musculoskeletal Symptoms

The high burden of musculoskeletal symptoms observed in this study is consistent with previous evidence indicating that musculoskeletal problems are common among people who engage in prolonged video gaming. Tholl et al. [7], in a systematic review of observational studies, identified negative musculoskeletal effects associated with video-game playtime and reported that the neck, shoulders, and back were among the commonly affected regions. Similarly, Schlesiger et al. [9] reported substantial musculoskeletal disorder prevalence among professional eSports players, with the lower back, shoulders, neck, and wrists among commonly affected regions.

The anatomical distribution observed in this study is therefore broadly consistent with the existing literature. The predominance of symptoms in the neck, lower back, shoulders, and wrists/hands may be

related to the combination of prolonged sitting, relatively sustained head and trunk positioning, and repetitive upper-limb interaction with keyboards, mice, or controllers. [7] characterised video gaming as a predominantly sedentary activity involving repetitive upper-limb movements, while the systematic review and meta-analysis by [26] similarly identified the spine and upper extremities as important sites of pain among eSports players.

The findings also support the importance of considering gaming exposure in terms of both quantity and pattern. Prolonged static sitting, sustained postural demands, repetitive upper-limb activity, and limited opportunities for breaks were common in the study population. Evidence from professional eSports populations has similarly identified prolonged training and inadequate ergonomic conditions as relevant to musculoskeletal problems [9]. The present findings therefore provide contextual evidence that gaming-related musculoskeletal burden may involve multiple interacting aspects of exposure rather than gaming duration alone.

The association between longer gaming duration and musculoskeletal symptoms is also broadly consistent with previous evidence. Tholl et al. [7] identified gaming duration as an important factor across several observational studies. Evidence from Nigerian computer users has likewise linked prolonged computer-use exposure with musculoskeletal symptoms [16, 17]. However, gaming should not be considered equivalent to general computer use. Gaming may involve distinctive combinations of visual attention, repetitive upper-limb activity, controller or keyboard and mouse use, sustained postures, and uninterrupted sessions. Evidence from general computer users therefore provides useful contextual support but should not be assumed to directly represent gaming populations.

An important implication is that the amount of time spent gaming may represent only one dimension of exposure. The observed associations with specific ergonomic characteristics suggest that the circumstances in which gaming occurs may also be relevant to musculoskeletal health. This distinction is important when considering preventive approaches, because attention to gaming posture, workstation characteristics, and opportunities for movement may complement consideration of total gaming duration.

Professional and Amateur Gaming

The greater frequency of several ergonomic exposures among professional gamers is consistent with the broader demands associated with competitive gaming. Professional gaming commonly involves more structured and intensive participation, which may increase opportunities for prolonged sitting, repetitive upper-limb activity, and sustained periods of gaming. Similar relationships between training demands and musculoskeletal problems have been reported among professional eSports athletes [9].

However, professional gaming status itself was not independently associated with overall musculoskeletal symptoms after adjustment. This distinction suggests that professional status may capture differences in gaming exposure and ergonomic behaviour rather than represent an independent determinant of musculoskeletal symptoms. The finding also reinforces the importance of examining

specific characteristics of gaming behaviour rather than relying solely on the professional or amateur classification.

The lower-back finding observed between the two groups is also compatible with evidence identifying the lower back as an important site of musculoskeletal problems among professional eSports players [9]. Nevertheless, regional differences should be interpreted cautiously because the study was not specifically powered to detect differences in individual anatomical regions. Differences between professional and amateur gamers may also reflect variation in individual exposure patterns, workstation arrangements, physical activity, and other factors not fully captured in the present analysis.

Ergonomic Factors Associated with Musculoskeletal Symptoms

The association between prolonged static sitting and musculoskeletal symptoms is biologically plausible and consistent with previous literature linking prolonged sedentary and sustained postural exposure with musculoskeletal problems [7, 9]. Static sitting may reduce opportunities for postural variation and may involve sustained loading of the trunk and lower-limb structures. Similarly, sustained neck and trunk positioning during gaming may be relevant to symptoms in regions commonly exposed during seated gaming.

The association observed for infrequent gaming breaks provides further support for considering the pattern of gaming sessions rather than duration alone. Regular interruption of prolonged static activity may provide opportunities for movement and postural variation. However, the present study cannot establish whether infrequent breaks preceded the development of symptoms. Participants experiencing musculoskeletal symptoms may have changed their gaming behaviour, including their posture or break practices, in response to those symptoms. Reverse causation is therefore an important consideration.

Repetitive upper-limb activity was associated with symptoms in the crude analysis but was not retained in the final multivariable model. This difference between crude and adjusted findings suggests that the observed crude relationship may overlap with other gaming-related or demographic characteristics included in the adjusted analysis. The finding illustrates the importance of considering potential confounding when interpreting associations between individual gaming behaviours and musculoskeletal symptoms.

Similarly, the association between gaming duration and symptoms remained after adjustment. This may indicate that cumulative or more prolonged gaming exposure is relevant to musculoskeletal health. However, the cross-sectional nature of the study means that the direction of this relationship cannot be established. Gaming duration may also be related to other characteristics, including occupational or educational sitting, physical activity, and lifestyle factors that were not completely captured in the present study.

Overall, these findings support a conceptual distinction between the quantity of gaming exposure and the conditions under which gaming occurs. Both dimensions may warrant consideration in future research examining musculoskeletal health among gamers.

Clinical and Practical Implications

The findings identify several modifiable aspects of gaming behaviour that may warrant attention. Ergonomic education could emphasise postural variation during gaming, appropriate workstation and upper-limb support, and regular interruption of prolonged gaming sessions. Assessment of gaming workstations may also help identify potentially unfavourable seating, monitor, or input-device arrangements.

For professional gamers, ergonomic assessment could potentially be incorporated into sports-health and performance-support services. Physiotherapists and other health professionals working with gaming and eSports populations may have a role in identifying musculoskeletal symptoms, assessing gaming-related ergonomic exposures, and providing individualised ergonomic and movement advice.

These implications should nevertheless be regarded as practical considerations rather than evidence of intervention effectiveness. The present study did not evaluate an ergonomic intervention and cannot establish whether modifying any of the observed exposures would reduce musculoskeletal symptoms.

Strengths and Limitations

A major strength of this study was the inclusion of both professional and amateur gamers, allowing gaming characteristics and ergonomic exposures to be examined across two distinct gaming populations. The study also assessed symptoms across multiple anatomical regions using the NMQ-E rather than focusing on a single body region.

Another strength was the examination of specific gaming-related ergonomic characteristics rather than relying on a single overall ergonomic score. The analysis also considered demographic and gaming-related variables when examining associations with musculoskeletal symptoms.

Several limitations should be considered. First, the cross-sectional design prevents determination of temporal relationships between gaming-related exposures and musculoskeletal symptoms. Reverse causation is possible because participants experiencing symptoms may have modified their posture, workstation, or break practices.

Second, convenience sampling may have introduced selection bias and limits the generalisability of the findings to the wider Nigerian gaming population. Although recruitment involved both gaming centres and online gaming communities, participants may not fully represent gamers across Nigeria.

Third, gaming exposure, ergonomic characteristics, and musculoskeletal symptoms were self-reported and may therefore have been affected by recall and reporting bias. Objective assessment of gaming

duration, posture, workstation configuration, and movement behaviour could provide more precise exposure measurements.

Fourth, the ergonomic assessment incorporated items adapted from the Dutch Musculoskeletal Questionnaire and additional investigator-developed gaming-specific questions. Because these components were not validated as a single gaming-specific ergonomic instrument, the resulting measures should be interpreted as contextual indicators of self-reported ergonomic exposure rather than as scores from a validated gaming-specific scale.

Fifth, the relatively modest sample size limits the precision of subgroup and region-specific analyses. The study was primarily designed to examine overall musculoskeletal symptoms, and regional findings should therefore be interpreted cautiously.

Finally, although several potential confounders were considered a priori, residual confounding from unmeasured factors cannot be excluded. Factors such as occupational or educational sitting, previous musculoskeletal injury, workstation characteristics outside gaming, and other lifestyle factors may also influence musculoskeletal symptoms.

Recommendations for Future Research

Future studies should use larger and, where feasible, multicentre or probability-based samples to improve representativeness. Prospective cohort studies are particularly important for establishing whether gaming-related ergonomic exposures precede the development of musculoskeletal symptoms.

Objective measures of gaming exposure and ergonomics, including workstation assessment, observational ergonomic assessment, motion analysis, wearable sensors, or device-based measures of gaming duration, could complement self-reported data. Future research should also use validated gaming-specific ergonomic instruments where available.

Intervention studies are needed to determine whether ergonomic modification, scheduled breaks, exercise programmes, or combined ergonomic and physical-activity interventions can reduce musculoskeletal symptoms among gamers. Further research could also examine whether associations differ according to gaming device, game genre, competitive level, session duration, and physical activity outside gaming.

Conclusion

Musculoskeletal symptoms were common among professional and amateur video gamers, and several gaming-related ergonomic characteristics were frequently reported. The findings suggest that both the amount of gaming exposure and the ergonomic conditions in which gaming occurs may be relevant to musculoskeletal health. However, the cross-sectional design does not establish temporal or causal relationships. Larger prospective studies using objective exposure measures and validated gaming-

specific ergonomic instruments are needed to clarify these relationships and evaluate effective strategies for prevention.

Abbreviations

DMQ

Dutch Musculoskeletal Questionnaire

eSports

Electronic Sports

NMQ

E–Extended Nordic Musculoskeletal Questionnaire

STROBE

Strengthening the Reporting of Observational Studies in Epidemiology

Declarations

Author Contributions

CNU conceived the study. KEF contributed to the study design, development of the research questions, and methodology. AIO, JLE, CUE, UPM and CA contributed to participant recruitment and data collection.

KEF conducted the data analysis and drafted the initial manuscript. All authors contributed to the interpretation of the findings, critically revised the manuscript, read and approved the final version.

Ethics Approval and Consent to Participate

The study received ethical approval from the University of Nigeria Teaching Hospital Health Research Ethics Committee (NHREC/05/01/2008B-FWA00002458-1RB00002323). The study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants before participation.

Consent for Publication

Not applicable.

Competing Interests

The authors declare that they have no competing interests.

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Data Availability

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

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