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PAIN IN PROFESSIONAL ESPORTS ATHLETES: A PIONEERING ANALYSIS OF VALORANT AND LEAGUE OF LEGENDS IN BRAZIL

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ABSTRAC

In 2022, eSports reached a global audience of 532 million viewers, with Brazil among the leading markets. The growth of this industry has led to an increase in the number of eSports professionals (pro-players), who spend long hours in daily training, facing physical and cognitive challenges. Data were collected from 95 Brazilian professional League of Legends and Valorant players, highlighting the relationship between musculoskeletal pain and the specificities of each modality. The research identified differences in the frequency and location of pain between the MOBA and FPS categories, indicating the importance of considering the particularities of each game in managing players' pain. Keyboard positioning and mouse grip type also influenced pain levels, emphasizing the need for individual ergonomic adjustments. The study provides valuable insights for the prevention, treatment, and support of eSports athletes, aiming to ensure their well-being and success in the competitive world of electronic sports.

Keywords: electronic sports, video games, gaming, health, physiotherapy, e-Sport

INTRODUCTION

Electronic sports (eSports) are characterized by competitive video gaming that can be played on various platforms (consoles, PC, and smartphones)[1]. In 2022, eSports reached a global audience of 532 million viewers worldwide, marking an 8.7% increase compared to the previous year, and Brazil ranks among the top 10 countries in terms of both audience and market growth[2].

This growth has led to an increase in the number of professional eSports athletes (pro-players), and with the professionalization of the industry, a significant portion of their day is dedicated to game training. It is estimated that a pro-player's daily training time can range from 5.5 to 10 hours of gameplay, even among collegiate players[3]. This high demand is also associated with pain and injuries that are typically linked to the spine, upper limbs, and hands. As a result, similar to traditional sports, professional eSports teams have recognized the need to establish healthcare teams within their organizations, including physiotherapists, fitness

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professionals, nutritionists, doctors, and psychologists[3–5].

Competitive gaming features various modalities, which are classifications based on each game's characteristics. These characteristics are primarily related to the game's dynamics, in-game objectives, audiovisual elements, interaction with the in-game environment, and the type of screen perspective. The most common modalities in competitions are known as MOBA (Multiplayer Online Battle Arena) and FPS (First-Person Shooter), and within these modalities, two games from Riot® are significant in the competitive scene: League of Legends® (MOBA) and Valorant® (FPS). Due to the differences in gameplay between these modalities, there are also varying physical and cognitive demands. Consequently, healthcare teams working within professional eSports organizations may need to adopt different approaches to address the specific needs of players in each modality[6].

With the growth of the competitive gaming scene, it becomes essential to gather data specific to this population of professional athletes so that healthcare teams can tailor their approaches to pain treatment. Additionally, it is crucial to understand how other factors related to a pro-player's demands can influence pain behavior. The objective of this research is to assess the relationship between upper limb and spinal pain, postural patterns, and gameplay characteristics in a population of professional gamers in two different modalities (MOBA and FPS).

METHOD

PARTICIPANTS

Ninety-five players who are active professionals in one of the two researched modalities (MOBA and FPS) were included in the study. Out of this total, 45 athletes represented the MOBA modality (League of Legends players), and 50 athletes represented the FPS modality (Valorant players). Professional status for participation in the research was defined as follows: 1) the participant must have exclusive dedication to eSports; 2) they must belong to an organization that participates in national and international competitions; 3) they should be financially remunerated as athletes; 4) they must have participated in at least one national and/or international competition.

All participants were presented with an Informed Consent Form (via an online form), and in the case of participants under 18 years of age, the form was also presented to a legal guardian who authorized the use of their data. The project obtained approval from a local ethics committee identified by the code CAAE 71394123.1.0000.5512.

PROCEDURE

A questionnaire was developed using the Google Forms® platform (see Annex 1) and was disseminated through the internet and online groups where we could reach the profile of the target participants for our research. The questionnaire consists of 26 closed-ended questions with response options divided into 5 sections. One of the questions includes an illustration of a human figure with a pain scale ranging from 0 (no pain) to 10 (the worst pain ever experienced in life), while another question involves a representation of the hand for identification. The data collection period lasted for approximately 30 days.

ANALYSIS

The data were previously analyzed, and the numeric variables exhibited a non-normal distribution. Therefore, they will be presented as median and interquartile range (Q1 - Q3). To compare sensitivity values based on DPI (dots per inch of the mouse), weekly frequency, trunk pain, and finger pain, the Kruskal-Wallis test with DSCF post hoc analysis was employed. To assess the distribution of responses related to the cross-referencing of information obtained through the questionnaire, a Chi-squared test (χ^2) was conducted. For correlation between numeric data, the Spearman test was used. The categorization of correlations will follow these values: 0.00 to 0.19 for no correlation, 0.20 to 0.39 for weak correlation, 0.40 to 0.69 for moderate correlation, 0.70 to 0.89 for strong correlation, and 0.90 to 1.00 for very strong correlation[7]. The adopted values for categorizing effect sizes epsilon squared (ε^2) will be as follows: 0.00 to 0.01 for a very small effect, 0.01 to 0.06 for a small effect, 0.06 to 0.14 for a medium effect, and greater than 0.14 for a large effect[8]. The assumed significance level was set at $P \leq 0.05$, and the data are described as median and interquartile range. The statistical software used was Jamovi [9].

RESULTS

The sample consisted of 95 pro-players (age 22±3 years), representing over 90% of professional Brazilian players in both modalities. Considering the total sample of professional players in League of Legends (MOBA group) and Valorant (FPS group), the calculated margin of error was 4.10% for a confidence level of 99%. The MOBA group players were in the pre-competitive period, while the FPS group players were in the competitive calendar. All participants used their left hand for keyboard controls and their right hand for mouse usage.

PAIN

Table 1 displays the correlation between pain scores. There was no correlation between pain values, weekly gaming frequency, and mouse DPI ($p>0.05$).

The assessment of pain in all body segments mostly had the lowest score (level 0), indicating that Brazilian professional players did not report pain complaints during data collection. However, in some body segments, there was a difference in pain levels when cross-referencing the data in contingency tables with other collected information.

In MOBA, there is a higher frequency of neck pain at level 1 (12.6% vs. 4.2%); at level 2 (7.4% vs. 3.2%); and at level 5 (5.3% vs. 1.1%). On the other hand, in FPS, neck pain values are higher at levels 3 (5.3% vs. 1.1%) and level 4 (3.2% vs. 1.1%). The highest reported pain level reached level 7, with only one FPS player ($p=0.021$).

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Table 1. Correlation Matrix between Trunk and Upper Limb Pain

		5th digit L	4th digit L	3rd digit L	2nd digit L	1st digit L	5th digit D	4th digit D	3rd digit D	2nd digit D	1st digit D	Low Back	Fists	Elbows	Shoulders	Back (middle)	Neck
5th digit L	Spearman's rho	—															
	p-value	—															
4th digit L	Spearman's rho	0.708 ***	—														
	p-value	< .001	—														
3rd digit L	Spearman's rho	0.616 ***	0.889 ***	—													
	p-value	< .001	< .001	—													
2nd digit L	Spearman's rho	0.655 ***	0.935 ***	0.829 ***	—												
	p-value	< .001	< .001	< .001	—												
1st digit L	Spearman's rho	0.774 ***	0.795 ***	0.699 ***	0.739 ***	—											
	p-value	< .001	< .001	< .001	< .001	—											
5th digit D	Spearman's rho	0.595 ***	0.628 ***	0.622 ***	0.578 ***	0.577 ***	—										
	p-value	< .001	< .001	< .001	< .001	< .001	—										
4th digit D	Spearman's rho	0.587 ***	0.747 ***	0.734 ***	0.692 ***	0.669 ***	0.669 ***	—									
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	—									
3rd digit D	Spearman's rho	0.423 ***	0.441 ***	0.522 ***	0.397 ***	0.498 ***	0.472 ***	0.579 ***	—								
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	< .001	—								
2nd digit D	Spearman's rho	0.414 ***	0.547 ***	0.530 ***	0.500 ***	0.487 ***	0.388 ***	0.697 ***	0.669 ***	—							
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001	—							
1st digit D	Spearman's rho	0.488 ***	0.433 ***	0.509 ***	0.390 ***	0.585 ***	0.309 **	0.452 ***	0.468 ***	0.571 ***	—						
	p-value	< .001	< .001	< .001	< .001	< .001	0.002	< .001	< .001	< .001	—						
Low Back	Spearman's rho	0.058	0.155	0.176	0.195	-0.002	0.167	0.235 *	0.221 *	0.203 *	0.204 *	—					
	p-value	0.578	0.134	0.087	0.059	0.987	0.106	0.022	0.031	0.048	0.048	—					
Fists	Spearman's rho	0.202 *	0.201	0.208 *	0.181	0.233 *	0.196	0.299 **	0.203 *	0.244 *	0.381 ***	0.257 *	—				
	p-value	0.050	0.050	0.043	0.080	0.023	0.057	0.003	0.048	0.017	< .001	0.012	—				
Elbows	Spearman's rho	0.187	0.383 ***	0.303 **	0.339 ***	0.255 *	0.243 *	0.313 **	0.376 ***	0.273 **	0.138	0.272 **	0.128	—			
	p-value	0.070	< .001	0.003	< .001	0.013	0.018	0.002	< .001	0.007	0.183	0.008	0.217	—			
Shoulders	Spearman's rho	0.228 *	0.280 **	0.238 *	0.232 *	0.259 *	0.222 *	0.328 **	0.245 *	0.295 **	0.185	0.153	0.033	0.385 ***	—		
	p-value	0.026	0.006	0.020	0.024	0.011	0.031	0.001	0.017	0.004	0.072	0.139	0.747	< .001	—		
Back (middle)	Spearman's rho	0.082	0.093	0.094	0.053	0.078	0.096	0.232 *	0.035	0.119	0.256 *	0.339 ***	0.173	0.134	0.266 **	—	
	p-value	0.432	0.372	0.363	0.611	0.450	0.357	0.024	0.734	0.250	0.012	< .001	0.095	0.197	0.009	—	
Neck	Spearman's rho	0.222 *	0.317 **	0.351 ***	0.317 **	0.241 *	0.206 *	0.278 **	0.228 *	0.153	0.253 *	0.268 **	0.310 **	0.128	0.363 ***	0.306 **	—
	p-value	0.031	0.002	< .001	0.002	0.019	0.045	0.006	0.026	0.138	0.013	0.009	0.002	0.215	< .001	0.003	—

L=Left; R=Right; * p < .05; ** p < .01; *** p < .001

When assessing the frequency of responses regarding hand pain, only the hand that controls the keyboard (left hand) shows differences in pain levels between categories. Levels 1, 2, and 3 of thumb pain are higher in MOBA compared to no reports in FPS (7.4%, 1.1%, and 1.1%, respectively). The highest reported thumb pain level was level 6, with only one report (p=0.019). The left index finger also had the highest prevalence of pain in the MOBA category at levels 1 and 2, compared to no reports in FPS (7.4% and 2.1%, respectively). Level 4 had the highest pain score, with only one report in the FPS category (p=0.008). The left middle finger had a higher frequency of level 1 pain (7.4% vs. 1.1%) and level 2 pain (2.1% vs. 0%) in MOBA. The highest pain score was level 3, with one response for FPS (p=0.030). The left little finger also had a higher frequency of pain reports for the MOBA category, specifically at level 1 (6.3% vs. 0%), level 2 (2.1% vs. 1.1%), level 6 (1.1% vs. 0%), and level 7 (1.1% vs. 0%). Only at level 3 did FPS have one response compared to no reports in MOBA (p=0.49). There is also an association of pain with the keyboard position for the thumb of the hand that controls the keyboard (left hand). In this case, most of the pain responses were at level 1 (7.4%) for all participants who used the keyboard in a horizontal position. The highest reported pain level was level 6, reported by only one participant who used the keyboard in a vertical position (p<0.001). When comparing the pain scores between the fingers and keyboard position, only the horizontal keyboard position had a higher score than the inclined position (p=0.043; ε^2 .07; medium effect) in the left index finger. Comparing pain scores between the two modalities, MOBA has a higher score in the right ring finger (p=0.035; ε^2 .04; small effect), and in all fingers of the left hand (p<0.05; ε^2 .05 to .08; medium effect).

The type of mouse grip also showed differences in the frequency of pain responses related to the hand that controls the mouse (right hand). The highest frequency of pain was at level 1 (10.5%), with 5.3% related to the palm grip, 3.2% to the claw grip, and 2.1% to the fingertip grip. The second-highest frequency was at level 4 of pain (5.3%), with 4.2% related to the palm grip and 1.1% to the fingertip grip. The highest reported pain level was a single case at level 7 related to the palm grip (p=0.018). Regarding the middle finger, the highest frequency of pain reports was at level 1 (11.6%), with 8.4% representing the palm grip, 2.1% the claw grip, and 1.1% the fingertip grip. The second-highest frequency of pain was at level 2, with 4.2% of responses exclusively in the fingertip grip. The highest reported pain level was 2.1% at level 6 (p<0.001) in the palm grip. The ring finger had the highest frequency of pain responses at level 1 (10.5%), with 7.4% representing the palm grip, 2.1% the claw grip, and 1.1% the fingertip grip. The highest pain score was at level 7 with only one response for the palm grip (p<0.001). In the little finger, the highest frequency of

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pain response was at level 1 (9.5%), with 5.3% representing the palm grip and 2.1% representing both the claw and fingertip grips. The highest reported pain was at level 7 with one response for the fingertip grip (p=0.004). Comparing the pain score in the right hand with the different types of mouse grip, the fingertip grip had a higher pain score in the right thumb compared to the claw grip (p=0.013; ε^2 .08; medium effect). In the right middle finger, the fingertip grip had a higher pain score compared to the claw grip (p=0.017; ε^2 .11; medium effect), and the fingertip grip had a higher score than the palm grip (p=0.005; ε^2 .11; medium effect). In the right ring finger, the fingertip grip had a higher pain score compared to the claw grip (p=0.026; ε^2 .08; medium effect). In the right little finger, the fingertip grip had a higher score than the claw grip (p=0.017; ε^2 .13; medium effect), and the fingertip grip had a higher pain score than the palm grip (p=0.002; ε^2 .13; medium effect).

Another difference found in the frequency of responses is related to the time that participants have been experiencing some form of pain in relation to their daily streaming time and the reported nominal frequency of this pain. The majority (55.8%) of the sample has been experiencing pain for over 6 months, with 43% not engaging in streaming, 5.3% streaming for over 6 hours, 4.2% streaming between 4 and 6 hours, and 1.1% streaming for less than 1 hour (p=0.004). Comparing streaming time, a higher pain score was observed in the left index finger (p=0.043; ε^2 .11; medium effect) and left middle finger (p=0.043; ε^2 .12; medium effect) for the group streaming between 4 and 6 hours compared to those who do not stream.

Regarding the frequency of pain, 74.7% reported feeling pain “few times,” with 40% experiencing it for over 6 months, 24.2% for less than 6 months, and 10.5% not experiencing any pain (p<0.001).

There was also a difference in the frequency of responses when relating the body regions presented in the questionnaire to the reported nominal frequency of pain. Participants experiencing mid-back pain reported this pain as “few times” (9.5%) at level 1 (p<0.001). The most reported elbow pain (7.4%) was at level 1 as “few times” (p<0.001). Low back pain was reported at a higher frequency both at level 1 and level 2 (13.7%), with 12.6% of responses categorized as “few times” at level 2 and 9.5% at level 1 in the same category (p<0.001). In the hand that controls the mouse (right hand), thumb and ring finger pain both had the highest frequency at level 1 (5.3%) as “few times” (p=0.001 and p=0.038, respectively).

The reported nominal frequency of pain was also associated with the members comprising the healthcare teams of the teams involved in the research. Most reports of pain classified as “few times” (25.3%) were related to teams with only one psychologist and one physiotherapist. The second-highest frequency was for the same classification “few times,” but with teams having only the psychologist (20%), and the third-highest frequency was for the same classification (9.5%) with teams that had a physiotherapist, doctor, nutritionist, physical education professional, and psychologist (p=0.009).

The frequency of pain responses in relation to the time of experience as a pro-player only showed a difference in relation to pain in the middle finger of the right hand. Most pain responses were at level 1 (11%), with 8.4% having more than 4 years of experience, 2.1% having between 3 and 4 years of experience, and 1.1% having between 2 and 3 years of experience. The highest pain score was at level 6, with 2.1% of participants having more than 4 years of experience (p=0.005).

Ao comparar a pontuação de dor com outras variáveis como apoio dos braços, tempo diário de jogo, pausas durante o jogo, tempo de experiência, prática de exercício físico e se recebe orientação profissional não foi encontrada diferença estatística.

PLAYER CHARACTERISTICS

One characteristic of the League of Legends sample allowed for the separation of groups by in-game position (lane). From the total sample, 22% played as ADC (marksmen), 22% as Support, 20% as Mid-Lane, and 18% as Jungle and Top-Lane. However, there was no difference between the in-game position and player characteristics such as keyboard position (p=0.144), mouse grip type (p=0.436), upper limb support (p=0.561), and pain (p>0.05).

There was a difference in the frequency of responses related to upper limb support and keyboard position during the game. Most players (41%) who used the keyboard horizontally rested their elbows on the chair’s armrests. The second-largest group (21.1%) consisted of participants who used the inclined keyboard and rested their arms on the table, and the third-largest group (12.6%) also used the inclined keyboard but did not rest their upper limbs during the game (p<0.001).

When the frequency of responses for daily gaming time was related to mouse grip type, it was observed that the majority of the sample (51.6%) played for more than 10 hours using the palm grip type. The second-highest frequency (14.7%) was also for more than 10 hours using the claw grip, and the third-highest frequency (12.6%) was for 8 to 10 hours of daily gameplay with the palm grip. The palm grip type was the most commonly used within our sample, with a total frequency of 64.2% (p=0.048).

The keyboard position also differed when comparing the modalities, with the majority (37.9%) of those who used the keyboard horizontally being from the MOBA group. In second place (35.8%) was the FPS group with the inclined keyboard (p<0.001).

Most participants (52.6%) rested their elbows and arms on a chair, with 40% being MOBA players. The second most commonly used support option was the table (28.4%), with 26.3% being FPS players. The least used option was no support (18.9%), with 13.7% being FPS players (p<0.001).

There was a difference in mouse sensitivity (DPI) when comparing the different modalities. MOBA had a higher sensitivity than FPS (p<0.001; ε^2 .55; large effect) with values of 1600 dpi (Q1:1500 – Q3:1850) and 800 dpi (Q1:800 – Q3: 800), respectively. Sensitivity was also higher in participants who rested their elbows on the chair›s armrests compared to those who rested them on the table (p<0.001; ε^2 .24; large effect) and compared to those with no support (p=0.40; ε^2 .24; large effect).

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The weekly frequency of gaming showed a difference. The MOBA group played 7 days/week (Q1:7 – Q3:7), and the FPS group also had a median of 7 days/week (Q1:6 – Q3:7). However, when comparing the groups, the MOBA group had a higher weekly frequency ($p=0.002$; ε^2 .10; medium effect).

DISCUSSION

This study is pioneering in collecting data from the majority of Brazilian professional athletes in Valorant and League of Legends. The main results are related to the pain reports collected through the questionnaire. The majority of the sample reported not experiencing pain in the body segments indicated in the questionnaire. Therefore, the discussion will focus on the pain results that were found and other characteristics associated with the data obtained in the questionnaire.

Pain in eSports can be a consequence of excessive muscular use combined with tension and stress generated by the training and competitive environment[4,10](2. Although the study did not assess psychosocial aspects, we cannot disregard current research on the types of pain and their relationship to emotional states[11]. Pain is a factor that has a significant influence on executive tasks that involve decision-making, and even mild levels of pain can impact the performance of pro-players. Considering that both categories of games studied rely heavily on efficient and speedy decision-making, the influence of pain can be particularly significant[12–14].

PAIN AND KEYBOARD CONTROL

Another understudied factor is pain in different fingers of each hand, considering that hands perform different activities in eSports. In the studied sample, all participants used the keyboard with their left hand and the mouse with their right hand, and there were specific reports of pain related to the type of peripheral used. There is a correlation between pain in the fingers of the hand that controls the keyboard (left hand). The second and fourth fingers show a very strong correlation (0.93) in pain scores. These fingers are heavily used for screen movement in FPS and character skill usage in MOBA. The other fingers also have pain scores with strong and moderate correlations (Table 1). Injuries resulting from electronic gaming have been documented since the 1990s and were referred to as “nintendinitis.”[15,16]. The correlation between the pain in the fingers of the left hand is important information for healthcare professionals working on the prevention of pain in pro-players. It suggests a certain degree of urgency in addressing this pain.

In comparing the frequency of responses, MOBA is more associated with pain in the thumb, index finger, middle finger, and little finger. This factor may be related to different demands associated with the game category. In MOBA, players need to use a large number of keys (9 to 11 keys with the left hand) during the game and change the hand and finger positioning more frequently (e.g., using abilities and opening menus). Many game abilities have a faster cooldown time, causing these keys to be used throughout a match. In contrast, in FPS, fingers are positioned for character movement keys (W, A, S, D, Control, and Shift) for most of the time. Furthermore, other buttons that activate other abilities are used less frequently, and some buttons are pressed only once in a single match. When comparing the pain levels in all fingers of the left hand, MOBA shows higher scores. One characteristic of this modality that deserves attention is that the muscular effort is continuous for 25 minutes (the average duration of a match), while in FPS, the match duration ranges from 1 minute and 50 seconds to 2 minutes and 10 seconds, allowing players to have short breaks.

Keyboard position can also be a factor associated with pain. Our study showed a higher frequency of pain in players who use a keyboard in a horizontal position compared to inclined and vertical positions. Keyboard position has been studied for several decades in typists, and some evidence suggests that an approximate 14° degree angle in the alphanumeric keyboard reduces excessive ulnar deviation and wrist pronation[17,18]. However, in eSports, the use of the keyboard in different positions may be related to a player’s habit rather than ergonomic issues. In the late 1990s, when the first LAN centers started to appear in Brazil, many establishments opted to place many computers in minimal spaces where only the mouse and keyboard would fit. However, for games that required greater mouse movement, many players chose to tilt or even position the keyboard vertically to have more space to use the mouse. Our study found a higher frequency of responses reporting pain in the right thumb and higher overall average pain when using the keyboard in a horizontal position, which may be associated with these ergonomic issues.

PAIN AND MOUSE CONTROL

In the hand that controls the mouse (right hand), there was also a correlation between finger pain, ranging from weak to moderate (Table 1). Just like keyboard position was associated with pain, the type of mouse grip also had different frequencies of pain responses. The palm grip was associated with higher frequencies of pain in the thumb, middle finger, ring finger, and little finger. Out of the total sample of participants, 64% used the palm grip, 27% used the claw grip, and 9% used the fingertip grip. This may explain the higher frequency of lower-level pain responses in the palm grip. However, when comparing overall pain magnitude, the fingertip grip showed higher pain scores than the palm and claw grips. This is the first study to compare pain magnitude in different grip types, and despite existing mentions of grip types in the literature, scientific research lacks studies that address the biomechanical aspects of each grip type[10]. A possible explanation for fingertip grip showing higher pain magnitude could be related to increased tension in the extensor muscles of the fingers required to keep the fingers fully extended, unlike the palm grip where the fingers are completely at rest on the peripheral, and the claw grip, which allows the fingers to be flexed. Another factor that sets fingertip grip apart and could explain this increased muscular tension is that this grip type doesn’t have any palm support on the peripheral. In fact, athletes who use this grip type often use smaller mice. When comparing the frequency of pain reports during gameplay with pain severity classification, it becomes evident that the ring and thumb fingers are the ones with the highest frequency of “rarely” reported pain at level 1.

PAIN IN THE TRUNK AND UPPER LIMBS

Among the athletes who participated in the sample, most of the pain reports fell into the MOBA category (levels 1, 2, and 5). There was a difference in the frequency of responses when comparing the pain classification with different body regions. The middle back and elbows regions had pain “rarely” and at level 1. The lower back region also had pain classified as “rarely,” but at levels 1 and 2. When observing publications featuring players who play similar amounts, patterns of pain in other body regions beyond the neck and elbows, as seen in this research, are noticeable, such as in the wrist and shoulder regions, for example[19,20].

STREAMING, PAIN CLASSIFICATION, EXPERIENCE TIME

Streaming is a common practice among pro-players and is often seen as a way to earn extra income due to the large number of followers that players have and its commercial potential. However, streaming does not appear to be a primary factor for this pain, as most of the sample responded that they have experienced some type of pain for more than 6 months during gameplay (55.8%), and within this group, the majority (43%) do not engage in streaming. However, when comparing the magnitude of pain by group, players who engage in 4 to 6 hours of streaming experience more pain in the hand that controls the keyboard (left index and middle fingers) compared to those who do not engage in this practice.

When asked how they classify their pain during gameplay, the majority of responses (74.7%) indicated experiencing pain only a few times during a match. Among this group of responses, 40% have been experiencing pain for more than 6 months, suggesting that most of the sample experiences infrequent pain events, but this condition appears to be chronic.

Studies involving similar individuals have shown more frequent pain patterns in various regions when evaluating players participating in competitions[19,20]. Our study mostly had reports of no pain in the sample, and when only cases of pain were evaluated, the frequency and body regions affected were lower. This may be related to the presence of healthcare teams, which is a reality in some Brazilian professional organizations. The majority of the sample that reported pain "occasionally" during a match (25.3%) had a psychologist and a physiotherapist in their healthcare team. Following that, there were teams with only a psychologist (20%) and teams with a psychologist, physiotherapist, and physical education professional (9.5%). Unlike traditional professional sports in Brazil (soccer, volleyball, fighting sports, etc.), eSports still have small healthcare teams, often requiring one professional to perform the roles of multiple areas. Although our study did not find a relationship between the size of the healthcare team and pain but only an association with response frequency, we recognize the importance of these professionals within organizations[21]. All participants in our study reported having at least one professional within their healthcare team, and 9% of these participants were supported by teams consisting of 5 professionals (physiotherapist, physical education professional, nutritionist, doctor, and psychologist).

The time of experience as a pro-player also seems to be a factor associated with the presence of pain. Our sample had higher response frequencies of level 1 pain associated with a longer professional experience. This is a common factor in high-performance professional sports and is an important point because it can shorten the professional's competitive career due to injuries.

PLAYER CHARACTERISTICS

This study was also the first to evaluate some important characteristics of Brazilian professional gamers. In the MOBA group, there is no pattern between the in-game position (known as the lane) and other characteristics such as keyboard position, mouse grip type, upper limb support, and pain. This suggests that the in-game position does not appear to be a determining factor for offering any type of player health-related intervention.

Observing the posture of both groups while playing, the majority (41%) use the horizontal keyboard position with elbows supported on the chair, the second-largest portion (21.1%) uses an inclined keyboard position with elbows supported on the table, and the third-largest portion (12.6%) uses an inclined keyboard position without arm support. This relationship between arm positioning and keyboard usage is a delicate issue, as it is related to how each individual has become accustomed to positioning themselves for play due to available conditions (space, furniture type, etc.). Just like in traditional sports, patterns related to a player’s posture and how they use peripherals are considered a player’s “style.” There are currently no studies that show an efficiency relationship between each type of positioning.

Another data point related to posture is how the player holds the mouse. Most of the sample (51.6%) plays for more than 10 hours a day using the palm grip, the second-largest portion (14.7%) also plays for more than 10 hours with the claw grip. This data is interesting for directing professional teams and taking preventive measures for the potential consequences of the repetitive effort characteristic of each of these two grip types. The palm grip seems to be the most widely used within the sample, as it appeared in the third-largest portion of the sample, but in players who practice between 8 and 10 hours of gaming.

When comparing the MOBA and FPS groups, there was a difference in keyboard positioning preference, with a preference for horizontal keyboard use in the MOBA group and inclined keyboard use in the FPS group. This may be related to the fact (as described above) that some FPS players opt for mouse sensitivity settings that require larger movements, and one way to gain more space on the table is by tilting the keyboard. This could also be an interesting point to consider in other samples of professional gamers, as it may also be a factor to be addressed in injury prevention efforts. The MOBA group also shows a difference in positioning, with

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the majority of the sample supporting their arms on the chair. In contrast, the FPS group mostly opts for upper limb support on a table.

When studying the relationships between mouse sensitivity used by the sample, the MOBA group had higher median values than the FPS group. This seems to be a common choice when comparing the two modalities because in FPS games, many players opt for lower sensitivity (even though it increases the mouse's range of motion) to achieve greater precision, as the outcome of the match can be determined by accuracy in causing more damage or instant elimination. Another characteristic of sensitivity was that it was higher when individuals supported their upper limbs on a chair. This can be explained because the seated position with supported elbows can be more comfortable, and with higher sensitivity, mouse movements are less extensive, allowing for a more comfortable posture.

The MOBA group also had a higher weekly gaming frequency. This may have influenced some pain results that were also higher in this group because, in some way, players were exposed to longer periods of physical and mental tension.

STUDY LIMITATIONS

There were no questions related to the psychological aspect (stress, depression). We know that currently, pain has been studied from both a sensory and emotional perspective, and these factors can also explain and be related to the results. This is especially relevant in this population that undergoes significant mental demands due to the competitive environment (pressure, deadlines, high performance). Another point was to reduce the questionnaire by not separating the upper limbs bilaterally. The only separation we made was in relation to the fingers of the hands. Another form of pain assessment that was removed was headache (cephalalgia), which can be common in professionals with increased visual and cognitive demands, as is the case with eSports players.

In the evaluation of the healthcare team involved, aspects related to the type of care (in-person or online) and the characteristics of the interventions used were not assessed.

CONCLUSION

This pioneering study has provided important insights into pain among Brazilian professional athletes in League of Legends and Valorant. Most of the sample reported no pain in the specified body segments, suggesting healthy and effective practices adopted by pro-players, organizations, and healthcare teams to minimize musculoskeletal discomfort. However, for those who experienced pain, the correlation between pain in the fingers of the left hand, especially in the fingers used for movement and abilities, highlights the need for specific attention to these segments. The difference in pain response frequency between MOBA and FPS emphasizes the importance of considering the specificities of each gaming genre in managing players' pain. The keyboard position and mouse grip type also influenced pain levels, underscoring the relevance of individual ergonomic adjustments. The presence of healthcare teams appears to play a significant role in pain management and the overall health of pro-players. This study has practical implications for the prevention, treatment, and support of eSports athletes, aiming to ensure the longevity and success of these pro-players in the competitive world of MOBA and FPS electronic sports.

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