Physiological and Neurological Factors in Virtual Reality: A Survey-Based Analysis

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Abstract: Virtual Reality (VR) technology offers immersive, multisensory experiences that have transformative potential across entertainment, education, and professional domains. However, its use is also associated with a range of physiological and neurological responses that remain underexplored in large-scale user populations. This study investigates the prevalence, severity, and predictors of such responses through a survey-based analysis of 205 VR users. Participants completed a structured online questionnaire assessing their VR usage patterns, symptom experiences, and demographic background. Results indicate that the most frequently reported symptoms include nausea, headaches, visual fatigue, and neck discomfort, though these effects were generally mild and infrequent. Psychological symptoms such as anxiety, disorientation, and diminished motivation were reported less often but showed a strong association with higher daily screen exposure. In contrast, demographic factors like age and gender had limited predictive value. Notably, educational background and technical familiarity were linked to more functional and diverse VR use. The findings support prevailing theories of sensory conflict and cognitive overload while highlighting the cumulative role of digital lifestyle in shaping user responses. Future research should incorporate objective measurements and stratified sampling to better capture the complex interaction between immersive technology and human neurophysiology.

Keywords: Virtual Reality, Simulation, Cybersickness, Human Factors in VR, Immersive Technology, VR-Induced Symptoms, Screen Time Exposure

1 Introduction

Virtual reality (VR) offers immersive experiences that engage multiple sensory systems simultaneously, creating environments that feel compelling and, at times, indistinguishable from physical reality. While this technological potential opens new avenues for learning, entertainment, and simulation, it also introduces a range of human responses that warrant systematic investigation. This section focuses on the effects of VR exposure on the human body and brain, organized into two broad but interconnected categories, physiological and neurological responses. Physiological responses refer to observable bodily effects such as nausea, visual strain, musculoskeletal discomfort, and changes in autonomic function. In contrast, neurological responses encompass sensory conflicts, cognitive alterations, emotional reactions, and perceptual disturbances. Although analytically distinct, these domains often overlap, for example, dizziness and disorientation may arise from both vestibular disruption and cortical processing demands. Understanding how these effects emerge and interact is essential for improving VR system design, guiding responsible use, and minimizing adverse outcomes.

2 Human Responses to Virtual Reality

2.1 Physiological

One of the most prevalent immediate physiological responses to immersive VR exposure is nausea, accompanied by autonomic symptoms akin to classic motion sickness, such as increased salivation, pallor, sweating, dizziness, and stomach discomfort. These symptoms result primarily from sensory mismatches between visual motion cues and vestibular feedback (e.g. visual motion without corresponding vestibular input), triggering activation of the sympathetic nervous system, as demonstrated by elevated heart rate and increased skin conductance. [1] Ohyama et al. (2007) demonstrated that exposure to discordant visual-vestibular motion in VR can selectively increase low-frequency heart rate variability power, indicative of sympathetic activation, without a concurrent parasympathetic modulation. [2]

Visual (oculomotor) symptoms, including eyestrain, blurred vision, dryness, and headaches, arise largely due to vergence-accommodation conflicts caused by the stereoscopic displays of VR head-mounted devices (HMDs). This conflict compels ocular muscles and the ciliary accommodation reflex into continuous exertion, exacerbating visual fatigue, particularly during extended VR sessions. Additionally, prolonged exposure to VR screens emitting blue-enriched light can suppress melatonin secretion, potentially affecting circadian rhythms and delaying sleep onset. [3] Dymczyk et al. (2024) observed that 30 minutes of VR with a strong depth conflict led to a post-exposure rise in SSQ (Simulator Sickness Questionnaire) oculomotor scores (e.g. eyestrain, blurred vision) in participants. [4]

Spatial disorientation and disturbances in balance occur due to conflicts among visual, vestibular, and proprioceptive inputs, resulting in impaired postural stability, vertigo, and increased body sway both during and immediately following VR immersion. Users commonly experience transient difficulties with real-world orientation, manifesting as misjudgments of direction and reduced postural control even after removing the headset. [5] For example, Akizuki et al. (2005) found that

30 minutes in VR led subjects to misjudge their limb position and sway more, even after removing the HMD, indicating lingering proprioceptive aftereffects. [6]

Cardiovascular and stress reactions are significant, especially in emotionally intense VR scenarios. Studies document measurable increases in heart rate, blood pressure, and salivary cortisol levels, reflecting sympathetic nervous system activation similar to real-world fight-or-flight responses. This stress response can also occur during physically active VR scenarios, highlighting the physiological realism of virtual simulations. [7] Martens et al. (2019) reported that 20 minutes of a stress-inducing VR elevator scenario elevated heart rate and even altered heart rate variability indices indicative of stress. [8]

Musculoskeletal symptoms, frequently described as "VR neck" or shoulder discomfort, result from sustained muscle tension induced by the weight and ergonomic demands of VR headsets, causing strain particularly in the cervical spine, shoulders, and upper back. Repetitive movements and extended periods in unnatural postures further contribute to muscle fatigue and joint discomfort. [9] Kim and Shin (2021) quantified this effect: performing an hour-long office task in VR caused a 25–30% increase in neck muscle exertion (measured via EMG) compared to doing the task at a normal desktop. Participants also reported 60% higher neck discomfort and 18% higher shoulder discomfort after using the VR headset. [10]

Finally, general physical symptoms include fatigue, drowsiness, general malaise, and transient bodily discomfort. These diffuse symptoms are frequently reported after prolonged VR exposure and can impact user performance and safety immediately post-experience. [11] Sharples et al. (2008) found in a large-scale survey that over 80% of VR users reported at least some symptoms (ranging from fatigue to nausea) following use. [12] General physical symptoms can also include transient aches that don't fit neatly into one category.

2.2 Neurological

Neurologically, VR-induced responses are largely driven by sensory conflicts, characterized by mismatches between visual inputs and vestibular or proprioceptive feedback. This conflict is neurologically interpreted as an indication of toxin ingestion or neurological disturbance, thus activating protective mechanisms such as nausea and dizziness, key components of cybersickness. The intensity of these symptoms correlates closely with the severity of visual-vestibular conflicts, and this conflict-driven model remains the predominant explanation for VR-induced motion sickness. [13] Unexpectedly, individuals with less postural sway before and during VR exposure (a potential indicator of greater stability) reported more cybersickness symptoms in an HMD environment, contradicting the predictions of postural instability theory. [14] However, not all findings agree, and sensory conflict remains the dominant explanatory model.

Cognitive impairments also commonly occur, primarily due to the substantial cognitive load associated with processing complex, multi-sensory VR environments. VR users often experience temporary reductions in memory retention, slowed reaction times, diminished attention, and impaired cognitive-motor coordination immediately following immersive experiences. This transient cognitive decline is primarily related to mental fatigue and attentional demands induced by the sensory-rich VR environment. [15]

Spatial disorientation arises from neurological disruptions in the integration of visual, vestibular, and proprioceptive signals, causing temporary misjudgments of spatial orientation and depth perception upon exiting VR. Users frequently report difficulty accurately estimating directions, distances, and object positions in the real world immediately after immersive sessions, reflecting neurological recalibration in the brain's spatial processing regions. [16] As demonstrated in the work of Riecke and Wiener (2007), participants who were asked to point to cardinal directions after navigating in VR made significantly larger errors compared to a real-world navigation task, indicating a loss of true orientation. [17] In extreme cases, users in VR who physically rotate many times (perhaps in a twisting game or exploring an environment) often lose track of how much they have turned in reality, a phenomenon known as visual dominance. [18]

Headaches are another common neurological outcome, frequently resulting from prolonged oculomotor strain, incorrect headset alignment (particularly incorrect interpupillary distance), screen flicker, or low frame rates. These conditions induce ocular muscle tension and trigeminal nerve fatigue, leading to tension-type headaches or even migraines, particularly in predisposed individuals. [19] As noted by Rebenitsch and Owen (2016), an epidemiological observation is that a notable subset of users, especially those prone to headaches or migraines, consistently experience VR-induced headaches even in the absence of nausea. [20] VR-induced headaches are usually short-term and respond to rest (removing the headset, closing one's eyes) or analgesics if needed.

Although rare, epileptic reactions are a serious neurological concern related to VR, especially in photosensitive individuals who may experience seizures triggered by rapid visual stimuli, flashing lights, or repetitive patterns commonly found in VR content. [21] Approximately 1 in 4,000 people in the general population has photosensitive epilepsy, where certain flickering in the frequency range of ~3–60 Hz can provoke a seizure. [22] Careful content moderation and user screening can mitigate this risk effectively.

Psychological responses, including heightened anxiety, transient dissociation (such as feelings of depersonalization or derealization), and mood changes (e.g., post-VR blues), are induced by the immersive, emotionally charged nature of VR. Users frequently report intense emotional reactions to virtual stimuli, demonstrating VR's strong psychological impact, which can be therapeutic but also overwhelming when unexpected. [23] As documented by Zimmer et al. (2019), users have reported anxiety spikes, especially if they are prone to anxiety disorders, when confronted with stressful VR situations such as public speaking or survival scenarios. Empirical research using a refined virtual reality adaptation of the Trier Social Stress Test (TSST-VR) found higher self-reported anxiety and elevated physiological stress markers compared to a less immersive task, confirming that VR can amplify emotional stress. [24]

Sleep patterns can be influenced by pre-sleep VR use, depending on the content and intensity of the experience. While stimulating or stress-inducing VR sessions may risk delaying sleep onset due to cognitive arousal, some immersive environments designed for relaxation have been shown to improve sleep quality. For example, one study combining immersive VR with slow breathing found reduced pre-sleep anxiety, lower heart rate, and shortened sleep onset latency in adolescents. [25]

Short-lived perceptual distortions, such as misperceptions of limb positions, motion aftereffects, or skewed depth perceptions, are common post-exposure neurological phenomena, reflecting temporary neural recalibration within perceptual and sensorimotor pathways. One commonly reported distortion is the sense that the real world feels subtly “off” or unreal immediately after coming out of VR (as discussed under dissociative symptoms). [26] These aftereffects typically resolve within minutes to hours but indicate significant transient neuroplasticity induced by VR exposure. [27]

Cybersickness, the overarching syndrome encompassing many of these neurological and physiological responses, includes nausea, dizziness, visual discomfort, autonomic disturbances, and cognitive impairments. It represents the composite impact of neurological and physiological challenges posed by VR, significantly influencing user experience and acceptance, and necessitating ongoing technological improvements and user-adaptive strategies to reduce symptom severity and incidence. [28]

3 Research Methology

This study aimed to investigate Virtual Reality (VR) usage patterns and their associated physiological and neurological effects. Research was conducted with a questionnaire in early 2025 using convenience sampling. Participants were recruited through digital platforms such as Discord, Telegram, Facebook interest groups, and university mailing lists.

The research addressed three core questions: (1) how frequently and for what purposes individuals use VR; (2) what symptoms are experienced during or after VR use; and (3) how demographic factors (age, gender) and individual differences relate to usage patterns and symptom severity. Based on prior literature, frequent use is expected, especially for entertainment, education, creativity, social interaction, and fitness. Users are likely to report symptoms such as nausea, eye strain, headaches, dizziness, and anxiety, primarily driven by sensory conflict and cognitive load. Higher usage is anticipated among younger individuals and males, whereas females are expected to report greater symptom intensity; these patterns are presumed to be moderated by prior exposure and individual sensitivity.

The questionnaire consisted of 14 questions, systematically divided into three sections. The first section comprised five questions to assess participants general technology use and prior exposure to virtual reality. Respondents reported their average daily hours spent on work-related digital applications and gaming activities, indicated whether they owned a VR device, evaluated the likelihood of using VR in their professional life, and stated whether they had previously used VR technology.

The second section of the questionnaire assessed current VR usage patterns and self-reported effects. Participants indicated the frequency of their VR use, the type of device employed (PC-connected or standalone), and the extent to which they engaged in various VR applications, including entertainment, work, education, creative activities, social interaction, fitness, and healthcare, using a six-point frequency scale ranging from "never" to "always." This section also assessed the self-reported frequency of symptoms experienced during and after VR sessions using a six-point scale. These symptoms included nausea, eye strain, headaches, musculoskeletal discomfort, anxiety, aggression, diminished interest in real-world activities or relationships, difficulties distinguishing between virtual and physical environments, and sleep disturbances.

The third section focused on demographic information to enable subgroup comparisons. Participants were asked to report their age, gender identity, highest level of formal education, and areas of professional qualification, selecting from a predefined list that included disciplines such as economics, engineering, military and security, healthcare, natural sciences, education, information technology, arts, and social sciences. Multiple responses were permitted for the latter item, allowing participants to indicate up to four areas of specialization.

Previous research on virtual reality and simulation-related symptoms served as the basis for shaping the questionnaire’s content and focus. Relevant constructs (e.g., "discomfort," "anxiety," "visual fatigue") were operationalized into measurable variables using numerical scales. A pilot test with a small sample (n=10) was conducted to evaluate the clarity, relevance, and structure of the items, after which the instrument was refined accordingly to ensure comprehensibility and internal consistency.

Although the reliance on self-reported data and the use of non-probability sampling limit the generalizability of the findings and introduce potential biases (e.g., recall and social desirability bias), the study yields valuable preliminary insights into the relationship between user characteristics, VR usage patterns, and associated physiological and neurological phenomena. These findings serve as a foundation for future experimental research using controlled methodologies and objective physiological measurements.

4 Results

4.1 Research Sample

Of the 290 total respondents, 98 identified as female (33.8%) and 191 as male (65.9%). One respondent (0.3%) selected a non-binary option, this response was excluded from further analysis due to insufficient representation. The sample was therefore predominantly male, which may reflect existing gender disparities in VR usage or technology-oriented communities.

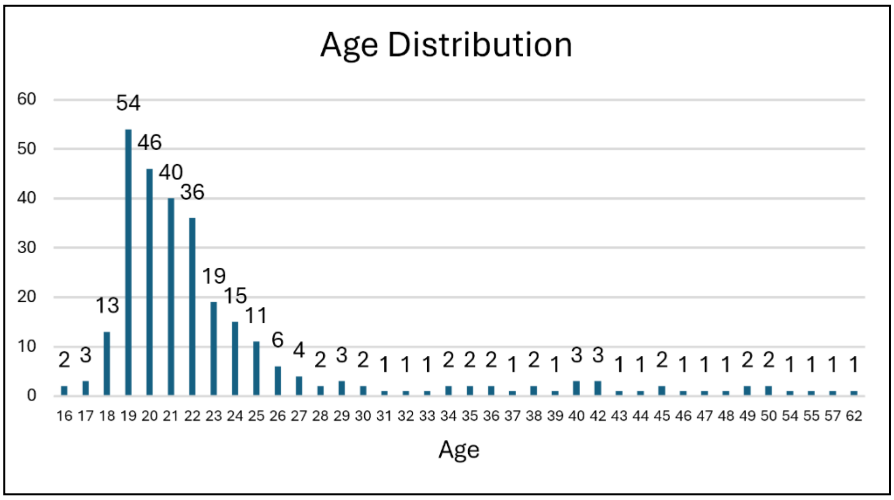

Figure 1
Age Distribution (Edited by the author based on research data)

The age of respondents ranged from 16 to 62 years (M = 23.73, SD = 7.73). As shown in Figure 1, the distribution is positively skewed (skewness = 2.52, SE = 0.143), indicating a strong concentration of younger participants. Kurtosis (6.314, SE = 0.285) suggests a leptokurtic distribution, with a pronounced peak and heavier tails compared to a normal distribution. A majority of respondents (54 at age 18, 46 at age 19, and 40 at age 20) were between 18 and 21 years old, comprising the modal cluster. Representation declines sharply after the mid-20s, with sporadic responses from older age groups. This suggests the sample primarily reflects younger, possibly student-aged, VR users, which aligns with trends in digital media adoption and gaming culture.

4.2 Research Results

Out of 290 respondents, 60 individuals (20.7%) reported owning a VR device at home, while the majority (79.3%) did not. However, 205 participants (70.7%) indicated prior experience with VR, suggesting that a significant portion of VR engagement occurs through shared, institutional, or public access rather than personal ownership. Regarding modes of use, 86 respondents reported using PC-based VR, while 59 used standalone headsets. Notably, 89 participants were unable to specify the type of VR device used, indicating either limited familiarity or indirect exposure (e.g., brief trial sessions). This highlights potential gaps in user awareness of technical specifications, particularly among casual or first-time users.

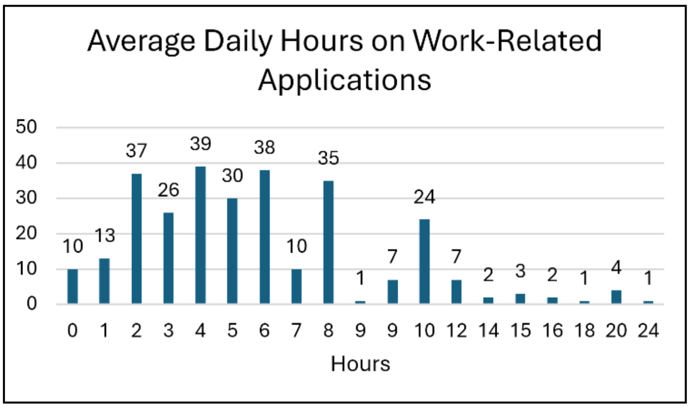

Figure 2
Average Daily Hours on Work-Related Applications (Edited by the author based on research data)

Participants reported a wide range of daily hours spent on work-related applications, from 0 to 24 hours (M = 5.76, SD = 3.88). As illustrated in Figure 2, the distribution is positively skewed (skewness = 1.38, SE = 0.143), indicating a concentration of responses at lower hour values with a long tail extending toward higher durations. The modal group reported 4–6 hours per day, with peaks at 4 (n = 39), 6 (n = 38), and 5 hours (n = 30). A substantial portion also reported 7–8 hours (n = 35 each), aligning with standard full-time work durations. Fewer participants reported extreme usage (e.g., 12+ hours), though a small subset indicated 16 to 24 daily hours, suggesting cases of intensive digital workload or continuous system access.

The kurtosis value (3.14, SE = 0.285) suggests a mesokurtic distribution, slightly more peaked than normal. Overall, the data reflect a heterogeneous sample with both moderate and extended digital work engagement, likely influenced by occupational roles and remote work habits.

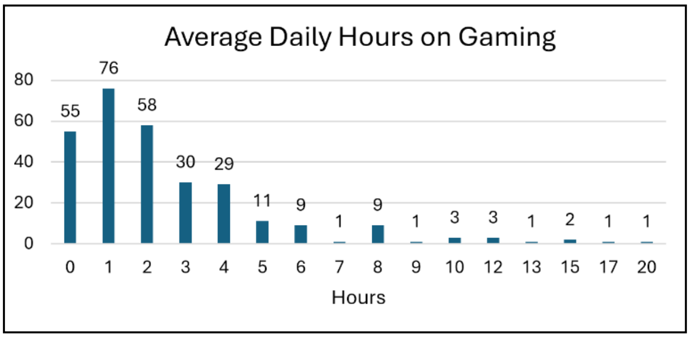

Figure 3

Average Daily Hours on Gaming (Edited by the author based on research data)

Participants reported daily gaming durations ranging from 0 to 20 hours (M = 2.55, SD = 2.94). As shown in Figure 3, the distribution is strongly positively skewed (skewness = 2.51, SE = 0.143) and highly leptokurtic (kurtosis = 8.49, SE = 0.285), indicating a sharp peak with heavy right-tailed extremities. The mode was 1 hour per day (n = 76), followed by 2 hours (n = 58) and 0 hours (n = 55), suggesting that the majority of respondents engaged in gaming casually or not at all. A steep decline is observed beyond 3 hours, with only a small subset reporting extensive daily gaming ($\geq$ 6 hours). This distribution reflects a primarily low-to-moderate gaming population, with a few high-engagement outliers, consistent with broader trends in general user behavior across age groups and lifestyle patterns

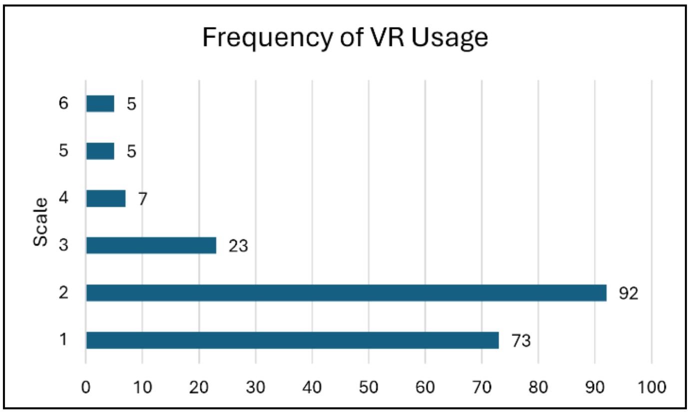

Figure 4
Frequency of VR Usage (Edited by the author based on research data)

VR usage frequency was measured on a 6-point scale (1 = "never" to 6 = "always"), yielding a mean of 2.00 (SD = 1.11). As illustrated in Figure 4, the distribution is positively skewed (skewness = 1.71, SE = 0.170) and moderately leptokurtic (kurtosis = 3.40, SE = 0.338), indicating a concentration at the lower end of the scale. The majority of respondents reported minimal usage: 92 selected level 2, and 73 selected level 1. Only 17 participants (8.3%) reported frequent or consistent VR use (levels 5–6), suggesting that regular engagement with VR remains limited within the sample. These results reflect early-stage or casual adoption patterns among most users, possibly influenced by access, familiarity, or the novelty of the technology.

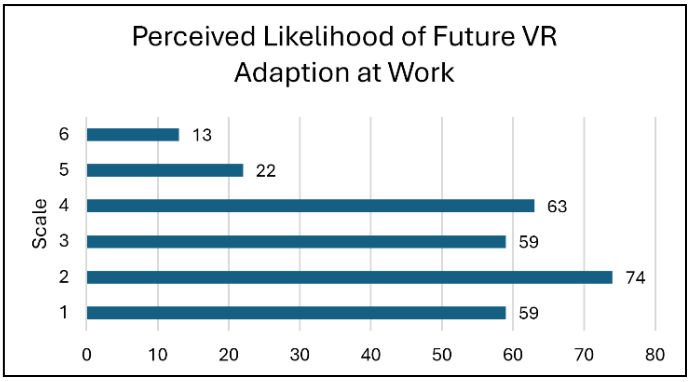

Figure 5
Perceived Likelihood of Future VR Adaption at Work (Edited by the author based on research data)

Participants rated the likelihood of VR adoption in their future work environment on a 6-point scale (1 = “very unlikely” to 6 = “very likely”), with a mean score of 2.84 (SD = 1.41). As shown in Figure 5, responses are moderately dispersed and approximately symmetrical (skewness = 0.40, SE = 0.143), with a slight platykurtic tendency (kurtosis = –0.68, SE = 0.285), suggesting a flatter distribution than the normal curve. Most responses clustered around the mid-range: 74 participants selected level 2, while 63 selected level 4. Equal numbers (n = 59) chose level 1 (“very unlikely”) and level 3, indicating overall ambivalence. Only 13 respondents (4.5%) expressed high confidence in future VR integration (level 6). These results reflect cautious optimism but also considerable uncertainty regarding the professional integration of VR technologies.

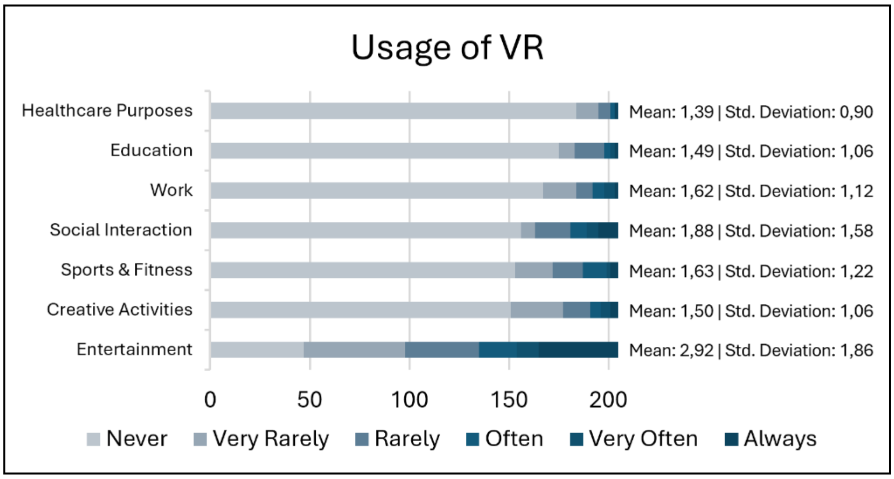

Figure 6
Usage of VR (Edited by the author based on research data)

Participants rated the frequency of VR use across seven domains on a 6-point scale (0 = Never, 5 = Always). As shown in Figure 6, entertainment was by far the most frequent use case (M = 2.92, SD = 1.86), reflecting the dominant role of recreational applications in current VR engagement. The high standard deviation suggests substantial variation, with some users employing VR for entertainment almost daily, while others do so only occasionally. In contrast, all other domains showed considerably lower mean values. Healthcare purposes (M = 1.39, SD = 0.90), education (M = 1.49), and creative activities (M = 1.50) were among the least frequent, indicating minimal integration into users’ daily routines. Slightly higher values were recorded for work (M = 1.62), sports and fitness (M = 1.63), and social interaction (M = 1.88), though the latter still fell below the midpoint of the scale.

These patterns suggest that while users may recognize the potential of VR across diverse contexts, in practice its use remains largely limited to entertainment. The relatively low adoption rates in functional domains may be attributed to content limitations, lack of institutional implementation, or user preferences. Notably, higher variability in domains like social interaction and fitness points to emerging interest, but also uneven access or awareness. Overall, the findings reflect an early-stage adoption landscape where non-entertainment VR applications have yet to reach widespread use.

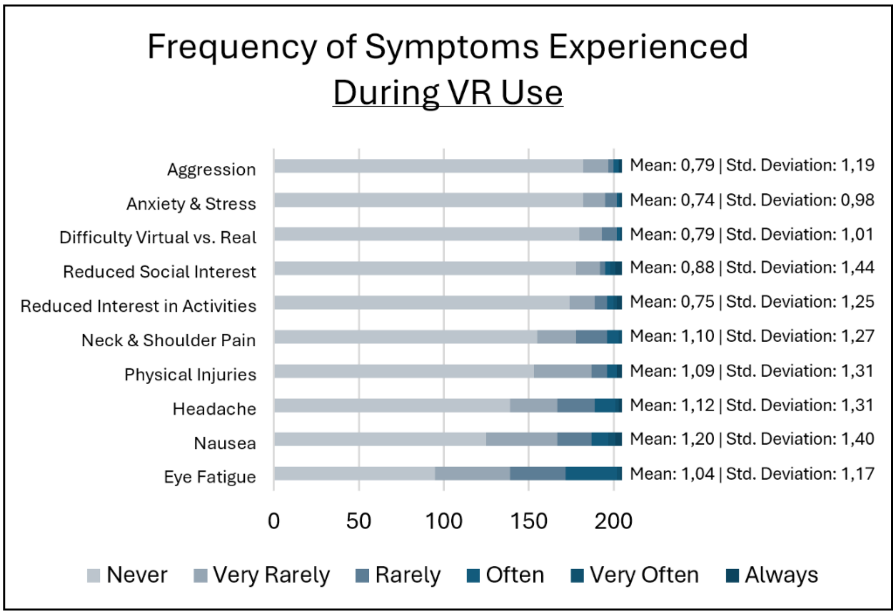

Figure 7

Frequency of Symptoms Experienced During VR Use (Edited by the author based on research data)

Participants assessed the frequency of ten common symptoms associated with VR exposure on a 6-point scale (0 = Never, 5 = Always). As shown in Figure 7, the overall prevalence of symptoms was low, with all mean values falling between 0.74 and 1.20. This indicates that, on average, most symptoms were experienced rarely or very rarely. The most commonly reported issues were nausea (M = 1.20, SD = 1.40), headaches (M = 1.12, SD = 1.31), neck and shoulder pain (M = 1.10, SD = 1.27), and eye fatigue (M = 1.04, SD = 1.17). These are consistent with symptoms typically linked to cybersickness and prolonged headset use. Their relatively higher standard deviations suggest that while many users experience these symptoms infrequently, a smaller subset may encounter them more regularly or intensely. In contrast, symptoms related to psychological and behavioral effects, such as aggression (M = 0.79), anxiety and stress (M = 0.74), and reduced interest in activities (M = 0.75), were rated as occurring less frequently. Difficulty distinguishing virtual from real environments (M = 0.79) and reduced social interest (M = 0.88) also showed low overall incidence, suggesting minimal psychological disorientation among the majority of users. The data suggest that while physical symptoms are more prominent than psychological ones, they remain mild in frequency for most respondents. Nonetheless, their presence highlights the need for ergonomic improvements, adaptive session design, and user education on optimal usage practices (e.g., breaks, posture, device calibration) to mitigate discomfort.

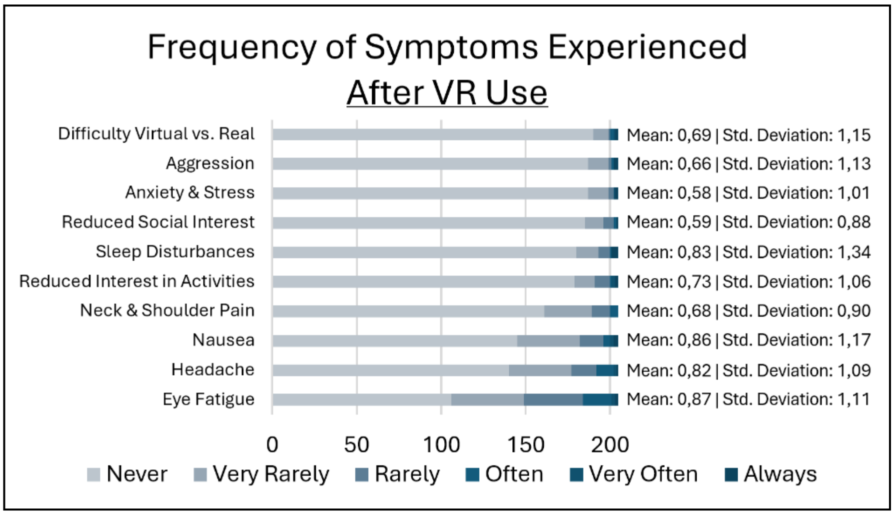

Figure 8

Frequency of Symptoms Experienced After VR Use (Edited by the author based on research data)

Participants rated the frequency of 10 symptoms experienced after VR sessions on a 6-point scale (0 = Never, 5 = Always). As shown in Figure 8, average symptom ratings remained low overall, with all means falling below 1.0, indicating that post-VR symptoms were generally experienced very rarely to rarely. The most frequently reported symptoms were eye fatigue (M = 0.87, SD = 1.11), nausea (M = 0.86, SD = 1.17), and sleep disturbances (M = 0.83, SD = 1.34), suggesting mild physical or cognitive aftereffects for some users. Headache (M = 0.82) and reduced interest in activities (M = 0.73) were also reported with slightly elevated frequency, though still below moderate levels. Psychological and social symptoms, including anxiety and stress (M = 0.58), reduced social interest (M = 0.59), and aggression (M = 0.66), were among the least frequently endorsed. Difficulty distinguishing virtual from real environments (M = 0.69) also remained low, indicating minimal disorientation post-use.

Overall, the data suggest that most participants experienced few adverse effects after VR use. Symptoms were generally infrequent and mild, with a slight tendency toward physical discomfort rather than psychological impact. These findings highlight the relative safety of VR use in typical consumer settings but point to the importance of monitoring fatigue and recovery, especially with extended or repeated use.

4.3 Relations Between Variables

The analysis revealed several statistically significant correlations ($p < .01$, two-tailed), offering insight into how demographic, educational, and behavioral factors relate to VR use and its associated effects. Educational attainment emerged as a notable predictor of functional VR engagement. Individuals with higher education levels were more likely to use VR for fitness or sports ($r = .226$), for work-related purposes ($r = .188$), and to utilize PC-based VR systems ($r = .227$). Similarly, participants with an IT background showed a positive correlation with PC-based VR usage ($r = .242$), suggesting that both formal education and domain-specific expertise facilitate access to more complex or task-oriented VR applications.

Daily work-related screen time showed moderate to strong positive correlations with several psychological and cognitive difficulties during VR use. Specifically, higher screen time was associated with increased levels of anxiety and stress ($r = .392$), reduced interest in real-world social interactions ($r = .489$), lower motivation for real-life activities ($r = .477$), and difficulty distinguishing between virtual and physical environments ($r = .497$). These findings suggest that high digital workload may intensify cognitive fatigue and reduce the psychological separation between immersive virtual content and everyday experience.

Interestingly, respondents who reported unfamiliarity with VR systems, or indicated not knowing which platform they had used, tended to report significantly fewer adverse symptoms. These participants experienced less nausea ($r = –.309$), eye fatigue ($r = –.414$), and physical discomfort or injuries ($r = –.358$). This likely reflects limited exposure rather than increased resilience, pointing to the cumulative effects of prolonged VR interaction on physical well-being.

In contrast, age showed no significant correlation with any measured variable, indicating that it had no predictive power in the present sample. Gender also showed limited influence: a small negative correlation was observed with VR use for entertainment ($r = –.188$), suggesting marginally higher usage among male respondents. Although the correlation between gender and work-related screen time reached statistical significance ($r = .042$), its effect size was negligible and not meaningful in practical terms.

Taken together, these results indicate that factors such as educational background, digital literacy, and screen time exposure are more strongly associated with patterns of VR use and symptom reporting than demographic characteristics such as age or gender. The findings underscore the need to consider individual lifestyle and professional context when assessing user experiences and risks in immersive environments.

Conclusions

This study examined the physiological and neurological responses associated with virtual reality use, based on self-reported data from a broad user sample. The research was guided by three key questions concerning usage patterns, symptom experience, and the role of demographic and individual factors.

Regarding the first question, it was initially assumed that VR would be used frequently, particularly for entertainment, education, creativity, social interaction, and fitness. The results partially confirmed this: although prior experience with VR was relatively common (70.7%), ownership and regular use were limited. Only 20.7% of respondents owned a VR device, and the average usage frequency was low (M = 2.00 on a 6-point scale). Among usage domains, entertainment was dominant (M = 2.92), while all other purposes, including education, fitness, and work, scored well below the midpoint. These findings indicate that despite growing familiarity, practical VR adoption remains largely confined to leisure contexts.

In relation to the second question, it was expected that users would report symptoms such as nausea, eye strain, headaches, dizziness, and anxiety, due to sensory conflicts and cognitive load. The data confirmed the presence of these effects, but at generally low levels. Symptoms experienced during VR sessions had low average ratings (M = 0.74–1.20), with nausea, headaches, and neck/shoulder pain being most common. Post-use symptoms were even less frequent (all means < 1.0), with eye fatigue, nausea, and sleep disturbances being most notable. Psychological symptoms such as anxiety, aggression, and depersonalization occurred rarely. Thus, while adverse effects are present, they are typically mild and infrequent.

As for the third question, it was hypothesized that age and gender would influence both usage frequency and symptom severity, anticipating higher usage among younger males, and increased symptoms among females. However, the data did not support these assumptions. Age showed no significant correlation with any variable, and gender had only a weak, negative association with VR usage for entertainment. Instead, stronger predictive relationships were observed with educational attainment, IT background, and daily screen exposure. Specifically, higher education and technical expertise were linked to increased functional VR use, while prolonged screen time correlated with elevated reports of anxiety, disorientation, and diminished motivation for real-world activity. These results suggest that usage patterns and vulnerability to symptoms are shaped more by digital lifestyle and cognitive load than by demographic identity alone.

Overall, the findings align with existing literature on cybersickness and attentional fatigue, underscoring the role of sensory mismatch and extended screen engagement in driving discomfort. Although self-report data have inherent limitations, the consistency between participant responses and prior studies supports the reliability of observed trends. Future research should employ objective measurements (e.g., EEG, heart rate, eye-tracking) and compare user groups based on sensitivity and prior experience. It would also be valuable to examine whether repeated VR use leads to adaptation or increasing mental and physical strain over time.

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