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SYSTEMATIC REVIEW: NEUROLOGICAL EFFECTS OF ONLINE PORN CONSUMPTION

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Abstract: There is neuroscientific evidence that pornography consumption affects the human brain in a similar way to drugs, causing in some of its users negative consequences of its uncontrolled use. Objective: To carry out a systematic review in order to investigate the neurological effects of online pornography consumption. Methods: A systematic review of 28 studies was carried out in the PubMed and Virtual Health Library (BVS) databases between May 15th and 29th, 2022. To maximize the uptake of works, the references of the selected literature were also searched. Results and Discussion: The chosen studies involved individuals aged between 18 and 49 years, with sample sizes ranging from 9 to 156 participants. Functional Magnetic Resonance was the most applied neuroimaging technique (n=8). The effects observed in the human brain caused by the frequent consumption of pornography found were a decrease in gray matter, erosion of the prefrontal cortex, and occurring during visual sexual stimulation there was activation of the hypothalamus in men, greater activation of the nucleus accumbens, greater activation of the amygdala and also increased insular activity. Conclusion: The neural effects exerted by the use of pornography consist of the dysregulation of dopamine levels and the neuroplasticity promoted in the limbic system. Such changes can lead to the development of compulsive behavior and depression.
Keywords: Visual stimulus; Neuroplasticity; dopamine.

INTRODUCTION

Pornography consists of materials that expose elements of nudity and sexual acts, with the aim of inducing sexual desire in its consumers. The dissemination of this form of entertainment was amplified with the advent of the internet, due to the financial

and virtual accessibility of this type of content and the anonymity guaranteed to the user (COOPER, 1998), as demonstrated by an American study that showed the monthly consumption of pornography by 66% of men and 41% of women in the country (PAUL, 2007).

This reality becomes worrying due to the relationship between pornography and the reward system of the human brain, with neuroscientific evidence that it affects the brain in a similar way to drugs (WSCIEKLICA et al, 2016; HILTON et al, 2013), causing in some of its users negative consequences of its uncontrolled use (MESSINA et al., 2017). In view of this, the American Society for Addiction Medicine (ASAM) expanded the concept of addiction in 2011, assessing both substantial causes, such as narcotics, and behavioral causes, interfering with the reward mechanism, such as the use of pornography, gambling, between others.

Studies have shown an association between the consumption of this content with the impairment of the system involved in the processing of memory and emotion, the limbic system (KARAMA et al., 2002), causing problems related to the overstimulation of dopaminergic receptors during use, creating a habituation extremely high brain activity (BARR, 2019), reflected in lower brain reactivity to sexual stimuli by frequent users (PRAUSE et al., 2015), and consequently neuroplastic changes (HILTON et al., 2013).

However, it is clear that the studies do not have a multifaceted approach on the subject, not addressing all the effects of the consumption of this content on the human brain, and a systematic review would allow a synthesis of the relevant evidence available in the literature.

Given the impact of the use of this content on the individual's brain, affecting their emotional, cognitive and behavioral processing capacity, the present study aimed to investigate how the consumption of online pornography acts on the individuals' neurological system.

METHODOLOGY

STUDY DESIGN

A systematic review study conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (MOHER et al, 2009) (Figure 1). To identify the studies that evaluated the neurological effects of online pornography, the PubMed and Virtual Health Library (BVS) databases were used from May 15 to 29, 2022 to search for articles without language and date restrictions. In the literature search, the search terms were selected using the Medical Subject Heading (MeSH) and Health Science Descriptors (DeCS) and combined as descriptors: Visual stimulus; Neuroplasticity; Dopamine in Portuguese and English. In addition, the identification of studies on the subject was also carried out by reading the references of the research filtered in the databases. After careful selection of studies filtered by descriptors, duplicates were excluded, and then titles and abstracts were analyzed in order to exclude studies irrelevant to this review. The full texts of the remaining articles were analyzed, and the studies relevant to this review were kept, as shown in Figure 1. From the selected studies, the following information was obtained: name of authors, year of publication, full title, place and date of publication. collection, age, sample size, method used to evaluate the effect and results found.

RESULTS

From the search in the electronic databases, 284 studies were identified. After excluding

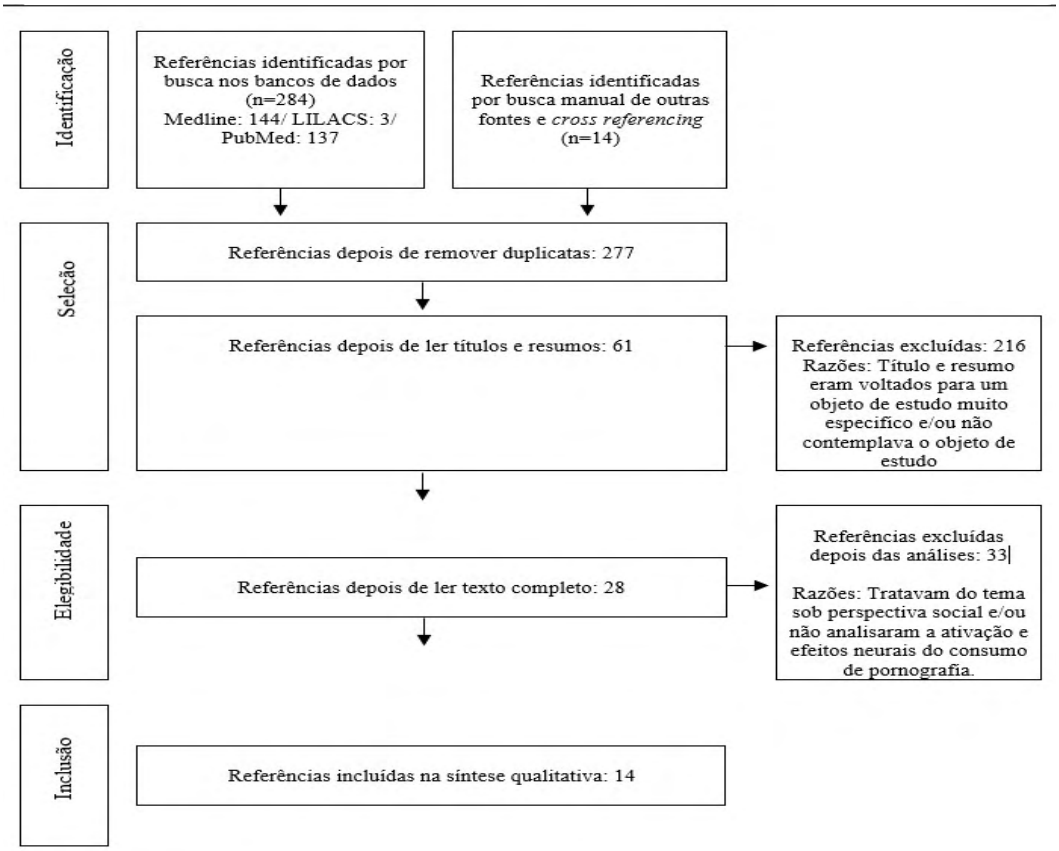

Figure 1. Flowchart for the search and selection of studies that are part of this systematic review.

Source: Authors themselves.

duplicate articles and reading titles and abstracts, 61 studies remained for full content reading. In the end, 28 articles remained in this review, of which 14 were included in the qualitative synthesis. The reasons for the exclusions of the studies can be seen in the flowchart of the search and selection of studies.

The chosen studies involved individuals aged between 18 and 49 years, with sample sizes ranging from 9 to 156 participants, and only 4 included women (LEE et al. 2015; WEHRUM-OSINSKY et al, 2014; HUYNH et al, 2012; KARAMA et al, 2002). Most studies were developed in Europe (MARKERT et al. 2021; CERA et al. 2020; KLEIN et al. 2020; WEHRUM-OSINSKY et al. 2014; COSTUMERO et al. 2013; HUYNH et al., 2012; PONSETI et al., 2012; PONSETI et al. al. 2009; REDOUTÉ et al. 2000) followed by North America (PRAUSE et al., 2015; KARAMA et al., 2002) and Asia (LEE et al., 2015; SEOK, PARK, SONH, 2016). Regarding the evaluation method, neuroimaging techniques were applied in the majority, 8 studies used Functional Magnetic Resonance (CERA et al., 2020; SEOK, PARK, SOHN, et al 2016; LEE et al., 2015; WEHRUM-OSINSKY et al. ., 2014; KUHN, GALLINAT, 2014; COSTUMERO et al., 2013; PONSETI et al., 2009; KARAMA et al., 2002), 2 used positron emission computed tomography (REDOUTÉ et al., 2000; HUYNH et al., 2000; HUYNH et al. al., 2012) and only 1 electroencephalogram (PRAUSE et al., 2015).

The effects observed in the human brain due to frequent pornography consumption were a decrease in gray matter (KUHN; GALLINAT, 2014), erosion of the prefrontal cortex (MARKERT et al., 2021; KLEIN., 2020; SEOK, PARK, SOHN. ., 2016; LEE et al., 2015; KUHN, GALLINAT., 2014; COSTUMERO et al., 2013; HUYNH et al., 2012; KARAMA et al., 2002; REDOUTÉ et al., 2000). During visual sexual stimulation, activation of the hypothalamus was observed in men (MARKERT et al., 2021; LEE et al., 2015; WEHRUM-OSINSKY et al., 2014; KARAMA et al., 2002), greater activation of the nucleus accumbens (MARKERT et al., 2021; KLEIN et al., 2020; WEHRUM-OSINSKY et al., 2014; COSTUMERO et al., 2013), increased amygdala activation (MARKERT et al., 2021; CERA et al., 2020; KARAMA et al., 2002) and also increased insular activity (MARKERT et al., 2021; CERA et al., 2020; PONSETI et al., 2009; KARAMA et al., 2002).

DISCUSSION

This review presents a broad analysis of studies conducted around the world, published from 1998 to 2021, that evaluated the effects of pornography and visual sexual stimulation in adults of both sexes. The most reported effects in the literature on the human brain caused by frequent pornography consumption were a decrease in gray matter in regions of the limbic system and erosion of the prefrontal cortex, occurring during exposure to visual sexual stimuli, hypothalamus activation in men, greater activation of the nucleus accumbens, increased amygdala activation, and increased insular activity, with frequent users showing less sensitivity to sexual stimuli and compulsive behavior.

Due to the abnormal and constant level of dopamine provided for extended intervals of time by pornography, there is a new habituation to the levels of the neurotransmitter, making the brain unresponsive to natural stimuli of pleasure (BARR, 2019). This is exemplified in the study by Prause et al (2015) in which an electroencephalogram exam showed that frequent users of online pornography have lower visual sexual stimuli in relation to neutral stimuli, when compared to less frequent users.

Similar to the effects of drugs, pornography provides neuroplasticity (the ability of the brain to physically and functionally change to stimuli) harmful to the organism (KAUER, MALENKA., 2007). In studies with drug addicted animals (KELZ et al., 1999, WSCIEKLICA, 2016), the same substance was identified as in animals with addictive behavior of consumption of natural rewards (NESTLER., 2005), the protein DeltafosB. This protein is a marker of behavioral dysfunction, also acting as a facilitator of the harmful neuroadaptation process (HILTON, 2013).

Kuhn & Gallinat (2014) identified neuroplasticity, using functional magnetic resonance imaging, and traced a direct relationship between the decrease in gray matter in regions of the limbic system and the consumption of online pornography. According to the authors, users with longer consumption of this material had a lower volume of gray matter in the right caudate nucleus and lower connectivity between the direct caudate nucleus and the dorsolateral prefrontal cortex. This gray matter loss, when in the anterior cingulate cortex, is also activated by visual sexual stimulation (CERA et al., 2020, LEE et al., 2015, KARAMA et al., 2002) is related to the development of depression, explaining problems of attention, motivation and decision-making skills (KANDILAROVA et al., 2019).

Pornography consumption still affects many regions of the limbic system, responsible for the individual's emotion and

memory, emphasizing the involvement of the prefrontal cortex. (MARKERT et al., 2021; KLEIN., 2020; SEOK, PARK, SOHN., 2016; LEE et al., 2015; KUHN, GALLINAT., 2014; COSTUMERO et al., 2013; HUYNH et al., 2012; KARAMA et al., 2002; REDOUTÉ et al., 2000). According to BARR (2019), the prefrontal cortex, primarily responsible for human intelligent behavior (MACHADO, HAERTEL., 2014), suffers erosion as a result of pornography consumption, predisposing compulsive behavior.

Such behavior is noticed in children, since the prefrontal cortex of the brain will only fully develop around the age of thirty (MACHADO, HAERTEL, 2014). Therefore, such content cognitively throws back its users. This consequence can be observed in a study by Negash et al. (2016) in which hyperbolic discount rates (when an immediate reward is forgone for a greater one over time) were higher in pornography users after just three weeks without using adult content, evidencing the weight of compulsiveness in users. pornography users. Similarly, in a study published by Messina et al (2017), more evidently, the difficulties in decision-making and cognitive processing of sexually compulsive men when under visual sexual stimulation were identified.

In addition, other regions are also activated by pornography consumption, such as the amygdala (MARKERT et al., 2021; CERA et al., 2020; KARAMA et al., 2002), in which its lesion causes hypersexuality (MACHADO, HAERTEL, 2014) and the hypothalamus, in which, in a study published by Karama (2002), using functional magnetic resonance imaging, it was possible to identify elevated BOLD (Blood Oxygenation Level Dependent, method for measuring brain activity) signals in the hypothalamus region. only in men when compared to women, when under sexual preferable visual stimulation.

A study by Wehrum-Osinsky (2014) also reached a similar result. Due to the functions of the hypothalamus, related to emotional processes of the limbic system, it is possible to trace this result as a possible explanation for why men consume more pornography for a longer time (HALD, 2006). Another association would be that women have their primary visual cortex deactivated when exposed to high-intensity erotic films (HUYNH et al., 2012) and therefore could be less susceptible to the consumption of such content.

Furthermore, brain activation under conditions of sexual visual stimuli is different between individuals depending on subjective preference. In a study published by Ponseti (2009) with hetero and homosexual men, using functional magnetic resonance imaging, BOLD levels were raised in the thalamus only by the sexual stimulus preferred by the user. In straight men, there was an increase in activity in the insula and cingulate cortex by male visual stimuli, showing that sexual arousal does not occur if there is no preference for visual sexual stimuli, since the insula and cingulate cortex are also activated in reactions of aversion (SAFRON et al., 2007).

CONCLUSION

From this review it was possible to conclude that the neural effects exerted by pornography consist in the deregulation of dopamine levels and the neuroplasticity promoted in the limbic system. Such changes can lead to emotional, cognitive and behavioral problems in users, such as the development of compulsive behavior, depression, and that men are considered more susceptible to their consumption.

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