

## Cardiovascular and pulmonary response in gaming disorder: A systematic review protocol

### Réponse cardiovasculaire et pulmonaire dans le trouble du jeu vidéo : Protocole d'une revue systématique

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#### ABSTRACT

**Introduction:** Internet Gaming Disorder (IGD) is a recognized mental health condition associated with autonomic nervous system (ANS) dysregulation. While heart rate variability (HRV) has been studied, ventilatory responses remain poorly explored. This systematic review aims to evaluate the impact of IGD on cardiovascular (HRV) and pulmonary (respiratory rate) parameters.

**Methods:** To conduct this systematic review, a literature search will be conducted on PubMed, Scopus, and Embase. We will include studies assessing HRV and respiratory rate in individuals aged  $\geq 12$  years with IGD. Studies without objective ANS measurements or those with non-DSM-5-defined populations will be excluded. Data extraction will focus on HRV (continuous ECG) and respiratory rate variations, stratified by gaming context and IGD severity. The risk of bias will be assessed using ROBINS-I.

**Conclusion:** This review will clarify ANS dysregulation patterns in IGD, informing clinical monitoring strategies. Limitations may include heterogeneity in measurement methods.

**Keywords:** heart rate variability, autonomic nervous system, Parasympathetic activity, respiration, Internet Addiction Disorder

#### RÉSUMÉ

**Introduction:** Le trouble du jeu vidéo (TJV) est un trouble mental reconnu, associé à une dysrégulation du système nerveux autonome (SNA). Alors que la variabilité de la fréquence cardiaque (VFC) a été étudiée, les réponses ventilatoires restent peu explorées. Cette revue systématique évaluera l'impact du TJV sur les paramètres cardiovasculaires (VFC) et pulmonaires (fréquence respiratoire (FR)).

**Méthodes:** Une recherche bibliographique sera effectuée dans PubMed, Scopus et Embase. Les études incluant des individus  $\geq 12$  ans avec TJV seront retenues. Seront exclues les études ne présentant pas de mesures objectives du SNA ou dont les populations ne sont pas définies par le DSM-5. L'extraction des données ciblera la VFC et les variations de la FR avec stratification selon le contexte de jeu et sévérité du TJV. Le risque de biais sera évalué via ROBINS-I.

**Conclusion:** Cette revue clarifiera les profils de dysrégulation du SNA dans l'IGD, guidant les stratégies de suivi clinique. Les limites incluront l'hétérogénéité des méthodes de mesure.

**Mots-clés:** variabilité de la fréquence cardiaque, Système nerveux autonome, activité parasympathique, Respiration, trouble addictif à l'Internet

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## INTRODUCTION

Internet Gaming Disorder (IGD) is recognized as a mental health condition associated with excessive video gaming, leading to functional impairments [1]. In 2013, gaming disorder was provisionally listed in Section III of the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) [1]. Since 2019, IGD has been officially classified by the 72nd World Health Assembly as a type of mental, behavioral, or neurodevelopmental disorder, and it was added to the 11th revision of the International Classification of Diseases [2]. The inclusion of IGD in the DSM-5 has underscored the importance of comprehensively understanding its physiological and psychosomatic effects. The diagnosis of IGD is based essentially on the detection of a gaming addiction, without including any objective physical signs [3]. Among the parameters that vary in people with this syndrome, several have been described in the literature, namely heart rate variability and activation of the prefrontal cortex. Heart rate variability (HRV) has been used to explore the autonomic nervous system (ANS) response of individuals with IGD [4]. However, the ventilatory response during IGD is also one of the parameters that reflect the activity of the ANS [5]. Little is known about it, as it is poorly assessed.

**Objectives:** This study aims to conduct a systematic review of the scientific literature to elucidate the impact of Internet Gaming Disorder on ventilatory and chronotropic heart responses.

## METHODS

### Eligibility Criteria

The present systematic review will analyze data exclusively extracted from published studies. As this study does not involve direct patient interaction, no ethical approval or informed consent is required. Two independent investigators (HC and SM) will perform the literature search, study selection, and data extraction processes. Any discrepancies between reviewers will be resolved through discussion with a third investigator (SL) to reach a consensus.

### Search strategy

The inclusion criteria are as follows: (1) study populations must include individuals aged 12 years or older with a formal diagnosis of Internet Gaming Disorder (IGD) according to DSM-5 criteria; (2) studies must report objective measurements of heart rate variability (HRV) through continuous electrocardiogram (ECG) and/or respiratory rate; (3) appropriate comparator groups must be included, consisting of either non-IGD individuals or moderate gamers; and (4) studies must report a primary outcome of HRV changes (including time and frequency domain metrics) or a secondary outcome of respiratory rate variations or pulmonary function, with stratification by IGD severity when available.

Exclusion criteria will encompass (1) studies involving populations not meeting DSM-5 criteria for IGD; (2) case reports, narrative reviews, or studies lacking quantitative assessment of autonomic nervous system parameters; (3) publications in languages other than English or French; and (4) duplicate publications or studies with overlapping datasets (in which case the most comprehensive study will be retained).

The research question was developed following the PICO framework: Population (P) - individuals with IGD diagnosed according to DSM-5 criteria [1]; Intervention (I) - measurement of HRV and/or respiratory rate; Comparison (C) - non-IGD individuals or moderate gamers; and Outcomes (O) - changes in autonomic nervous system parameters.

A comprehensive search strategy will be implemented across multiple databases including PubMed, Scopus, and Embase. Grey literature sources such as conference abstracts and unpublished theses will also be considered. The boolean queries for each database are represented in Appendix 1.

To ensure the comprehensiveness of the search,, additional methods will include manual examination of reference lists from included studies (backward citation tracking) and identification of articles that have cited key papers (forward citation tracking).

### Study Selection Process

The study selection process will adhere to PRISMA guidelines [6]. Initially, two reviewers (HC and SM) will independently screen titles and abstracts according to predefined eligibility criteria. Full-text articles will then be subjected to independent evaluation by both reviewers. At each stage, the reasons for exclusion will be documented. The final selection process will be presented in a PRISMA flow diagram, detailing the number of studies identified, screened, assessed for eligibility, and included in the review.

### Data Extraction

Data extraction will be performed using an Excel file. Two reviewers (HC and SD) will independently extract the following information from each included study: publication details (including the title, journal, authors, year, country where the study was conducted, type of publication, and the specialties of the authors—whether medical or non-medical); participant details (including sample size, age range, gender distribution, population characteristics, and IGD diagnostic criteria, as well as the severity of IGD where available); methodology (covering methods used for evaluating heart and respiratory rates, the timing and duration of assessments, and the gaming context); outcome data (specifically baseline and follow-up HRV parameters and respiratory rate measurements); and study limitations (including any limitations reported by the study authors, as well as selection bias, response bias, information bias, and limitations related to the assessment tools used). In cases of missing or unclear data, study authors will be contacted for clarification.

## Appendix 1. Search Strategy

| Database | Component 1: Disorder Terms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Component 2: Physiology Terms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pubmed   | («Internet Addiction Disorder»[MeSH Major Topic] OR «Addiction Disorder, Internet» OR «Internet Addiction Disorders» OR «Disorder, Internet Addiction» OR «Disorders, Internet Addiction» OR «Internet Addiction» OR «Addiction, Internet» OR «Addictions, Internet» OR «Internet Addictions» OR «Internet Gaming Disorder» OR «Disorder, Internet Gaming» OR «Disorders, Internet Gaming» OR «Gaming Disorder, Internet» OR «Gaming Disorders, Internet» OR «Internet Gaming Disorders» OR «Smartphone Addiction» OR «Addiction, Smartphone» OR «Addictions, Smartphone» OR «Smartphone Addictions» OR «Social Media Addiction» OR «Addiction, Social Media» OR «Addictions, Social Media» OR «Media Addiction, Social» OR «Media Addictions, Social» OR «Social Media Addictions») | AND (“autonomic nervous system”[MeSH Major Topic] OR “heart rate variability” OR «Cardiac Chronotropism» OR «cardiac chronotropy» OR «chronotropism, cardiac» OR «Chronotropy, Cardiac» OR «Control, Heart Rate» OR «Heart Rate Control» OR «Heartbeat» OR «Heartbeats» OR «pulse rate» OR «Pulse Rates» OR «Rate Control, Heart» OR «Rate, Pulse» OR «Rates, Pulse» OR «Heart Rates» OR «Rate, Heart» OR «Cardiac Rate» OR «Cardiac Rates» OR «Rate, Cardiac» OR «Respiratory Sinus Arrhythmia» OR «diastolic pressure» OR «Pressure, Diastolic» OR «Pressure, Pulse» OR «Pressure, Systolic» OR «Pressures, Systolic» OR «pulse pressure» OR «systolic pressure» OR «Cardiovascular Physiological Phenomena» OR «Phenomena, Cardiovascular Physiological» OR «Physiological Phenomena, Cardiovascular» OR «Physiology, Cardiovascular» OR «Cardiovascular Physiology» OR «Cardiovascular Physiological Concepts» OR «Cardiovascular Physiological Concept» OR «Concept, Cardiovascular Physiological» OR «Concepts, Cardiovascular Physiological» OR «Cardiovascular Physiological Process» OR «Physiological Process, Cardiovascular» OR «Processes, Cardiovascular Physiological» OR «heart rate variability» OR «pulse-rate variability» OR «HRV» OR «PRV» OR «cardiovascular response» OR «Parasympathetic activity» OR «Cardiac vagal activity» OR «sympathetic activity» OR «Instantaneous pulse rate variability» OR «Autonomic regulation» OR «Cardiorespiratory coupling» OR «rate, respiration» OR «rate, respiratory» OR «rates, respiration» OR «rates, respiratory» OR «respiration rate» OR «respiration rates» OR «respiratory rates» OR «Phenomena, Respiratory Physiological» OR «Physiological Phenomena, Respiratory» OR «Respiratory Physiological Concepts» OR «Concepts, Respiratory Physiological» OR «Respiratory Physiological Processes» OR «Respiratory Physiology» OR «Pulmonary Physiological Processes» OR «Physiology, Pulmonary» OR «respiratory response» OR «respiratory function» OR «breathing» OR «respiration» OR «respiratory rate» OR «pulmonary function» OR «hyperventilation syndrom» OR «Abdominal respiration» OR «Abdominal wall movement») |
| Embase   | ('gaming disorder' OR 'video game addiction' OR 'internet gaming disorder' OR 'pathological gaming' OR 'problematic gaming' OR 'compulsive gaming' OR 'competitive gaming' OR 'video game disorder' OR 'problematic internet use' OR 'excessive gaming')                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | AND ('heart rate variability' OR 'pulse-rate variability' OR 'hrv' OR 'prv' OR 'cardiovascular response' OR 'parasympathetic activity' OR 'cardiac vagal activity' OR 'sympathetic activity' OR 'instantaneous pulse rate variability' OR 'autonomic regulation' OR 'cardiorespiratory coupling' OR 'respiratory response' OR 'respiratory function' OR 'breathing' OR 'respiration' OR 'respiratory rate' OR 'pulmonary function' OR 'hyperventilation syndrom' OR 'abdominal respiration' OR 'abdominal wall movement')                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Scopus   | TITLE-ABS-KEY («Addiction Disorder, Internet» OR «Internet Addiction Disorders» OR «Disorder, Internet Addiction» OR «Disorders, Internet Addiction» OR «Internet Addiction» OR «Addiction, Internet» OR «Addictions, Internet» OR «Internet Addictions» OR «Internet Gaming Disorder» OR «Disorder, Internet Gaming» OR «Disorders, Internet Gaming» OR «Gaming Disorder, Internet» OR «Gaming Disorders, Internet» OR «Internet Gaming Disorders» OR «Smartphone Addiction» OR «Addiction, Smartphone» OR «Addictions, Smartphone» OR «Smartphone Addictions» OR «Social Media Addiction» OR «Addiction, Social Media» OR «Addictions, Social Media» OR «Media Addiction, Social» OR «Media Addictions, Social» OR «Social Media Addictions»)                                      | AND TITLE-ABS-KEY (“heart rate variability” OR «Cardiac Chronotropism» OR «cardiac chronotropy» OR «chronotropism, cardiac» OR «Chronotropy, Cardiac» OR «Control, Heart Rate» OR «Heart Rate Control» OR «Heartbeat» OR «Heartbeats» OR «pulse rate» OR «Pulse Rates» OR «Rate Control, Heart» OR «Rate, Pulse» OR «Rates, Pulse» OR «Heart Rates» OR «Rate, Heart» OR «Cardiac Rate» OR «Cardiac Rates» OR «Rate, Cardiac» OR «Respiratory Sinus Arrhythmia» OR «diastolic pressure» OR «Pressure, Diastolic» OR «Pressure, Pulse» OR «Pressure, Systolic» OR «Pressures, Systolic» OR «pulse pressure» OR «systolic pressure» OR «Cardiovascular Physiological Phenomena» OR «Phenomena, Cardiovascular Physiological» OR «Physiological Phenomena, Cardiovascular» OR «Physiology, Cardiovascular» OR «Cardiovascular Physiology» OR «Cardiovascular Physiological Concepts» OR «Cardiovascular Physiological Concept» OR «Concept, Cardiovascular Physiological» OR «Concepts, Cardiovascular Physiological» OR «Cardiovascular Physiological Process» OR «Physiological Process, Cardiovascular» OR «Processes, Cardiovascular Physiological» OR «heart rate variability» OR «pulse-rate variability» OR «HRV» OR «PRV» OR «cardiovascular response» OR «Parasympathetic activity» OR «Cardiac vagal activity» OR «sympathetic activity» OR «Instantaneous pulse rate variability» OR «Autonomic regulation» OR «Cardiorespiratory coupling» OR «rate, respiration» OR «rate, respiratory» OR «rates, respiration» OR «rates, respiratory» OR «respiration rate» OR «respiration rates» OR «respiratory rates» OR «Phenomena, Respiratory Physiological» OR «Physiological Phenomena, Respiratory» OR «Respiratory Physiological Concepts» OR «Concepts, Respiratory Physiological» OR «Respiratory Physiological Processes» OR «Respiratory Physiology» OR «Pulmonary Physiological Processes» OR «Physiology, Pulmonary» OR «respiratory response» OR «respiratory function» OR «breathing» OR «respiration» OR «respiratory rate» OR «pulmonary function» OR «hyperventilation syndrom» OR «Abdominal respiration» OR «Abdominal wall movement»)                                   |

Any disagreements in data extraction will be resolved through discussion or, if necessary, arbitration by the third reviewer (SL).

### Risk of Bias Assessment

The methodological quality of included studies will be rigorously evaluated using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool [7]. Two reviewers (SD and SL) will independently assess each study across seven domains: (1) confounding; (2) selection of participants; (3) classification of interventions; (4) deviations from intended interventions; (5) missing data; (6) measurement of outcomes; and (7) selection of reported results. Discrepancies in quality assessment will be resolved through consensus discussion with the third reviewer (HC). A 'low' risk of bias rating is assigned only when a study is deemed to have robustly controlled for all key confounding domains and has low risk of bias across all other domains. The overall risk increases to 'moderate', 'serious', or 'critical' as the severity and number of biases increase.

### Data Synthesis

Given the anticipated heterogeneity in study designs and outcome measurement methods, the primary approach to data synthesis will be narrative. Studies will be grouped by design (observational vs. interventional) and outcomes (HRV parameters, respiratory rate). Subgroup analyses are planned to examine potential differences related to IGD severity (mild, moderate, and severe) and gaming context (genre, duration, and intensity).

## CONCLUSION

This protocol describes the systematic review of the cardiovascular and respiratory response to IGDs by rigorous methods. By synthesizing evidence on the variability of heart rate and respiratory rate patterns, this study will clarify the effect of IGD on the function of the autonomous nervous system. The results may help to inform pathological gamers' clinical monitoring strategies and to identify future intervention research. Possible limitations include the heterogeneity of the measurement method and different sample characteristics during the study. Ultimately, these results could contribute to a more holistic assessment and management approach to the management of game-related disorders.

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