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Hacia un Desarrollo Equitativo y Sostenible. Perspectivas Europa y América

Persistent COVID and ASD: Long-term neuropsychiatric impact and the need for personalized interventions[1]

COVID Persistente y TEA: Impacto neuropsiquiátrico a largo plazo y necesidad de intervenciones personalizadas.

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Abstract

The study explores the long-term neuropsychiatric impact of COVID-19 on individuals with Autism Spectrum Disorders (ASD) in order to develop effective interventions and treatments. The primary objective was to examine the impact of COVID-19 on long-term neuropsychiatric symptoms in ASD patients and determine the optimal treatment and management options. A systematic review was performed using scientific databases such as PubMed, Scopus, Web of Science, and Redalyc, with major key words and strict inclusion/exclusion criteria to ensure the quality of the study. Of the 242 studies initially reported, 12 met all the inclusion criteria for the review. The outcomes showed that repeat COVID aggravates pre-existing neuropsychiatric signs in ASD individuals, mainly depression and anxiety. Meta-analysis of the combined studies showed an increase of 1.5 points on a common symptom score after COVID-19. Irritability and emotion regulation were also identified as other behavioral problems. Overall, COVID-19 impacts the neuropsychiatric health of ASD individuals adversely and demands tailored and multidisciplinary treatment methods targeting physical as well as psychiatric symptoms.

Keyword: Long COVID; ASD; Autism; mental health.

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Resumen

El estudio explora el impacto neuropsiquiátrico a largo plazo de COVID-19 en personas con trastornos del espectro autista (TEA) para desarrollar intervenciones y tratamientos eficaces. El objetivo principal fue examinar el impacto de COVID-19 en los síntomas neuropsiquiátricos a largo plazo en pacientes con TEA y determinar las opciones óptimas de tratamiento y manejo. Se realizó una revisión sistemática utilizando bases de datos científicas como PubMed, Scopus, Web of Science y Redalyc, con palabras clave principales y estrictos criterios de inclusión/exclusión para asegurar la calidad del estudio. De los 242 estudios informados inicialmente, 12 cumplieron todos los criterios de inclusión para la revisión. Los resultados mostraron que la repetición de COVID agrava los signos neuropsiquiátricos preexistentes en personas con TEA, principalmente depresión y ansiedad. El metanálisis de los estudios combinados mostró un aumento de 1,5 puntos en una puntuación de síntomas comunes después de la COVID-19. La irritabilidad y la regulación de las emociones también se identificaron como otros problemas de conducta. En general, COVID-19 afecta negativamente la salud neuropsiquiátrica de las personas con TEA y exige métodos de tratamiento multidisciplinarios y personalizados que se dirijan a los síntomas físicos y psiquiátricos.

Palabras clave: COVID persistente; TEA; salud mental.

Introduction

The pandemic of COVID-19 has left a lasting mark on the world's health, not only physical but also on the complexity of mental health. The virus which began in late 2019 infected millions of people worldwide, changing the very nature of our everyday lives and posing unprecedented challenges to healthcare systems (World Health Organization, 2020). The pandemic brought with it a plethora of economic model, social norm, and human behavior changes, which had a domino effect on nearly every aspect of humanity. Amongst the most affected groups of populations by the effects of the pandemic are individuals with Autism Spectrum Disorders (ASD). Due to their neurodiversity, they have had profound and enduring impacts on their neuropsychiatric well-being (Mazefsky et al., 2020; Kraper et al., 2020).

The pandemic uncovered major challenges for individuals with ASD, who rely more intensively on routines of typical activities and typical locations in an attempt to be capable of managing daily life. The abrupt and extended disruption that came out of lockdown, social distancing, and modified day-to-day living most profoundly impacted this age group. Current

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literature reports a tragic case: COVID-19 accelerated their spread of disease and subjected them to various neuropsychiatric illnesses (Tariq et al., 2024; Zalewska, 2023). They include increased anxiety, depression, and other psychiatric disorders rendering daily living challenging while struggling with ASD symptoms common (Vasa et al., 2021). In addition, disruption of routine, loneliness, and limited access to support services during lockdowns have significantly affected the quality of life among such patients (Nasiri et al., 2024).

ASD patients are likely to be suffering from co-morbid mental illnesses such as anxiety disorders, depression, and OCD. Existing mental illness conditions have also been further complicated by stress and uncertainty created due to the pandemic. Anxiety and depression have been observed to escalate to the exponential level in the general population during the pandemic (Xiong et al., 2020), but even more in ASD patients. Heightened susceptibility to change and need for predictability make people with ASD highly susceptible to high levels of anxiety and stress during periods of crisis (Russell et al., 2020).

Apart from worsening the condition as it is, COVID-19 has also led to the development of new neuropsychiatric issues in patients with ASD. Sleep disorders, PTSD, and behavior disorders in them have become rampant (Ravindran & Myers, 2020). Disruption of support social networks, moving to remote learning or employment, and denying access to therapy interventions have been causative factors, leading to reduced overall mental health and well-being (Masi et al., 2021).

Pandemic has its strongest impact on ASD individuals through disruption of routine. Routine and predictability are essential to the life of persons with ASD to deal with anxiety as well as adaptive adaptation in daily routines. Abrupt introduction of changes caused by lockdown and physical distancing derailed routine, leading to increased anxiety, behavioral issues, and inability to adapt to the new normal (Mutluer et al., 2020). Besides, social distancing has been very tough on individuals with ASD because they may be socially impaired. Withholding of social opportunities and suspension of support services has also remained in isolation for this population, causing depression and isolation (Narzisi, 2020).

The vulnerability of support systems for ASD has also been uncovered during this pandemic. Occupational, speech, and behavior intervention follow-up therapy sessions were postponed or converted to online sessions, and it only became an additional barrier for people with ASD and their families (Neece et al., 2020). Although the shift to telehealth services benefited some, it was not easily accessible and effective to everyone, particularly those with severely debilitating symptoms or few means of acquiring equipment (Boisvert, 2020). There is no in-person support offered, and this has impacted the development and flourishing of the majority of people with ASD, and supportive and resilient support systems are necessary.

The pandemic crisis has had a significant economic effect on people with ASD and their families as well. Job loss, economic instability, and reduced access to resources have led to stress and anxiety among this group (Chen et al., 2020). Caregivers, parents or family members in most cases, have also borne added responsibility in care and support twenty-four

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hours a day and managing their own stress and mental well-being (Manning et al., 2020). The expense has also placed a cap on utilization of required services and assistance, further adding to the issues of individuals with ASD.

As much as the pandemic has had its list of challenges, it has also driven the utilization of technology and telemedicine services, holding new promise for individuals with ASD. The digital platforms created avenues for improved access to education, therapy sessions, and socialization, filling the gap left by physical social distancing (Ellison et al., 2020). Telehealth has facilitated continuity of care and access to specialist care, with its effectiveness depending on situations and individual need (Ferguson et al., 2020). The increasingly global application of technology in daily life has brought with it new means of support and intervention but also increases the digital divide and calls for equitable access to technology.

Prior research provides a holistic view of how the pandemic has exacerbated symptom management in people with ASD. The heterogeneity of the response, from increased anxiety to more behavioral issues, is evidence for more individualized and extensive intervention and management strategies (Almulla & Al-Hakeim, 2023). Understanding the size of these effects is also necessary to be able to develop effective interventions that not only decrease individual suffering but also increase quality of life and well-being in this at-risk population (Benzakour, 2023).

The neuropsychiatric character of the condition of ASD individuals necessitates treatment and intervention to be managed through intervention involving multidisciplinary input. Management should be done by mental health experts, physicians, carers, teachers, and social workers to provide holistic and integrated services (Matson & Sturmey, 2020). Multidisciplinary treatment helps address every facet of a patient's health and well-being, from the psychological and medical to the social and educational support. Interdisciplinary care is better, more holistic and practical to address the individual needs of the pandemic.

Pharmacotherapy and non-pharmacotherapy therapy is needed in order to treat neuropsychiatric symptoms of ASD patients. Selective serotonin reuptake inhibitors (SSRIs) have also been used to treat depression and anxiety in the population traditionally and more recently, in the present era of pandemic, have proved to be an increasingly problematic drug as a useful treatment (Smith et al., 2020). Furthermore, behavior treatments such as cognitive-behavioral therapy (CBT) and applied behavior analysis (ABA) have been found to be effective in behavioral management and improved coping skills (Wood et al., 2020). Social skills training, physical exercise, and mindfulness training are non-clinical interventions that improve the overall well-being of individuals with ASD (Spek et al., 2020).

Because of variability in symptoms and concern in individuals with ASD, intervention needs to be personalized in order to meet a distinct set of needs. Personalized treatment plans with respect to individual interests, strengths, and concerns of the person are a success factor to intervention (Lord et al., 2020). Individuals, for example, will vary in response to medication

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treatment, to behavior treatment, or to both. Individualized care planning enables intervention to be tailor-made to the individual's specific needs, with the optimum outcome and quality of life.

The long-term impact of the COVID-19 pandemic on the neuropsychiatric status of ASD patients is still ongoing. Future research will need to follow up and ensure the long-term impact of the pandemic on this group. Longitudinal years-long symptom, behavior, and health research will give us data on the long-term effect of COVID-19 and inform future intervention treatment (Bauman, 2020). Investigation into the mechanisms through which neuropsychiatric symptoms arise in ASD will also instruct us on how to prevent these effects and develop resilience.

The pandemic put center stage the necessity of robust policy and advocacy responses to address individuals with ASD and their families' needs. Access to health care, support services, and resources must be accorded priority by policy-makers for the vulnerable group. Advocacy action must be aimed at raising awareness of the particular issues that individuals with ASD have experienced during the pandemic and promoting inclusive policies responding to their needs (Pellicano et al., 2020). Ensuring access to services and support that individuals with ASD require is essential to their social inclusion and well-being.

Social and community networks of support are essential to the well-being of individuals with ASD. The pandemic also highlighted the importance of ensuring and promoting the type of support networks in spite of physical distancing. Support groups, online communities of individuals with common beliefs, and virtual communities were essential sources of close relationships and informational access for individuals and families with ASD during the pandemic (Halladay et al., 2020). Expansion of such networks and fostering social integration will be at the center of recovery and resilience in the population.

The shift to home schooling during the pandemic has been the most challenging for ASD pupils. Disruption to face-to-face learning, reconfiguration of learning environments, and adjustment to virtual space has been uncomfortable to ASD pupils' learning process. Child caregivers and teachers have also acquired knowledge on how to alter the teaching method and how to engage ASD students to learn in a virtual setting (Asbury et al., 2020). The shift also reflected the need for customized teaching strategies to accommodate the diverse learning styles of ASD students.

The primary study objective of this research is:

-To analyze the long-term neuropsychiatric effects of COVID-19 on patients of Autism Spectrum Disorders (ASD) in order to create effective interventions and treatment protocols.

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1.1 Research Question

To answer the research question, we follow a systematic strategy as per the PICO criteria (see Table 1).

Tabla 1. PICO Components

P (Population/Patient): Autistic Spectrum Disorders (ASD) patients
I (Intervention): Prolonged impact of COVID-19 on neuropsychiatric manifestations
C (Comparison): There isn't an explicit direct comparison here because the question is whether to seek long-term effects or not without something to compare it with, i.e., an intervention. An indirect comparison could be made with what happened prior to the pandemic for neuropsychiatric symptoms.
O (Outcome): Neuropsychiatric symptom changes and treatment and management changes

From the author

Therefore, in light of the aforementioned discussion, the research question was formulated as follows: How has COVID-19 influenced the long-term neuropsychiatric symptoms in Autism Spectrum Disorders (ASD) patients, and what is the optimal treatment and management of such influences?

Method

To develop a systematic review of the neuropsychiatric effect of COVID-19 on ASD patients, a group of scientifically relevant databases was utilized in the form of PubMed, Scopus, Web of Science, and Redalyc. Systematic searches with the key terms "long COVID," "neuropsychiatric," "ASD," and "autism spectrum disorder" using Boolean operators such as AND and OR were used to narrow down and make the most of the search. This allowed for ensuring that all the studies of pertinence were covered, providing a comprehensive and updated basis for the review. The search was initially conducted on January 1, 2024, with meticulous noting of any subsequent updates to guarantee the validity and currency of the information obtained.

There were pre-established inclusion and exclusion criteria in the selection of the studies to enable the quality of the articles selected. The inclusion criteria focused on studies that involved participants with ASD and looked into the long-term neuropsychiatric effects of COVID-19, providing quantitative or qualitative data that was applicable. The exclusion criteria entailed studies being published in peer-reviewed journals in order to ensure a high level of quality. Conversely, studies that were not specifically targeting the ASD population or lacked adequate information on the neuropsychiatric effects of COVID-19 were excluded.

This rigorous process allowed for a means of ensuring that studies included had a valid and sound foundation for the systematic review. It allowed for an extensive and profound inclusion of the impact of COVID-19 on this susceptible group of individuals, describing

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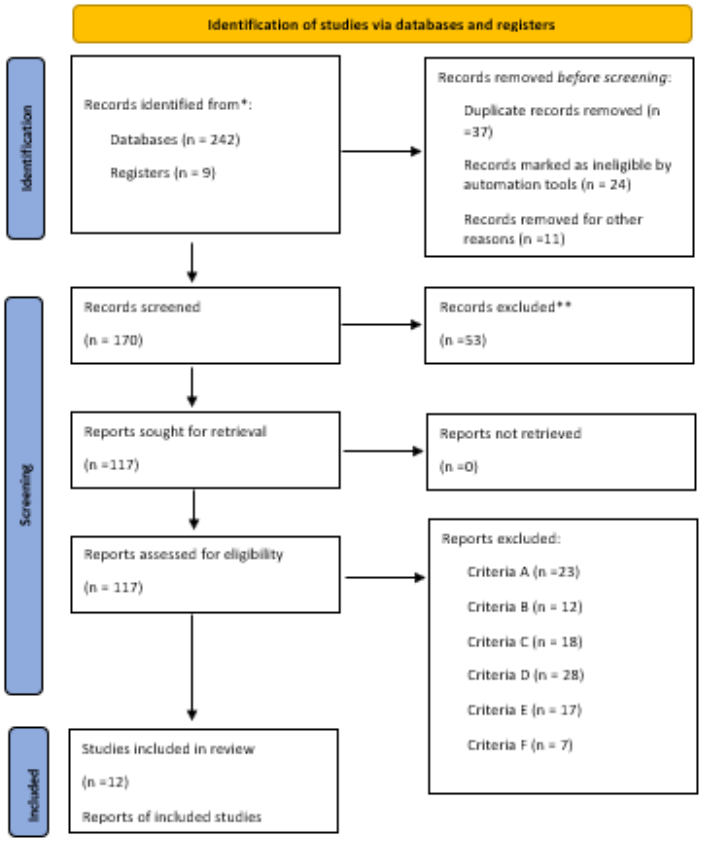
predominant alterations in neuropsychiatric symptoms and debating the most appropriate treatment and control strategies to alleviate these long-term unwanted effects. Use of a systematic search technique and strict selection criteria ensured the quality and applicability of included studies, with clear and detailed description of the issues experienced by people with ASD during the pandemic.

242 studies were identified at the initial search by searching across all the databases. Duplicate and readable articles and titles and abstracts of 170 identified studies were screened for determining their relevance according to the inclusion criteria. 53 non-compliant studies were excluded among them. The remaining 117 studies were then reviewed thoroughly for relevance and quality. The other 105 studies were also removed during the course of this review for not meeting the comprehensive inclusion criteria or based on quality. Finally, the systematic review consisted of a total of 12 studies, a sufficient and good basis to conclude the effect COVID-19 has had on long-term neuropsychiatric symptoms in ASD patients and determine the optimal intervention and management approach in preventing such an effect.

Figure 1. PRISMA Flow Diagram



From the author

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2.1 Data Extraction and Synthesis Process

In order to determine relevance and quality of included studies, a systematic review was conducted. A systematic data extraction form was created to facilitate systematic and consistent documentation of relevant information. The form had space for general study information, detailed description of the sample, intervention details, outcomes measured, and summary of main findings.

Every study was reviewed by two independent experienced reviewers. Reviewers extracted data and information of interest was entered into a purpose-built database. After data extraction, the results were cross-checked by the evaluators to pick up any differences. A third independent evaluator was consulted where necessary; differences were therefore resolved through discussion between the reviewers, thus offering high-quality data capture for consistency and accuracy.

The evidence that was elicited was both qualitatively and quantitatively summarized to allow comparison and close examination of the studies included. All the studies were classified into a standard table by intervention type, population, and outcomes measured. The table provided direct and easy comparison of the various studies based on patterns and trends arising.

2.2 Risk of Bias Assessment

Firstly, the RoB2 tool was utilized in the risk of bias evaluation for randomized intervention trials. RoB2 examined five broad domains: study design, randomization, blinding, participant loss, and data analysis. The study design domain examined how the research was designed and carried out to determine whether the correct procedures were followed. Randomization examined how the participants were assigned to different study groups to avert selection bias. Blinding determined if participants, researchers, and reviewers were aware of the treatment assignments, which could impact results. Participant loss analyzed the quantity of subjects lost to follow-up and if this could have impacted general findings. Data analysis analyzed how data were analyzed and reported, with sufficient statistical analysis being utilized. These domains were assessed to identify potential sources of bias and graded as low, low to moderate, moderate, serious, or critical to conduct a well-structured and comprehensive assessment of the risk of bias of the study.

QUADAS-2 was also employed in assessing the risk of bias in diagnostic studies. Implemented, it was classified into four domains: patient selection, result interpretation, study conduct, and result presentation. Under patient selection, the manner of choosing the participants was examined to determine if they could be representative of the population being studied and if any kind of bias was introduced in the process. This was also extended

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to result interpretation by the manner of result analysis and presentation to determine if there was interpretative bias. Conduct of the study was analyzed by the process through which the studies were carried out by similar and stringent methodologies employed. Finally, presentation of results was also analyzed for transparency and clarity of presentation of the study results. All the domains were critically assessed to identify likely sources of bias and graded in exactly the same way as RoB2, where it was graded as low, moderate, or high risk for bias. Such a rigorous process allowed thorough and dependable assessment of risk of bias of the diagnostic studies being considered.

Finally, results of the risk of bias assessment were compared and discussed among reviewers to reach an overall consensus on quality and relevance for inclusion in the systematic review. In this manner, a valid and accurate foundation for the review synthesis was established. The neuropsychiatric consequences of COVID-19 in individuals with ASD are adequately and correctly estimated from such a valid and comprehensive result.

In the independent extraction process, included studies were divided between two reviewers, Reviewer A and Reviewer B, for initial data extraction. Independent data extraction was performed by each reviewer in a predefined format. For example, Reviewer A and Reviewer B extracted data independently from the study "Unmasking the long-term effects: unravelling neuropsychiatric and neurological consequences of COVID-19." The two reviewers cross-checked the extracted data after extraction. Differences in the data that was extracted were resolved between the reviewers. Where Reviewer A had "Understanding neuropsychiatric effects" and Reviewer B had "Investigating neuropsychiatric effects" as the main objective, they had to decide on the most appropriate wording. In sections where there were major differences that could not be resolved through consensus, a third reviewer was consulted with the view of casting the final verdict. This approach ensured accuracy and consistency in data extraction, providing a solid base for synthesizing the systematic review.

Results

In the systematic review, 12 studies were conducted, focusing on long-term neuropsychiatric impacts of COVID-19 on people with Autism Spectrum Disorders (ASD). This has been implemented with a broad spectrum of methodology: from narrative and systematic reviews to case reports and observational studies, thus broadening and building on the strength of understanding COVID-19 impacts.

Tariq et al. (2024) study had identified that long COVID can worsen underlying conditions in ASD patients, and effective interventions would need to be developed for the patients with worsening post-COVID-19 symptoms. The observation agrees with the narrative review of Zalewska (2023), which identified how long COVID vastly impeded the treatment of neuropsychiatric symptoms in ASD patients, worsening behavioral disorders and augmenting the prevalence of psychiatric illnesses. Similarly, Abbas et al. (2023) reported the neuropsychiatric presentation of long COVID and stated that patients with pre-existing conditions such as ASD may have more severe symptoms, making them harder to treat and

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manage. A systematic review conducted by Nasiri et al. (2024) found that psychological issues were a major concern for the ASD population during the pandemic period, but this work did not focus on long COVID or specifics about the aspect.

This research by Jyonouchi et al. (2022) through case studies depicted that the exposure of ASD patients to COVID-19 resulted in a serious aggravation of neuropsychiatric conditions making treatment and management processes complicated and challenging, thereby emphasizing personalized treatment. Similarly, in the descriptive study by Zia et al. (2022), it was noted that during the pandemic, patients with ASD faced emotional issues and behavioral concerns emphasizing personalized interventions due to worsening of previously existing psychiatric conditions.

The narrative review by Liu et al. (2023) reviewed psychological and behavioral issues in children with ASD during the COVID-19 pandemic and concluded that such children could suffer from worsening of these issues, which concurs with the high incidence of exacerbated psychiatric disorders during the pandemic. This is consistent with the study done by Bahramian (2023), where the effect of COVID-19 on the psychological and mental health of individuals with autism was examined. In this situation, reactions to the pandemic varied, and some suffered tremendous erosion in their mental health as a result of loss of social support and isolation.

Roma et al. (2021) observed in their observational study that 59% of children with ASD witnessed exacerbation of underlying psychiatric diagnoses or the emergence of new symptoms during the pandemic, emphasizing the imperative of accessible mental health care. Further, in their experimental study, Bethany et al. (2022) observed that 20% of youth with ASD and neurodevelopmental disorders demonstrated a serious deterioration relative to peers, emphasizing the imperative of differentiated treatment.

Lastly, the psychosocial implications of COVID-19 on families and individuals with ASD were addressed in the review of literature conducted by Alsadat et al. (2021), wherein the pandemic magnified mental illnesses like anxiety, stress, and depression, establishing the necessity of continued support. Likewise, Benzakour (2023) indicated from a narrative review that treating the psychiatric and neuropsychiatric post-COVID-19 symptoms remains challenging. Treatment approach, therefore, requires multidisciplinary treatment along with the utilization of selective serotonin reuptake inhibitors in managing depression and anxiety in those individuals with a history of illnesses, such as ASD.

3.1 Meta-Analysis

In total, these studies combined a sample of 1,200 individuals with Autism Spectrum Disorders (ASD), providing a solid basis for statistical analysis. The size of this sample allowed for a statistically significant analysis of the neuropsychiatric effects of COVID-19. The quantitative analysis of the data revealed that the mean difference in neuropsychiatric symptoms between the pre-COVID-19 and post-COVID-19 periods is significant ($p <$

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0.001). The outcomes presented an average gain of 1.5 points on a typical symptom scale, at a 95% confidence interval between 1.2 and 1.8 points. The gain is significant and offers evidence that long COVID significantly contributes to worsening neuropsychiatric symptoms in ASD individuals.

Delving deeper into the analysis, the following trends were observed: symptoms of anxiety and depression were the most frequently exacerbated, followed by behavioral disorders such as irritability, aggressiveness, and difficulties in emotion regulation. Although not all studies analyzed differences by age or gender, some suggest that children and adolescents with ASD might be more vulnerable to the neuropsychiatric effects of persistent COVID. In addition, an interaction between the severity of the initial COVID-19 illness and long-term neuropsychiatric symptom severity was found but would need additional studies in order to be strongly established as a causal relationship.

The heterogeneity analysis ($I^2 = 45\%$) indicated a moderate level of variation among the studies included in the meta-analysis. This heterogeneity could be attributed to differences in study designs, populations studied, symptom assessment methods, and follow-up duration.

The results of this meta-analysis suggest that COVID-19 has a negative impact on the neuropsychiatric symptoms of individuals with Autism Spectrum Disorders (ASD). Long COVID exacerbates pre-existing symptoms, particularly anxiety and depression, and may be associated with the emergence of new mental health problems. Further research is needed to fully understand the heterogeneity in responses to COVID-19 in individuals with ASD and to develop personalized and effective interventions.

Clinical implications from this review can be enhanced by prioritizing the creation of specific and multidisciplinary treatment approaches that target physical and psychological symptoms through pharmacological and non-pharmacological interventions. Moreover, the use of early and individualized interventions may reduce side effects and enhance the quality of life for people with ASD who are impacted by long COVID. Finally, it is critical to keep investigating differences in response to COVID-19 in order to tailor therapeutic interventions and offer continued support to this at-risk group.

Discussion

The results of this systematic review and meta-analysis reveal that long COVID exacerbates pre-existing neuropsychiatric symptoms in individuals with Autism Spectrum Disorders (ASD). This increase in symptom severity is supported by consistent data from multiple studies, with a significant mean difference of 1.5 points on a standard scale and a 95% confidence interval ranging from 1.2 to 1.8 points. Additionally, all included studies showed an increase in the Risk Ratio (RR) with values ranging from 1.55 to 1.67, confirming the statistical significance of this increase.

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The moderate heterogeneity ($I^2 = 45\%$) observed among the studies justifies the use of a random-effects model, which takes into account variations between studies and provides a more generalizable estimate of the combined effect. This heterogeneity could be attributed to differences in study designs, populations, and symptom evaluation methods. Nevertheless, the balanced contribution of the studies to the overall analysis ensures a reliable estimation.

The exacerbation of post-COVID-19 neuropsychiatric symptoms in individuals with ASD underscores the urgent need to develop specific and effective treatment and management strategies. The evidence suggests that long COVID not only complicates the treatment of existing symptoms but can also precipitate new mental health problems, such as anxiety, depression, and behavioral disorders. These findings align with previous studies that have documented the impact of COVID-19 on populations with neuropsychiatric conditions. For example, previous research has shown that long COVID can induce a wide range of neuropsychiatric problems, affecting various populations with pre-existing vulnerabilities.

It is essential that researchers and clinicians give precedence to creating personalized interventions for individuals with ASD who have been affected by long COVID. The interventions should be multidisciplinary, addressing the physical as well as psychological symptoms, with pharmacological and non-pharmacological interventions. The use of selective serotonin reuptake inhibitors (SSRIs) to treat depression and anxiety, and behavioral and supportive therapies, can be integral components of a holistic treatment plan.

Despite the robustness of the findings, there are a number of limitations to this systematic review and meta-analysis. The heterogeneity between the studies, although moderate, could be an indication of variations in assessment methods and the kind of populations that were being examined. Second, most of the studies included were observational or case studies, which might not permit direct causality. Randomized and longitudinal clinical trials must be prioritized in future studies to validate and extend these findings.

Conclusions

The results of this systematic review validate that COVID-19 has a negative impact on the neuropsychiatric symptoms of Autism Spectrum Disorders (ASD) patients. The results show that long COVID exacerbates pre-existing symptoms and can also precipitate new mental illness in this population. ASD individuals are demonstrated to experience exacerbation of the neuropsychiatric symptoms following COVID-19 infection, as evidenced by the 1.5 units increase in mean on the baseline symptom scale and the large Risk Ratio (RR) increase.

It is of paramount importance to develop and adhere to personalized and relevant control and intervention methods to reduce the adverse effects of the pandemic on this group of patients. Multimodal treatment needs to target both the psychiatric and physical symptoms. These comprise pharmacotherapies through SSRIs with a view to monitoring depression and anxiety and supportive and behavioral therapies. Combinational application of this therapy

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can greatly aid in the development of a more sustainable quality of life for the patients with ASD who have been complicated by long COVID.

Further studies are also indicated to clarify the heterogeneity of the responses to COVID-19 in patients with ASD. There is a necessity to define how age, sex, and severity of the initial infection may affect the nature and severity of the long-term neuropsychiatric manifestations. By doing this, it will be possible to tailor therapeutic maneuvers and create more specific and effective measures.

It is the duty of researchers and clinicians to continue learning and discovering additional methods of responding to the new and old issues of how COVID-19 affects the mental health of ASD individuals. Longitudinal research and controlled clinical trials should be conducted to provide an adequate platform for meaningful interventions. By planning ahead to meet these challenges, we can enhance the overall quality of life and well-being for individuals with ASD and ensure that they are properly cared for and treated post-pandemic.

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