

The Impact of Long COVID-19 Symptoms on Adolescent Mental Health

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ABSTRACT

COVID-19 has severely impacted the world and has caused millions of deaths worldwide. The pandemic has the potential to severely impact the mental health of adolescents. Those who have tested positive may experience symptoms after their recovery, called Long COVID-19. The purpose of this study was to analyze Long COVID-19's impact on adolescent mental health. The hypothesis is that Long COVID-19 symptoms have a detrimental impact on the mental health of adolescents. The null hypothesis is that there has been no impact on adolescent mental health. An electronic survey was sent with 13 stress-related questions and an informed consent. The responses were based on a Likert's scale of 1 to 5, where 5 is the most positive impact and 1 is the most negative impact. Results were analyzed with standard statistical methods, and a p-value of ≤ 0.05 was considered significant. There was a total of 141 responses, and 59.3% of the respondents tested positive for COVID-19 and 40.7% did not. A t-test was run on the overall response between those who tested positive and had Long COVID-19 symptoms and with no symptoms, and $p < 0.01$, showing a significant difference between the responses of those who tested positive with Long COVID-19 symptoms and those who tested positive with no symptoms. More studies need to be conducted to accurately assess the impact of Long COVID-19 on adolescent mental health.

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a novel coronavirus which was first identified in Wuhan, China, in December 2019 (Centers for Disease Control and Prevention, 2021). This virus causes acute respiratory infection in humans leading to multi organ disease and death. This infection was declared a pandemic by the World Health Organization (WHO) on March 11, 2020. (World Health Organization, 2020). According to Johns Hopkins University of Medicine Coronavirus Research Center, as of January 30, 2023, there were more than 670 million total reported COVID-19 cases around the world, and more than 6.8 million reported deaths in the world (Johns Hopkins University, 2023). In the United States, since the beginning of the pandemic, there have been more than 103 million total reported COVID-19 cases and more than 1.1 million total reported deaths (Johns Hopkins University, 2023). According to the American Academy of Pediatrics website, as of January 26, 2023, there were more than 26 million total reported COVID-19 cases in children in the United States, accounting for more than 18.1% of the total reported cases in the US. (American Academy of Pediatrics, 2023).

Some of those who have tested positive were discovered to have Long COVID-19, an onset of symptoms affecting the body after one recovers from COVID-19 (Center for Disease Control and Prevention, 2022). These symptoms are various, such as fatigue, cough, changes in menstrual cycle, headaches, and others. These symptoms are often present in those who have had a severe COVID-19 infection but may be found in those who are asymptomatic as well. Those who have been infected with COVID-19 more than once also have an

increased risk for Long COVID-19 (Ho, 2022). Long COVID-19 is a relatively new issue, thus there is not an expansive base of literature. However, it is still being researched in terms of symptoms and treatment.

The impact of COVID-19 on adolescent mental health has been explored since the beginning of the pandemic in March 2020. General results found an increase in mental health issues throughout adolescents. Anxiety, depression, and irritability and anger were common during COVID-19 quarantine, and the period caused psychological damage (Panchal et al., 2021). In addition to this, students were reported to have a decrease in life satisfaction, and restricted learning caused an increase in mental health, whereas feeling socially connected protected adolescent mental health (Magson et al., 2021). These mental health issues increased and were larger as compared to pre-pandemic rates (Magson et al., 2021).

Because Long COVID-19 is newly discovered, there is limited research. Most of the focus has been on adults with Long COVID-19, and there has been developing research about symptoms and treatment methods. There has been little focus on adolescents who may have Long COVID-19 and its symptoms, and its impact on mental health has not been thoroughly explored. Thus, the purpose of this study is to analyze the effects of Long COVID-19 symptoms on adolescent mental health. The hypothesis is that Long COVID-19 symptoms will have a detrimental impact on the mental health of adolescents who have tested positive. The null hypothesis is that Long COVID-19 symptoms will have no impact on the mental health of adolescents who have tested positive.

Materials and Method

An anonymous and confidential survey was sent out to the community via email, school forums, social media, and text messages. No personal identifiers were required and only age, gender, and COVID-19 information were required. The survey consisted of an informed written consent from the participants and a responsible adult. Then, there were demographic questions about age, gender, and COVID-19 information. The next question asked if the respondent had tested positive for COVID-19. All participants, irrespective of their COVID-19 history, were included in the survey, and listed symptoms that the respondent might have felt during the COVID-19 pandemic period. This was followed by thirteen questions with answers based on a scale. These questions focused on anxiety, depression, memory, concentration, productivity, sleeping habits, diet habits, and relationships with family and loved ones. The responses to the mental health related questions were based on a scale of 1 to 5, with 1 being the most negative impact and 5 being the most positive impact. The respondents were divided into two groups. The first group included students who had not been infected with COVID-19, confirmed by standard laboratory tests, since the pandemic began. The second group of students included students who had been infected with COVID-19, confirmed by standard laboratory tests. The responses were analyzed. This second group of students was divided into those who tested positive and experienced Long COVID-19 symptoms, and those who tested positive but did not. The responses were analyzed. All data was analyzed using Student's t test and a p-value ≤ 0.05 was considered significant.

Data and Observations

Which age group do you belong to?

139 responses

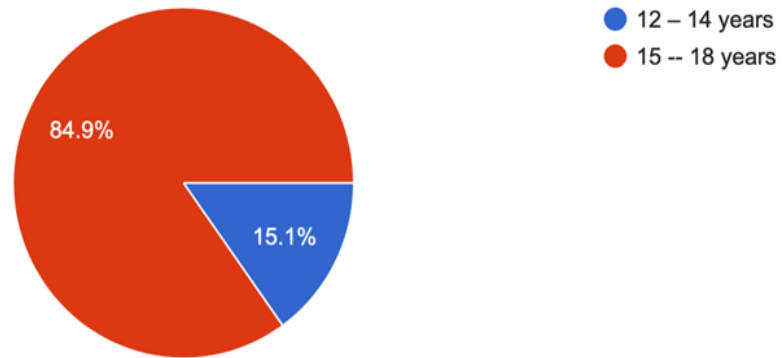


Figure A. Distribution of respondents' age

What sex do you identify with?

140 responses

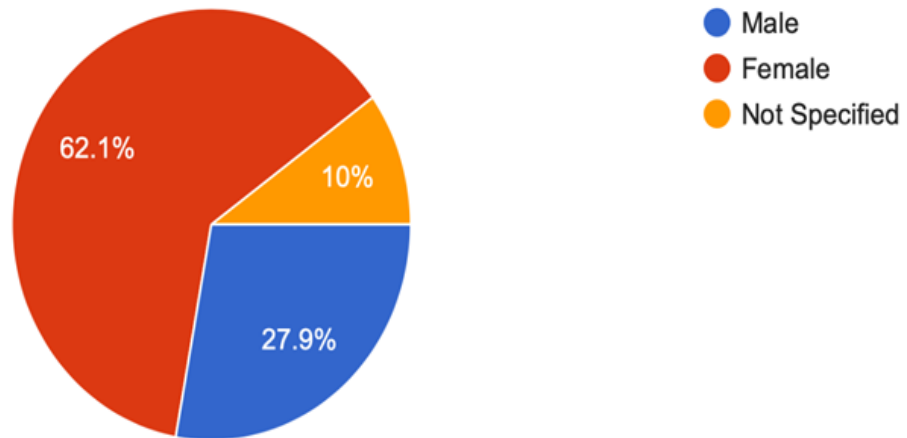


Figure B. Distribution of respondents' gender

Have you been infected with COVID-19, confirmed by standard laboratory tests, since the pandemic begun?

140 responses

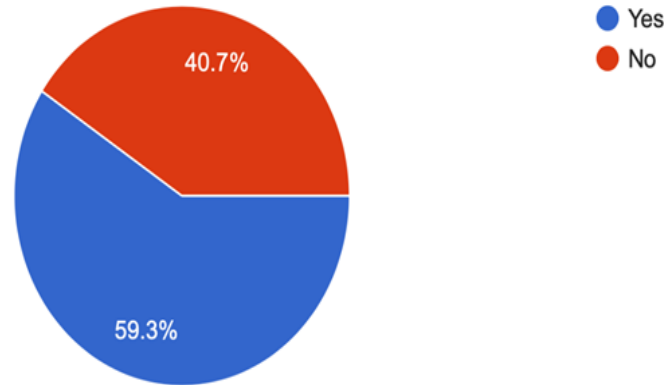


Figure C. Distribution of respondents' COVID-19 infections

Since March 2020, have you experienced any of the following symptoms? (Select more than 1 response if applicable)

140 responses

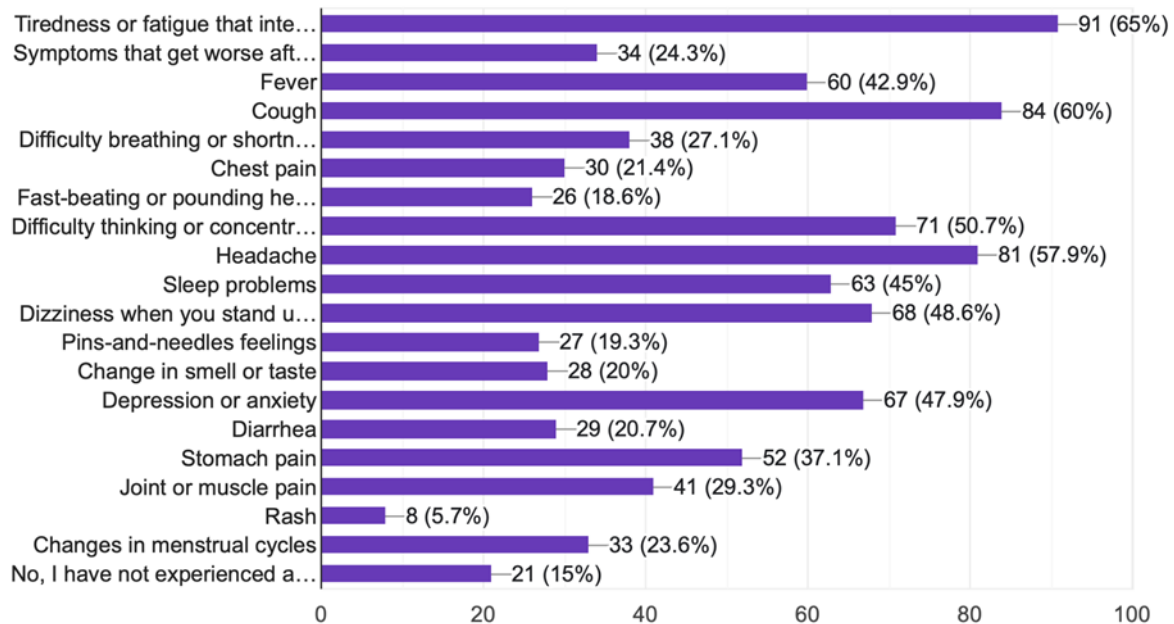


Figure D. Distribution of respondents' Long COVID-19 symptoms

Table 1. Average overall response for respondents who tested negative and respondents who tested positive for COVID-19.

	Negative	Positive	p-value
How has the COVID-19 pandemic impacted your anxiety when you go out in public?	2.666666667	2.698795181	0.4299930535
How has the COVID-19 pandemic impacted your anxiety of getting sick?	2.649122807	2.78313253	0.2463950217
How has the COVID-19 pandemic impacted your general anxiety?	2.456140351	2.554216867	0.3055281986
How has the COVID-19 pandemic impacted feelings of depression?	2.456140351	2.614457831	0.2283459874
How has the COVID-19 pandemic impacted your diet?	2.666666667	2.722891566	0.3885706532
How has the COVID-19 pandemic impacted your sleeping habits?	2.438596491	2.614457831	0.1972579405
How has the COVID-19 pandemic impacted your concentration?	2.438596491	2.337349398	0.2907405789
How has the COVID-19 pandemic impacted your productivity?	2.561403509	2.590361446	0.4493179586
How has the COVID-19 pandemic impacted your memory?	2.771929825	2.78313253	0.47692644
How has the COVID-19 pandemic impacted your short-term memory?	2.859649123	2.626506024	0.09055285556
How has the COVID-19 pandemic impacted your relationships with peers?	2.543859649	2.65060241	0.3003202005
How has the COVID-19 pandemic impacted your relationships with family?	2.894736842	3.156626506	0.1119721331

How has the COVID-19 pandemic impacted your relationships with loved ones?	2.98245614	3.120481928	0.2416255031
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Table 2. Average overall response for COVID positive respondents with and without Long COVID-19 symptoms

	No Symptoms	Symptoms	p-value
How has the COVID-19 pandemic impacted your anxiety when you go out in public?	3.28571429	2.64473684	0.07484547
How has the COVID-19 pandemic impacted your anxiety of getting sick?	2.71428571	2.78947368	0.435918
How has the COVID-19 pandemic impacted your general anxiety?	2.85714286	2.52631579	0.23076062
How has the COVID-19 pandemic impacted feelings of depression?	3	2.57894737	0.20528694
How has the COVID-19 pandemic impacted your diet?	3.42857143	2.65789474	0.05256777
How has the COVID-19 pandemic impacted your sleeping habits?	3.28571429	2.55263158	0.06418347
How has the COVID-19 pandemic impacted your concentration?	3.14285714	2.26315789	0.00927946
How has the COVID-19 pandemic impacted your productivity?	3.28571429	2.52631579	0.06970226
How has the COVID-19 pandemic impacted your memory?	3.28571429	2.73684211	0.11633601
How has the COVID-19 pandemic impacted your short-term memory?	3.14285714	2.57894737	0.08160978

How has the COVID-19 pandemic impacted your relationships with peers?	3.28571429	2.59210526	0.07797873
How has the COVID-19 pandemic impacted your relationships with family?	3.28571429	3.14473684	0.38977818
How has the COVID-19 pandemic impacted your relationships with loved ones?	2.71428571	3.15789474	0.16851045

Results

There were a total 141 responses. 15.1% (n=21) of responders were 12 - 14 years of age. 89.4% (n=118) of responders were 15-18 years of age. 62.1% (n=87) of responders identified as female. 27.9% (n=39) identified as male and 10% (n=14) responders did not identify with the above. 59.3% (n=83) of the respondents tested positive for COVID-19, confirmed by standard laboratory tests, and 40.7% (n=57) did not. See Appendix 1-13 to see the overall distribution for each question. The mean overall response for those who tested negative was 2.64507, and the mean overall response for those who tested positive was 2.71177. A student's t-test was run on the positive and negative groups' individual average responses to the questions to analyze the impact of Long COVID-19 symptoms and diagnosis on mental health and the p value was found to be 0.04166876, which is determined to be significant. This shows that the difference in the mean response between these two groups was significant. Meanwhile, a student's t test was run on the average response from each group for individual questions, rather than overall, and the p-values were not significant (see Table 1).

The group of students who tested positive was further analyzed to accept or reject the hypothesis and null hypothesis. The positive group was split into two smaller groups, one consisting of people who tested positive and experienced symptoms (n=75), and people who tested positive and did not experience symptoms (n = 7). The overall responses for the individual questions between these two groups were analyzed. All differences were insignificant except for the response to "How has the COVID-19 pandemic impacted your concentration?" (p < 0.01). The difference between the response for the positive group with Long COVID-19 symptoms and the positive group without Long COVID-19 symptoms was significant. Because of the unbalanced population size, an unbalanced, one-way ANOVA test was run on the overall mean responses for the questions from each group. The p < 0.01 which was considered to be significant. Thus there is a statistically significant difference in the response between those who have tested positive for COVID-19 with Long COVID-19 symptoms, and those who have tested positive without symptoms, with those testing positive with Long COVID-19 symptoms responding with lower numbers than those without.

Discussion

There have been very few significant studies that analyze Long COVID-19's impact on mental health as of January 2023. Very few studies analyze Long COVID-19 in adolescents as well. Long COVID-19 is still a relatively new issue, yet it has not been fully explored. This study aimed to analyze the impact of Long COVID-19 symptoms on adolescent mental health.

When analyzing the difference in overall response between those who tested negative and those who have tested positive, the p-value was found to be significant. It was found that people who tested positive had a significantly positive overall response to the stress-related questions as compared to those who tested negative. This may be due to the fact that those who tested positive may have been more social than those who tested negative. Due to the nature of the virus, COVID-19 would be transmitted between close social interactions and groups (World Health Organization, 2021). In addition to this, it was found that people who had social connections during the COVID-19 pandemic had a protected mental health (Magson et al., 2021). This could be synonymous with those who tested positive, as they may have found solace in a community where others had been infected with COVID-19, thus improving their mental health.

A second test was run in order to accept or deny the hypothesis and null hypothesis. This test analyzed the difference between those who tested positive with Long COVID-19 symptoms, and those who tested positive with no symptoms. This significance suggests that the difference between the variances and means for the two groups was statistically significant. Those who had Long COVID-19 symptoms had a significantly negative response overall as compared to those with no symptoms. This could be due to the nature of Long COVID-19 symptoms that may have a neurological toll on the brain and body. Long COVID-19 symptoms may decrease their quality of life which would lead them to have more stress and a lower response overall. Therefore, the null hypothesis was rejected, and the hypothesis was accepted.

In addition to this, there was a significant difference in the response to the COVID-19 pandemic impacting concentration. Those who had no symptoms showed a higher number on average, 3.143, as compared to those who tested positive and had symptoms with an average response of 2.2631. This analysis was significant, meaning that Long COVID-19 symptoms have negatively impacted concentration, especially in those that tested positive. This could be due to the fact that some of the most common Long COVID-19 symptoms reported in this survey, like brain fog and fatigue, directly impact concentration as one will have a lack of mental clarity and confusion (Ocon, 2013). However, more studies need to be done with a larger sample size in order to accurately understand the impact of Long COVID-19 on concentration.

This study presents significant findings that may be beneficial for research and studies surrounding Long COVID-19 and its impact on mental health. However, the test between those that tested positive with symptoms and without symptoms had two groups did not have the same sample size. This may present statistical error, and a larger population of people who tested positive with no Long COVID-19 symptoms will be needed in order to accurately analyze the difference. Therefore, more studies need to be conducted that involve a larger sample size and a longer period of time in order to accurately draw conclusions and analyze the impact of Long COVID-19 symptoms on adolescent mental health.

Conclusion

Very few studies focus on Long COVID-19, and very little literature exists for Long COVID-19's impact on adolescent mental health. This study found that there was a statistically significant difference in the overall response between those who tested negative and those who tested positive ($p < 0.05$). The study also found that there was a statistically significant difference in the overall response between those who tested positive and experienced Long COVID-19 symptoms, and those who tested positive and experienced no Long COVID-19 symptoms ($p < 0.001$). Those who tested positive and had no symptoms often answered with higher numbers, signifying a positive impact on mental health, while those who had symptoms responded with lower numbers, signifying a negative impact on mental health. In addition to this, there was a significant impact on concentration as those who tested positive with Long COVID-19 symptoms had a lower response as compared to those who tested positive with no symptoms ($p < 0.001$). Therefore, the hypothesis is accepted. The study had 141 respondents, and the positive group with symptoms versus without symptoms had a significant difference in population size. While this study has critical implications for the community with regards to mental health

recognition and approach, more studies need to be done with a larger population to fully understand the impact of Long COVID-19 symptoms on adolescent mental health.

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