A COMPARATIVE ANALYSIS OF ATTENTION ABILITIES IN POST-COVID AND NON-COVID PATIENTS USING ACE-III SCALE

By

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Declaration

It is hereby declared that

1. The thesis submitted is my/our own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

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Approval

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Ethics Statement

This study does not involve any kind of human and animal trial.

Abstract/ Executive Summary

This study investigates the impact of COVID-19 on attention skills among patients. Using a comparative cross-sectional design, attention scores from the ACE-III questionnaire were analyzed in post COVID-positive and COVID-negative patients. Methodology involved collecting and analyzing data from patient interviews. Results suggest a practical difference in attention between the two groups. Mean attention score for COVID-positive was 14 with a standard deviation of 1.51 , and for COVID-negative was 13 with a standard deviation of 2.41. The t test result was found 1.71 and the value for Cohen's d was 0.501. The t-test was not statistically significant. Moderate effect size indicates potential attentional differences related to COVID-19. These findings highlight the need for further research and tailored approaches for patient care.

Keywords:

COVID-19, attention skills, ACE-III questionnaire, cognitive impact

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List of Acronyms

Covid 19	Corona Virus Disease
ACE III	Addenbrooke's Cognitive Examination

Glossary

COVID-19	A respiratory illness caused by the SARS-CoV-2 virus, leading to a range of symptoms from mild to severe.
ACE-III Questionnaire	Addenbrooke's Cognitive Examination-III assesses cognitive functions, including attention and memory.
Comparative Cross-sectional Design	Research design comparing two or more groups at a single point in time to determine differences.
Effect Size	A measure quantifying the magnitude of difference or strength of a relationship between groups.

Chapter 1

Introduction

1.1 Background

The global outbreak of SARS-CoV-2, commonly known as COVID-19, has profoundly affected people worldwide since its emergence in 2019. While the virus is well-known for causing respiratory symptoms, its impact extends beyond the lungs. Many COVID-19 patients experience ongoing difficulties with thinking clearly, focusing, and processing information. These cognitive challenges can continue even after the initial illness has resolved, affecting daily activities and overall well-being (Becker et al., 2023).

The challenges can affect memory, thinking speed, and overall mental performance, showing how health conditions can impact mental well-being (COVID-19 and the Nervous System, n.d.). Similar cognitive difficulties can be seen in people undergoing chemotherapy or recovering from a concussion.

Recent investigations by Ciaccio et al. (2021) highlight the neurological consequences of SARS-CoV-2 infection and emphasize the potential emergence of neurodegenerative processes. As we explore this complex area, we use the ACE-III scale to guide our understanding, focusing on its "attention" parameter. This tool assesses various aspects of cognition, including attention, memory, language, and spatial skills. Attention is essential for daily tasks like working, making decisions, and overall quality of life. Through the ACE-III scale, doctors can identify attention problems in COVID-19 patients and compare them to people who haven't been infected (Borah et al., 2021).

As we dive into the cognitive effects of COVID-19, we also consider the impact of prolonged isolation during quarantine, which can lead to changes in behavior and increased emotional distress. These changes can worsen cognitive difficulties, highlighting the connection between mental health and the effects of infectious diseases.

The ongoing effects of COVID-19, known as post-acute sequelae of SARS-CoV-2 (PASC) or long COVID, are a growing concern. About 75% of people hospitalized with COVID-19 continue to experience symptoms like decreased attention, difficulties with thinking and planning, and mental haziness, even six months after diagnosis. Studies have shown that cognitive abilities like memory and attention can decline, showing the long-lasting impact of COVID-19 on thinking skills (Covid-19 May Have Small but Lasting Effects on Cognition and Memory, 2024).

By using the ACE-III scale and considering the insights from recent research, we aim to understand these cognitive challenges in detail. This tool gives us valuable information about how people's thinking skills can be affected by COVID-19 and helps us explore the intricate interplay between the virus and cognitive function (Beishon et al., 2019) . It shows us how people's ability to cope with challenges and their vulnerability can vary when facing the difficulties brought by the pandemic.

In conclusion, our study offers a detailed look at the cognitive effects of the pandemic. As we continue our research in this area, we aim to better understand how COVID-19 affects people's attention, thinking, and overall mental well-being. Our goal is to gain insights that go beyond just the virus and help us understand more about cognitive health during global health crises.

1.2 Research Gap

Extensive research on the respiratory complications of COVID-19 has been conducted, but there's still a significant gap in understanding its neurological effects, especially concerning attentional deficits. Many studies have focused on acute respiratory symptoms, often overlooking potential cognitive consequences that could persist post-recovery (Fraser, 2020).

Recent investigations by Ciaccio et al. (2021) highlight the virus's neurological consequences and suggest the potential emergence of neurodegenerative processes. However, there is limited data assessing the long-term cognitive impact of COVID-19, specifically in the domain of attention.

Furthermore, there is a lack of comparative research examining attentional deficits in COVID-19 positive and negative individuals using standardized cognitive assessment tools like the ACE-III scale.

Addressing this research gap is crucial, especially with the emerging concern about post-acute sequelae of SARS-CoV-2 (PASC) or long COVID. Focusing on cognitive health outcomes, particularly attentional functions, will enhance our understanding of the virus's comprehensive impact and contribute to the development of targeted interventions for affected individuals (Burdick & Millett, 2021).

1.3 Objectives

This study aims to assess and compare attention in post COVID-19 positive and negative individuals using the ACE-III scale. We will determine COVID-19's impact on attention and identify any deficits post-recovery.

1.4 Significance

Understanding the long-term effects of COVID-19 is crucial for improving patient care and outcomes. This research is important because it helps healthcare professionals identify and address attention issues in patients who have had COVID-19. Early recognition of these challenges can lead to better support and treatment.

Identifying attention issues early with the ACE-III scale allows doctors to offer targeted interventions and support. This early recognition can make a significant difference in the recovery process for post-COVID patients.

Ultimately, our findings could improve the lives of post-COVID patients. Enhancing focus and attention could positively influence their overall well-being and recovery after dealing with COVID-19.

Chapter 2

Methodology

The flowchart illustrates the step-by-step process we followed in our research methodology. It visually outlines how we selected participants, collected data, conducted interviews, and analyzed the attention scores using statistical tests. This flowchart provides a clear and structured overview of the methods we employed in our study, ensuring transparency and understanding of our approach.

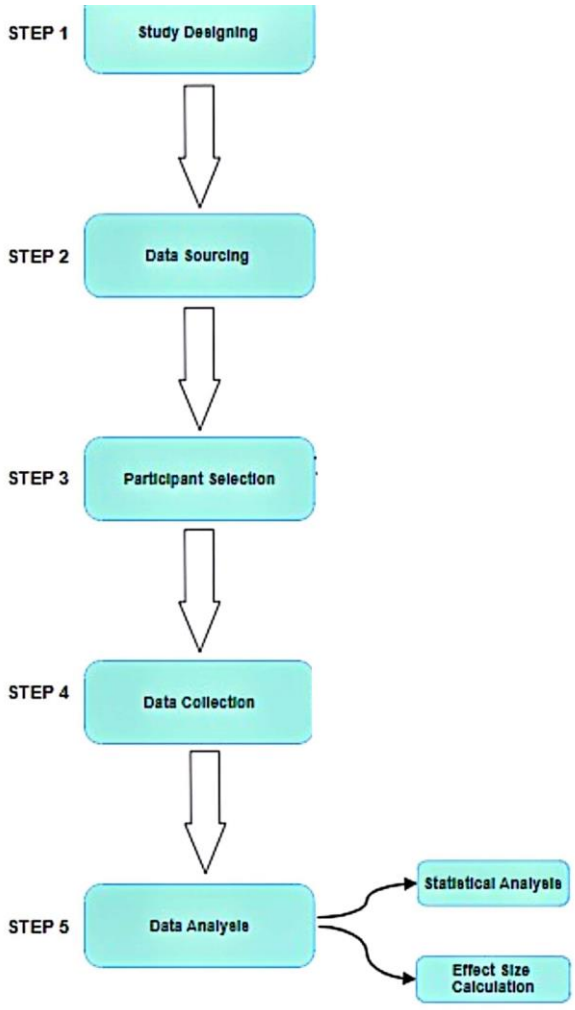

Figure 1: Flowchart of Research Methodology Steps

2.1 Study Design

This study involved a total of 25 participants, comprising 15 post COVID-positive and 10 COVID-negative individuals. All participants gave their consent to join the study. The study used a comparative cross-sectional design to examine the impact of COVID-19 on attention skills.

2.2 Data Source

The data came from the National Institute of Neuroscience, which provided patient records for both post COVID-positive and COVID-negative statuses.

2.3 Participant Selection

Participants were chosen based on specific criteria, resulting in 25 participants aged above 25 years. Some participants with health conditions such as hypertension, walking disabilities, and speech problems were excluded from the study.

2.4 Data Collection

For data collection, we interviewed participants using the ACE-III questionnaire. We conducted these interviews either face-to-face or through online video conferencing. This approach ensured we gathered accurate and comprehensive data on attention skills. Participants completed the ACE-III questionnaire to evaluate their attention skills. This questionnaire includes specific questions related to attention.

5. Data Analysis

For data analysis, we cleaned and organized the collected data to remove inconsistencies. Then, we used statistical tests to compare attention scores between the post COVID-positive and COVID-negative groups.

(i) Statistical Analysis

The attention scores obtained from the ACE-III questionnaire were analyzed using the Independent Samples t-test to compare mean scores between the post COVID-positive and COVID-negative groups.

- Null Hypothesis (H0): There's no difference in mean attention scores between post COVID-positive and COVID-negative individuals.

- Alternative Hypothesis (H1): There's a difference in mean attention scores between post COVID-positive and COVID-negative individuals.

(ii) Effect Size Calculation

Along with the t-test, effect sizes like Cohen's d were calculated to quantify the magnitude of the difference in attention scores between the groups.

Chapter 3

Result and Discussion

3.1 Result

Table 1 offers an overview of the attention scores for 10 patients who tested negative for COVID-19. Each patient's score, derived from the ACE-III questionnaire, is presented alongside their identifier, facilitating individual evaluation and comparison.

Table 1: Attention Scores of COVID-Negative Patients

Serial Number of Patient	Covid Negative Patient Score
1	14
2	17
3	15
4	13
5	13
6	11
7	9
8	10
9	10
10	18

Table 2 provides a detailed breakdown of the attention scores for 15 patients who tested positive for COVID-19. The scores, obtained from the ACE-III questionnaire, are listed alongside each patient's identifier, allowing for individual assessment and comparison.

Table 2: Attention Scores of post COVID-Positive Patients

Serial Number of Patient	Post Covid Positive Patient Score
1	12
2	15
3	10
4	8
5	15
6	17
7	17
8	14
9	8
10	14
11	16
12	14

13	11
14	17
15	14

The tables show the attention scores for post COVID-positive and COVID-negative patients. We made graphs from this data. The graphs help us see the difference in attention scores between the two groups easily.

Now, Figure 2 shows the attention scores for post COVID-positive patients, displaying a diverse range, stretching from a low of 8 to a high of 18. Notably, scores of 14 and 15 are predominant, with each of these values occurring four times among the patients. On the lower end of the spectrum, scores of 8 and 10 are recorded twice each, indicating some patients with more pronounced attention challenges. Conversely, on the higher end, a score of 18 was achieved by a single patient, showcasing variability in attention capabilities within this group.

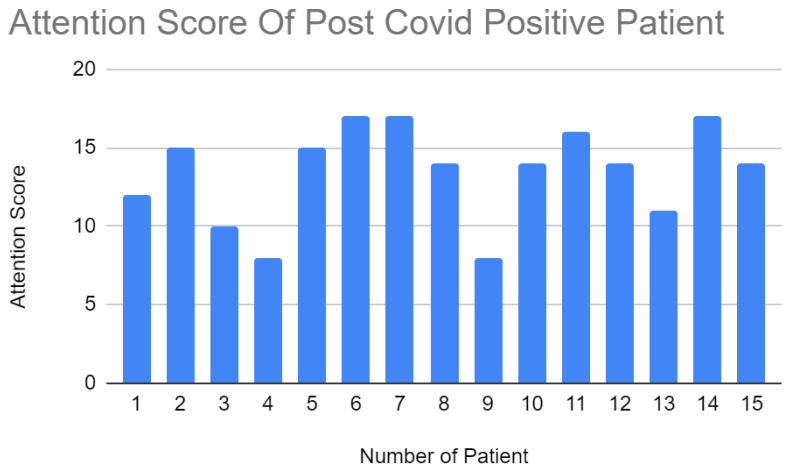

Figure 2: Graphical Representation of attention score of Post Covid Positive Patient

In figure 3, we see for the COVID-negative patients, attention scores are more tightly clustered but still show variability. The scores range from 9 to 17. The score of 10 emerges as the most common, being observed three times, followed by scores of 11 and 14, each appearing twice. This suggests a central tendency around these values, with most patients in this group displaying relatively consistent attention scores.

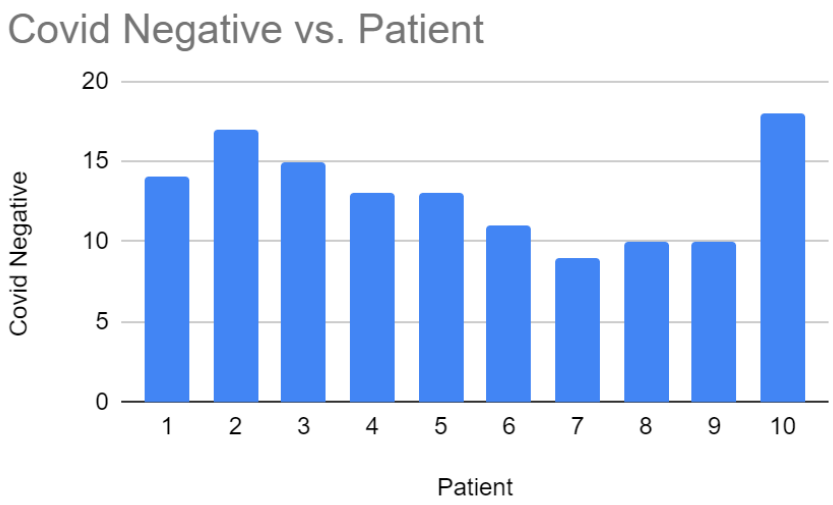

Figure 3: Graphical Representation of attention score of Covid Negative Patient

The table 3 shows the average and spread of attention scores for both groups. It helps us compare these scores from the previous tables and graphs. The average tells us the typical score for each group. The spread shows how scores differ from this average. This helps us see the differences between the post COVID-positive and COVID-negative groups more clearly.

Table 3: Comparison of Mean and Standard Deviation for Attention Scores by COVID Condition

Covid Condition	Mean	Standard Deviation
Positive	14	1.51
Negative	13	2.41

The t-test is a statistical method we used to see if there's a significant difference between the attention scores of post COVID-positive and COVID-negative groups. This test checks if any differences in scores are meaningful or just due to chance. We chose this test to understand how COVID-19 might affect attention in these two groups differently. It helps us pinpoint if there's a notable difference we should focus on

Calculation of T-test:

$$t=\frac{MEAN\ OF\ GROUP\ 1-MEAN\ OF\ GROUP\ 2}{\sqrt{(\frac{STANDARD\ DEVIATION\ OF\ GROUP\ 1^2}{NUMBER\ OF\ SCORES\ IN\ GROUP\ 1})+(\frac{STANDARD\ DEVIATION\ OF\ GROUP\ 2^2}{NUMBER\ OF\ SCORES\ IN\ GROUP\ 2})}}$$

$$t=\frac{14-13}{\sqrt{(\frac{1.51^2}{15})+(\frac{2.41^2}{10})}}$$

t= 1.17

The result indicates that there is no statistically significant difference in mean attention scores between Post COVID-positive and COVID-negative individuals, supporting the Null Hypothesis (H0)

Next, we calculated Cohen's d to measure the size of the difference between the two groups' attention scores. Cohen's d gives us an idea of how big or small this difference is. We used this measure to better understand the practical significance of any observed differences. It helps us gauge the real-world impact of COVID-19 on attention in these groups

Calculation of Cohen's d:

$$s_{pooled} = \sqrt{\frac{Standard\ deviation\ of\ group\ 1^2 + Standard\ deviation\ of\ group\ 2^2}{2}}$$

$$s_{pooled} = \sqrt{\frac{1.51^2 + 2.41^2}{2}}$$

$$s_{pooled} = \sqrt{\frac{9.58}{2}}$$

$$s_{pooled} = 2.01$$

Now for the value of d-

$$d = \frac{Mean\ of\ group\ 1 - Mean\ of\ group\ 2}{pooled\ standard\ deviation}$$

$$d = \frac{(14-13)}{2.01}$$

$$d = \frac{1}{2.01}$$

$$d = 0.501$$

We've included a visual guide in the form of a table that helps interpret the Cohen's d scores. This table clarifies what range of scores indicates a moderate, strong, or weak difference in attention scores between the Post COVID-positive and COVID-negative groups. It serves as a quick reference to understand the significance of the differences we've observed.

Cohen's d	Meaning
0-0.20	Weak Effect
0.21-0.50	Modest Effect
0.50-1.00	Moderate Effect
>1.00	Strong Effect

Figure 4: Interpretation of Cohen's d Scores for Attention Differences

Cohen's d value of 0.501 indicates a medium effect size, suggesting a moderate difference in attention scores between the post COVID-positive and COVID-negative groups.

3.2 Discussion

(i) Interpreting Effect Sizes:

The moderate effect size of 0.501 indicates a notable difference in attention scores between post COVID-positive and COVID-negative patients. Although the statistical test didn’t show a significant difference at the conventional threshold (likely due to sample size or variability), the observed difference in scores remains meaningful and noteworthy. This suggests that attentional capabilities could indeed be impacted by COVID-19, even if not consistently across all patients. There is a study on COVID-19's neurological effects that aligns with our finding of a moderate effect size in attention scores. This suggests COVID-19 might impact attentional capabilities, echoing concerns about cognitive impairment(Guo et al., 2021).

(ii) Clinical Significance:

Despite the t-value of 1.17 not reaching the conventional threshold for statistical significance, the moderate effect size of 0.501 has practical implications for patient care and rehabilitation. Healthcare professionals should consider these attentional differences when planning treatments and interventions for COVID-19 patients. The observed moderate effect size highlights the need for a nuanced approach to patient care, recognizing and addressing these attentional challenges. The systematic review's focus on cognitive decline supports our moderate effect size's clinical significance. Despite the t-value, it emphasizes the need for nuanced patient care, mirroring our findings(Tavares-Júnior et al., 2022).

Chapter 4

Conclusion, Limitations & Future Recommendations

4.1 Conclusion

The conclusions drawn from our analysis are:

i. Personalized assessment and rehabilitation are crucial for addressing the specific challenges COVID-19 presents to attentional capabilities.

ii. The moderate effect size suggests that attention scores differ practically between post COVID-positive and COVID-negative patients.

iii. The variability in attention scores within the post COVID-positive group points to the diverse impact of the virus on cognitive functions.

iv. It's essential to consider both statistical and practical significance in evaluating the influence of COVID-19 on attention.

4.2 Limitations

i. The sample size was limited due to challenges in participant recruitment, resulting in a smaller dataset for analysis.

ii. Participants with hypertension or movement disorders were unable to attend the interview center, affecting data collection.

iv. Participants with speech disorders were excluded due to communication challenges, limiting data availability.

4.3 Future Recommendations

For future studies, considering a broader range of participants could enhance the robustness of the findings. Exploring alternative methods or locations for data collection might help reach individuals who face accessibility challenges.

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Appendix

The four questions that were asked for the part attention are-

1. “Which Day, No./Floor, Date, Street/Hospital, Month, Town, Year, County, Season, and Country are you currently on?"
2. "Which Day, No./Floor, Date, Street/Hospital, Month, Town, Year, County, Season, and Country?"
3. "I’m going to give you three words: lemon, key, and ball. Repeat them back to me. Remember them, I’ll ask you later."
4. "Could you subtract 7 from 100 and keep subtracting 7 from each new number until I tell you to stop?"