

# STATUS OF COGNITIVE DECLINE IN POST COVID-19 BANGLADESHI PATIENTS

By

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A thesis submitted to the Department of pharmacy in partial fulfillment of the  
requirements for the degree of bachelor of pharmacy (hons.)

School of Pharmacy  
BRAC University  
December 2022

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## **Declaration**

It is hereby declared that

1. The thesis submitted is my original work while completing my 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 that 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

The thesis/project titled “Status of cognitive decline in post covid-19 Bangladeshi patients” Submitted by Pranta Saha Bapan (18346022) of Spring2022 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy (Hons.) on 31-01-2023

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## **Ethics Statement**

All of the responders in this survey were given background information regarding the objectives of the study. Before the participants were allowed to fill out their responses, they were required to sign a consent form. Additionally, it was brought to their attention that none of their private information will be made public without first obtaining their permission.

## **Abstract**

Coronavirus disease (COVID-19) patients had greater incidences of neurological and cognitive disorders. This research studied the link between neurological illness and Coronavirus. An investigation of the experiences of 317 individuals, both online and offline, who had been afflicted by COVID-19 was carried out in the form of a survey. Here, neurological issues both before and after COVID-19 infection are recorded. A person may experience neurological difficulties or problems for a variety of causes, such as forgetting an event, experiencing memory loss, having difficulty thinking and planning, and many other similar issues. After the epidemic, there was a large uptick in people reporting problems with their thinking and planning, forgetting an event, and memory loss which is established symptoms of neurological diseases like dementia and Alzheimer's. The results of a statistical analysis of the survey responses on health concerns before and after COVID-19 infection showed a substantial difference.

**Keywords:** COVID-19; Mental health; Cognitive decline; SARS-CoV-2; Dementia;  
Neurological difficulties

## **Dedication:**

In honor of the School of Pharmacy, BRAC University.

## **Acknowledgment:**

First and foremost, I want to thank God for all of his blessings and for being so kind to me. I want to thank him for giving me the tremendous patience, strength, and assistance I needed to complete this project.

I would first want to express my gratitude to my honored faculty supervisor, Dr. Afrina Afrose, Assistant Professor, School of Pharmacy, BRAC University, for her direction, support and advice throughout the time I spent working on my thesis. I commend her for her invaluable counsel and calm demeanor every time I ran into trouble during this phase. I also want to express my thanks to Dr. Eva Rahman Kabir, our esteemed Chairperson, School of Pharmacy, BRAC University.

In closing, I would want to express my gratitude to my parents for their unwavering support and encouragement during every stage of my life. I am thankful to the participants for providing the data. They also gave advice throughout my academic career and stood by me whenever I needed them.



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## **List of Acronyms**

AD: Alzheimer's disease

ACE-2: Angiotensin-converting enzyme 2

A $\beta$ : Amyloid beta

WHO: World Health Organization

SPSS: Statistical Package for the Social Sciences

CNS- Central Nervous System

# Chapter 1

## Introduction

### 1.1 Background

#### 1.1.1 Covid-19

SARS-CoV-2 causes COVID-19, an infectious disease caused by the coronavirus virus. The majority of individuals who contract COVID-19 will experience mild to moderate symptoms and recover without additional treatment. The Corona Virus is an infectious disease that is passed from person to person through the exchange of fluids, such as through sneezing, coughing, shaking hands, and other similar behaviors. Nonetheless, some will become gravely ill and require medical care. The report of the World Health Organization (WHO) has received reports of 629,370,889 confirmed cases of COVID-19, including 6,578,245 deaths globally as of November 7, 2022. The Chinese city of Wuhan had a spike in the incidence of pneumonia in December of this year. After extensive research, scientists identified the mysterious ‘Corona virus’ as the disease's causative agent. It was then given the name ‘COVID-19’ to reflect the virus's origins. The Covid virus, or Covid-19, quickly spread throughout China and beyond. The World Health Organization (WHO) issued a global public health emergency declaration on January 30, 2020. However, due to the coronavirus's unpredictability and unusual traits, there is currently no single approved treatment approach other than preventative activities like mass vaccination and other precautions like social distancing, hand sanitization, and mask-wearing. The government of Bangladesh has adopted guidelines for several treatment techniques for the clinical management of asymptomatic, mild, moderate, and severe cases of covid-19 patients. These guidelines are intended for patients who have the virus (*Mapping the Human Genetic Architecture of COVID-19 / Request PDF, n.d.*).

## 1.1.2 Cognitive decline

The gradual loss of thinking abilities such as learning, remembering, paying attention, and reasoning is an indicator of cognitive decline. Knowledge, memory, language, rationality, coordination, and recognition all suffer as a result of cognitive decline. Aging, persistent illness, or head trauma can all develop lesions in the brain, which leads to cognitive decline. Memory, perception, thought, and problem-solving issues, both severe and mild, can all be symptoms of this condition. In certain cases, these symptoms signal the beginning of a more serious illness like dementia (Han et al., 2022).

### Stages of cognitive decline:

1. **Non cognitive impairment (NCI):** There is no change in the individual's cognitive abilities or the multitude of skills involved in thinking.
2. **Subjective cognitive decline (SCD):** The patient has a gradual decline in certain of their cognitive abilities, but this decline does not yet impair their ability to carry out their daily activities (Letang et al., 2021).
3. **Mild cognitive impairment (MCI):** Patients' cognitive abilities deteriorate, including their capacity for thinking, memory, language, judgment, and accurate perception of the world around them (Baker et al., 2022).
4. **Dementia:** Patients often struggle with doing even the most basic of tasks. They are responsible for driving, making financial obligations, maintaining their home, and taking care of their physical and mental health (Cunningham et al., 2015).



## **1.2 Research gap:**

Scientists are not able to become so sure about the main cause and link between covid 19 patients and cognitive decline as it leads to some neuronal diseases like Alzheimer's disease or not.

## **1.3 Objectives**

The primary purpose of the research is to evaluate the current level of cognitive decline in patients who have received post-covid 19 treatments. In addition, the purpose of the research is to identify the causes of brain damage and conditions that have an effect on the brain.

Objective 1: To determine overall neuronal difficulties in post covid patients.

Objective 2: To determine the individual difficulties that affect the brain.

Objective 3: To determine the correlation between covid 19 patients and cognitive decline.

## **1.4 Significance of the study:**

This project focused on the correlation between neuronal loss with the covid patients after they are affected by this virus facing some problems like neuronal loss or cognitive impairment that may lead to Alzheimer's disease as it is a long-term neurological disorder that causes severe damage in the brain which can decrease patients' life quality.

## **Chapter 2**

### **Methodology**

#### **2.1 Patients' selection:**

In this research, the participants are being selected based on the criteria that is the post COVID-19 patients over 25 years old. All of the respondents did so voluntarily and with a genuine interest in the survey's outcome. They all met the survey's criteria, including being 25 years older and covid-positive.

#### **2.2 Research design:**

The purpose of the study is to conduct a survey of post covid 19 patients in Bangladesh. Among the 317 covid patients who voluntarily filled out the survey, there is a wide range of ages represented, from 26 to 65 and beyond. There were 317 total participants in the study. The goal of the study was to identify whether neurological abnormalities emerge in post covid patients.

#### **2.3 Data collection:**

By using Google form, a well-structured and peer-reviewed questionnaire was created, and the link was distributed to the necessary respondents via online social media platforms such as Messenger, Facebook, WhatsApp, etc. In addition, the survey form was sent manually to covid patients who qualified for the questionnaire. Prior to replying, participants provided their informed consent to the survey. In this survey, participation was completely voluntary. 317 individuals replied to the survey. Certain responses were omitted due of irreverent information. In the end, 317 replies were collected for analysis. The survey was administered between 1 August to 30 November 2022.

## **2.4 Data analysis:**

IBM SPSS 27 was used for all of the data analysis and statistical calculations. The study's participants' data were analyzed using a descriptive method. The relationship among the dependent and independent variables was analyzed using multiple regression. Spearman's Correlation was used to find statistically significant correlations between a wide variety of independent variables and contributing elements.

## **Chapter 3**

### **Literature Review**

Recent studies have shown that the effects of the coronavirus on the brain are more far-reaching than was previously believed. Clinical manifestations suggest that coronavirus infection affects the brain. They are experiencing cognitive problems, forgetfulness, and mental confusion. Concern and melancholy were also mentioned. Furthermore, patients exhibit symptoms similar to those of chronic fatigue syndrome, including a lack of focus and energy.

### **3.1 Neuronal difficulties**

#### **3.1.1 Thinking and planning problems**

As a natural part of the aging process, people gradually lose their memories. Memory problems and loss are common among elderly persons as a natural consequence of aging. It is no longer possible for the brain to function as it once did. As a result, individuals are unable to make effective use of their brains for thinking and planning. They gradually lose the ability as a result of the pressures of old age, multiple anxieties, or other mental phases that occur during life.

#### **3.1.2 Forgetting an event**

After a certain time of period, people used to forget the scenarios from the past of their life. In scientific language it is called synaptic pruning. In psychology, the term "pruning" refers to the elimination of synaptic connections. These synaptic interactions are the connections that exist between neurons, also known as brain cells. In most cases, the synaptic connections are severed because scientists have

determined that they are either useless or inappropriate. The process of pruning helps to ensure that the brain operates as well as possible. When we are young, our brains go through a process called synaptic pruning, which serves to fortify vital neuronal connections while eliminating extraneous ones(*Synaptic Pruning & Neural Connections | What Is Pruning in Psychology? | Study.Com*, n.d.).

### **3.1.3 Memory loss**

Concern about memory loss and other cognitive capacities is common among the elderly population. For instance, they may worry that it is taking them longer to learn new things or that they may forget to make a payment. These shifts are more indicative of the regular forgetfulness that comes with aging than of any major memory issues. It is natural for us to lose focus every now and then as we become older; however, major memory problems can make it challenging to carry out routine tasks such as driving, using the telephone, and navigating your way back home(*Memory, Forgetfulness, and Aging: What's Normal and What's Not? | National Institute on Aging*, n.d.). Dementia refers to a group of neurodegenerative diseases that cause a gradual decline in memory and other cognitive abilities severe enough to impair day-to-day functioning. Alzheimer's disease is the most well-known kind of dementia; however, there are numerous additional causes, such as diseases of the blood vessels, substance misuse, and other forms of brain injury. Loss of brain cells and other neurological abnormalities are hallmarks of Alzheimer's disease.

### **3.1.4 Difficulty in counting**

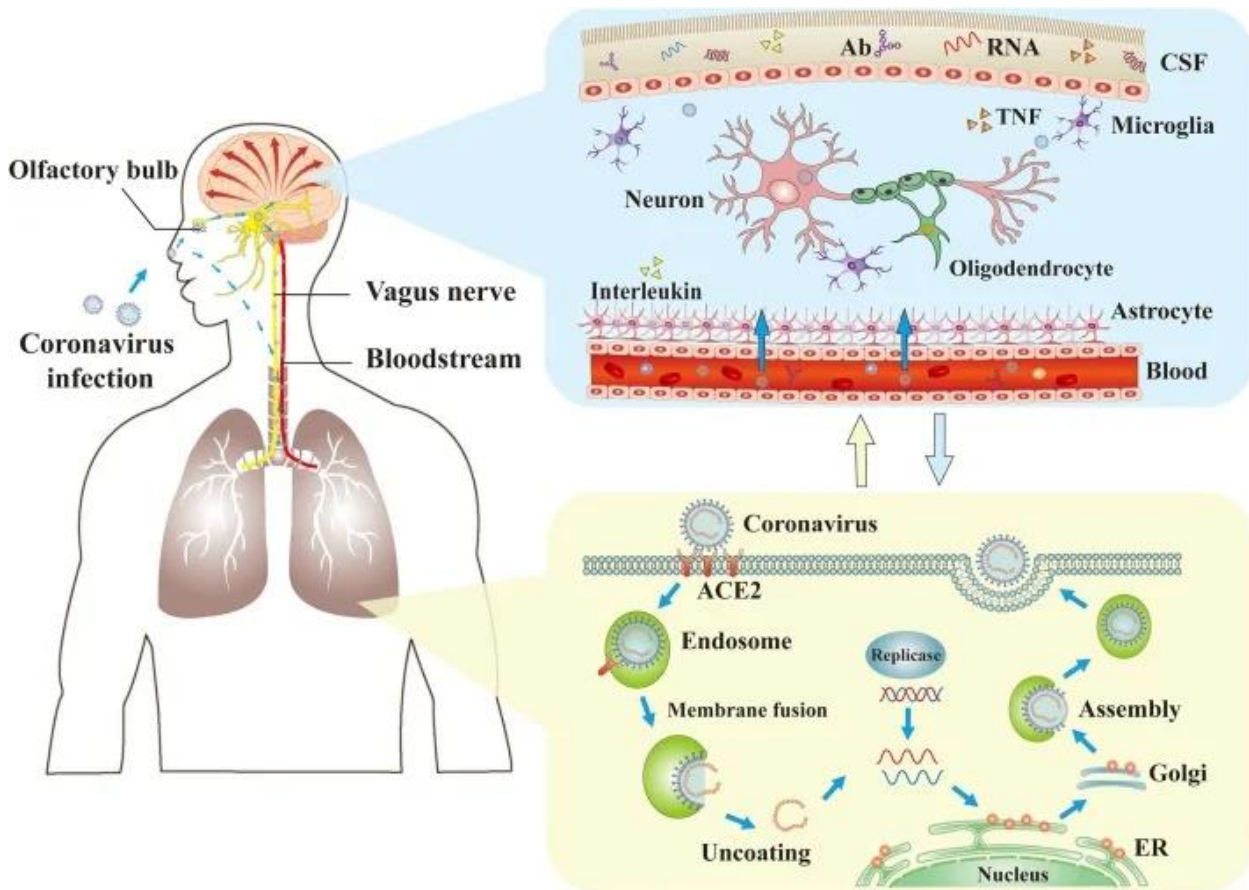
Adults who have neurological damage as a result of the covid-19 pandemic have, in addition to memory loss that occurs naturally with aging, a brain that is unable to function as well as it once did and is unable to remember things as they once did. They are also unable to rely on their ability to correctly remember information.

### **3.2 How corona virus affects the brain:**

It is possible for viruses to infiltrate brain tissue during certain infections. Encephalitis refers to inflammation of the brain caused by a response from the immune system. The corona virus causes damage by triggering an overreactive immunological response in the body, which can happen although it is quite uncommon. This can trigger inflammation, which in turn can damage neurons and other brain cells necessary for proper cognitive function.

To begin with, the coronavirus might get into your system through our eyes, nose, or mouth. Then it travels down the trachea and into the lungs, where it might enter the bloodstream and have an effect on the respiratory system. The immune system responds to this threat by unleashing a barrage of cells and chemicals called cytokines. Medics have a name for this: inflammation. It has the potential to facilitate the formation of blood clots. Clots form when blood vessels narrow and blood cannot flow freely, resulting in decreased blood flow to the heart and other organs, including the brain, which can lead to the death of brain cells(Graham et al., 2021). Stroke can result from it in the worst circumstances. Still, low oxygen levels aren't the only thing that can be harmful. The brain's protective barrier can be compromised by inflammation, rendering the organ more susceptible to injury. The blood-brain barrier provides a protective environment for the brain. Some molecules, cells, and nutrients are able to get in and out of the brain thanks to a biological barrier known as the blood-brain barrier(Spudich & Nath, 2022). The blood-brain barrier effectively blocks the entry of harmful substances and infectious microbes into the brain. The endothelium is a protective lining of cells that can be infected by the coronavirus. Brain inflammation results from the immune system going into overdrive in response to this disturbance. Inflammation can also harm the neurological system in other ways, though. Infection can also harm cells that supply nutrients to the olfactory neurons in the nose. Whenever these cells die, patients may lose their sense of smell and taste, according to scientists.

Studies on other infections have shown that inflammatory impulses can travel down neurons all the way to the brain, where they can trigger even more inflammation (Graham et al., 2021).



**Figure 1:** How corona virus affects human brain (How COVID-19 Affects the Brain in Neuroimaging / Imaging Technology News, n.d.)

## Chapter 4: Results and Discussion

### 4.1 Participant's characteristics:

144 of the participants were female, and 173 of the participants were male out of a total of 317 participants (Table 1).

*Table 1: Male and female participation rates*

Gender	Frequency	Percent	Valid percent
Male	173	54.57	54.57
Female	144	45.43	45.43
Total	317	100	100

There were 317 participants; 10.73% were between the ages of 25 to 34; 35.33% were between the ages of 35 to 44; 21.45% were between the ages of 45 to 54; 24.29% were between the ages of 55 to 64, and 8.20% were 65 or older (Table 2).

*Table 2: Different age groups' participation rates and frequency*

Age group	Frequency	Percent	Valid percent
25-34 years old	34	10.73	10.73
35-44 years old	112	35.33	35.33
45-54 years old	68	21.45	21.45
55-64 years old	77	24.29	24.29
65 and above years old	26	8.20	8.20
Total	317	100	100



## 4.2 Frequency tables:

*Table 3: Case Summary*

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Before pandemic	147	46.4%	170	53.6%	317	100.0%
After pandemic	211	66.8%	106	32.2%	317	100.0%

We can see from the data in the (table 3) above that of the 317 people who participated, 147 (or 46.4%) had a diagnosis for at least one of the problems listed below prior to the pandemic, whereas 170 (or 53.6%) were not. Of the total number of people who participated in the study following the pandemic, 211 (66.8%) were diagnosed with at least one of the problems listed below, whereas 106 (32.2% of the sample) were not. Thus, it can be concluded that neurological impairments developed among patients in the wake of the epidemic.

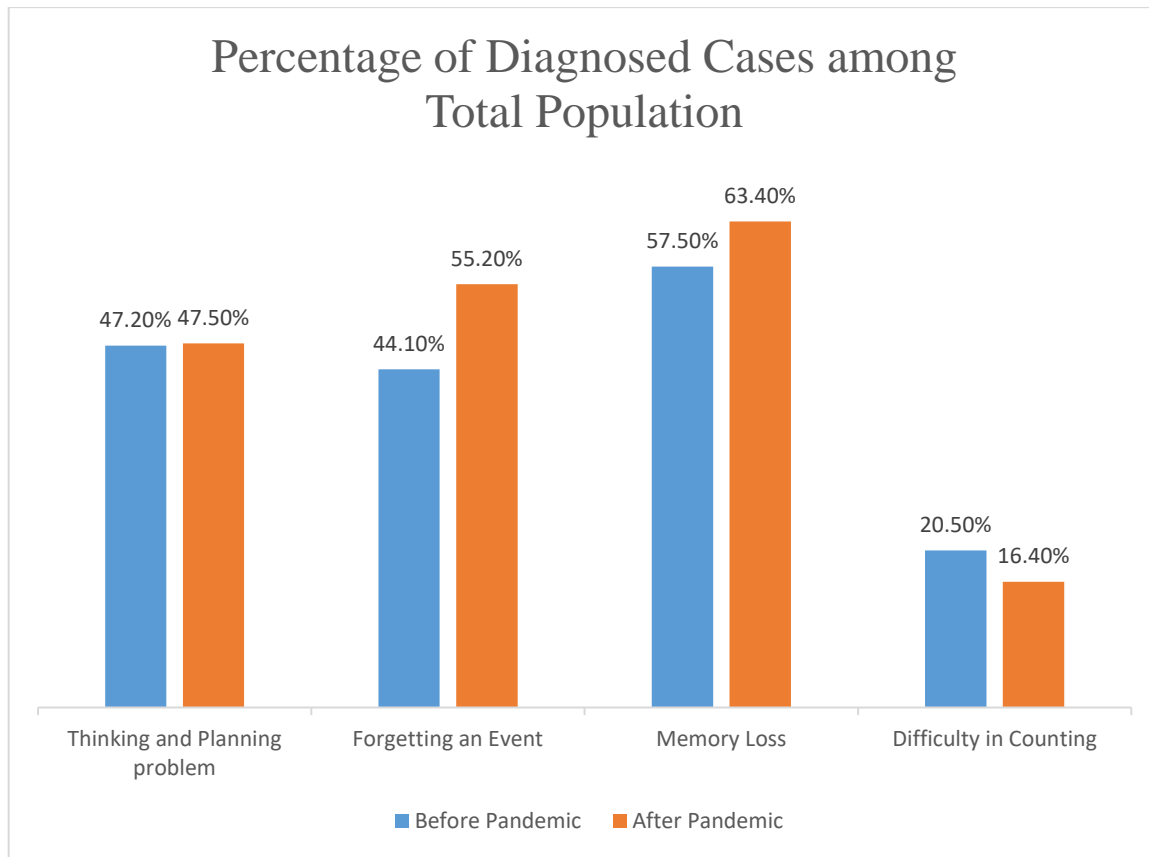
*Table 4: Diagnosed by a Professional Before Pandemic Frequencies*

		Responses		Percent of Cases
		N	Percent	
Diagnosed Before Pandemic	Thinking and Planning Problems	69	27.7%	47.2%
	Forgetting an Event	65	26.1%	44.1%
	Memory Loss	85	34.1%	57.5%
	Difficulty in Counting	30	12.1%	20.5%
Total		249	100.0%	169.3%

**Table 5: Diagnosed by a Professional After Pandemic Frequencies**

		Responses		Percent of Cases
		N	Percent	
Diagnosed After Pandemic	Thinking and Planning Problems	100	26.0%	47.5%
	Forgetting an Event	116	30.1%	55.2%
	Memory Loss	134	34.8%	63.4%
	Difficulty in Counting	35	9.09%	16.4%
Total		385	100.0%	182.5%

**4.3 Graphical representation:**



**Figure 2: Percentage of diagnosed cases among the total population**

People who had been infected with the COVID-19 virus were found to have increased neuronal difficulties after being introduced to the virus. These difficulties included difficulties in thinking and planning problems with a percentage of 47.50%, forgetting an event with a ratio of 55.20%, and memory loss problems with a percentage of 63.40%. Prior to the pandemic, the ratios were at least 10% lower than the results obtained after the pandemic.

#### 4.4 Assessing the overall situation before pandemic and after pandemic:

*Table 6: Diagnosed Before Pandemic \* Diagnosed After Pandemic Cross tabulation*

Count		Diagnosed with Disease After Pandemic					Total
		0	1	2	3	4	
Before Pandemic	0	91	56	14	7	2	170
	1	6	33	33	7	4	83
	2	6	7	16	7	1	37
	3	2	0	6	5	2	15
	4	0	0	1	6	5	12
Total		105	96	70	32	14	317

0= No Disease; 1= One disease; 2= Two diseases; 3= Three diseases; 4= Four diseases

#### 4.5 Correlation:

To see the change in data, the “Related-samples McNemar test” has been performed in table 7. Null Hypothesis,

H<sub>0</sub>: The distribution of different values before the pandemic and after the pandemic are equally likely for a certain disease.

**Table 7:** Related-samples McNemar test

<b>Disease</b>	<b>N</b>	<b>DF</b>	<b>Test Statistic</b>	<b>P-value</b>	<b>Decision</b>
Thinking and Planning Problem	317	1	11.458	0.001***	Reject H <sub>0</sub>
Forgetting an Event	317	1	30.730	0.000***	Reject H <sub>0</sub>
Memory Loss	317	1	24.845	0.000***	Reject H <sub>0</sub>
Difficulty in Counting	317	1	0.265	0.607	Accept H <sub>0</sub>
Significance: *** p<0.01, ** p<0.05					

By the “Related-samples McNemar test”, it is shown that the test statistic is calculated and H<sub>0</sub> is true. For thinking and planning problems, the statistic test value is 11.458, under H<sub>0</sub>. Now the p-value is 0.001 which means the probability of the test statistic is 11.458 given H<sub>0</sub> is true which is 0.001 which means it is very unsightly to get a static value like this when H<sub>0</sub> is true. So, we can conclude that H<sub>0</sub> is not true. Therefore, the distribution of different values before the pandemic and after the pandemic is not equally likely for thinking and planning problems. Moreover, For forgetting an event, the statistic test value is 30.730, under H<sub>0</sub>. Now the p-value is 0.000 which means the probability of the test statistic is 30.730 given H<sub>0</sub> is true that is 0.000 which means it is very unsightly to get a static value like this when H<sub>0</sub> is true. So, we can conclude that H<sub>0</sub> is not true. Therefore, the distribution of different values before the pandemic and after the pandemic is not equally likely for forgetting an event. Furthermore, for memory loss, the statistic test value is 24.845, under H<sub>0</sub>. Now the p-value is 0.000 which means the probability of the test statistic is 24.845 given H<sub>0</sub> is true that is 0.000 which means it is very unsightly to get a static value like this when H<sub>0</sub> is true. So, we can conclude that H<sub>0</sub> is not true. Therefore, the distribution of different values before the pandemic and after the pandemic is not equally likely for memory loss. But, for difficulty in counting the statistic test value is 0.265, under H<sub>0</sub>. Now the p-value is 0.607 which means the probability of the test statistic is 0.265 given H<sub>0</sub>

is true which is 0.607 which means it is very unsightly to get a static value like this when Ho is true. So, we can conclude that Ho is accepted. Therefore, the distribution of different values before the pandemic and after the pandemic is equally likely for difficulty in counting.

From table 7, it is certain that the distributions of different values for “Thinking and planning problems, forgetting an event, and memory loss” changed significantly after the pandemic.

**Table 8:** *Diagnosed Before Pandemic \* Diagnosed After Pandemic Correlation*

		Value
Interval by Interval	Pearson's R	0.571
Ordinal by Ordinal	Spearman Correlation	0.570
N of Valid Cases		317

Here, the data is ordinal. That is why the Spearman rank correlation is more appropriate (0.570).

If a patient has at least 2 difficulties before the pandemic then that patient may develop 2 or more diseases after the pandemic effect or after being infected by the coronavirus because here in table 8 is the Spearman correlation value is 0.570 which is moderately positive. The correlation value range is from -1 to +1.

## **Chapter 5**

### **5.1 Conclusion:**

In summation, we are able to state that we have been successful in drawing attention to the elements that are connected with neurological problems as well as the correlation between cognitive decline and COVID-19 disease. 317 patients who were being treated for COVID-19 took part in a survey that was carried out both online and offline. It was discovered that a person can have neurological difficulties for a variety of reasons, some of which include difficulty with thinking and planning, memory loss, forgetting an event, and many other reasons as well. People might suffer from a variety of mental health conditions, including anxiety, depression, panic attacks, and personality disorders, amongst others. The COVID-19 impact is associated with a significant increase in the number of neuronal deaths. In addition, the significance of maintaining one's mental health cannot be overlooked. Because to COVID-19, it has become difficult to focus on this particular aspect of health. Because of all of our other responsibilities, it's easy for us to unknowingly let ourselves become stressed out and overlook the need of meditation and mental calmness for maintaining excellent mental health. When faced with a predicament that is fraught with danger and ambiguity, people frequently respond with fear and worry. We may take care of ourselves by eating well, exercising regularly, getting an adequate amount of sleep, and avoiding adding any unnecessary stress to our lives. For the sake of our neurological health, we should make sure to both take any medications that have been prescribed to us by our physicians and also engage in any necessary physical activity.

## **5.2 Limitations:**

- 1) This poll included a total of 317 individuals that answered the questions. There is a possibility that the findings could be more accurate if the sample size was increased.
- 2) When compared to interviewing a group of people all at once, conducting a survey with individual responses and a large sample size is a relatively more time-consuming process. Because of this, it took several months before we got the response we were hoping for. However, it is recommended that the survey be finished within the next one to two months.

## **5.3 Future recommendations:**

- 1) The survivors of long and repeatedly infected by COVID-19 could be recorded by the ministry of health so that they can be examined and followed up for their long term cognitive function status.
- 2) Blood or cerebral spinal fluid (CSF) of the long COVID-19 survivors can be tested to identify/confirm the risk of developing dementia or Alzheimer's like brain as a long term complication.

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## Appendix:

Post COVID-19 Patient Survey (Bapan)

COVID-19 patients survey

Project name: Correlation of cognitive decline in post COVID-19 patients

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ID: 18346022

University: Brac University

Participants: Post COVID-19 patients aged over 25 years

Project Supervisor: Dr. Afrina Afrose, PhD

Assistant Professor, Department of Pharmacy, Brac University.

\*Required

Disclaimer

All the data for this survey will be used for research purpose only. The subject's name and identity will not be disclosed in any research publication.

I acknowledge that I have been asked to participate in a survey regarding social media usage. This survey is conducted by

Pranta Saha Bapan . I understood the disclaimer and agreed to participate willingly. \*

\* Required

1. Are you well concerned about the study and willingly participating in the survey? \*

*Mark only one oval.*

Yes

No

2. Your name \*

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3. Contact number \*

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4. Your gender

*Mark only one oval.*

Male

Female

5. What age group do you belong?\*

*Mark only one oval.*

25 to 34

35 to 44

45 to 54

55 to 64

65 and above

6. What was your employment status before the COVID-19 pandemic?\*

*Mark only one oval.*

Full-time employed

Part-time employed

Unemployed

Retired

7. Your family income

*Mark only one oval.*

- <20000
- 21000-35000
- 36000-45000
- 46000-60000
- >60000

8. Have you ever felt difficulty with everyday life activities before the pandemic? \*

*Check all that apply.*

- Thinking and planning problems
- Forgetting an event
- Memory loss
- Difficulty in counting
- No difficulties

9. Have you been infected with novel coronavirus (SARS-COV-2)? \*

*Mark only one oval.*

- Yes
- No

10. Have you been hospitalized because of a SARS-COV-2 infection? \*

*Mark only one oval.*

- Yes
- No

11. How long have you been hospitalized?

*Mark only one oval.*

- One week
- Two weeks
- Three weeks
- Four weeks
- None

12. Have you taken medication (antiviral medicines) for recovering from COVID-19? \*

*Mark only one oval.*

- Yes
- No

13. Do you feel fully well after recovering from COVID-19? \*

*Mark only one oval.*

- Yes
- No

14. What type of following difficulties are you facing nowadays? \*

*Check all that apply.*

- Thinking and planning problems
- Forgetting an event
- Memory loss
- Difficulty in counting
- No difficulties

15. Have you consulted with a professional to recover from the recent difficulties? \*

*Mark only one oval.*

- Yes
- No

16. Have you been diagnosed with any neurological disease? \*

*Mark only one oval.*

- Yes
- No
- If yes which disease
- Other: \_\_\_\_\_

17. Have you been infected with novel coronavirus (SARS-COV-2) again? \*

*Mark only one oval.*

- Yes
- No

