

"INVESTIGATING SLEEPING HABITS AND VISUOSPATIAL
ABILITIES IN COVID-19 SURVIVORS USING THE
ACE-III SCALE ".

By

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A thesis submitted to the School of Pharmacy in partial fulfillment of the requirements for
the degree of
Bachelor of Pharmacy (B. Pharm)

School of Pharmacy
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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/We have acknowledged all main sources of help.

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Approval

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Ethics Statement

This research was conducted with strict adherence to ethical standards ensuring the integrity and credibility of the study. All data were collected and reported with integrity and transparency, compiling with relevant ethical guidelines and regulations.

Abstract/ Executive Summary

COVID-19 pandemic a life threatening disease caused by a virus has initiated many problems among the patients like sleeping problems, depression, anxiety and many more mental health related issues around the world. The main objective of this research is to find out sleeping habit and visuospatial abilities in COVID-19 survivors using the ACE-III scale. ACE-III assessment were used among 60 patients, both male and female aged more than 25. There were 40 post Covid participants and 20 non Covid participants recruited in this study. The non Covid participants are used as a controlled group. In this study, we aimed to find out any kinds of cognitive impairment and sleeping problems or symptoms faced by the Covid-19 survivors and make a comparison with the control group of 20 non-Covid participants to find out the differences or changes. The findings from this research has shown that the post Covid patients have more sleeping problem that those of non-Covid participants. Moreover, we found that the visuospatial ability of Covid patients is less than those of non-Covid-19 participant. Since, the data set of my study is smaller so it can be more accurate if the data set is larger in amount.

Keywords: SARS-CoV-2, COVID-19, Sleeping and visuospatial abilities, Survivors

Dedication

“To my unwavering pillars of support, my parents—whose love, encouragement, and sacrifices have made this journey possible.”

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I am very glad to working under the supervision of Dr. Afrina Afrose. She is a very helpful person who always guided me in this project. She trained me about the dealing with patients and co-operate with them during the interview session of data collection. She always helped me whenever I face any difficulties during this project. Also, I would like to thank to School of Pharmacy, Brac University and National Institute of Neuroscience Hospital (NINS) for their support throughout the project.

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List of Acronyms

ACE-III	Addenbrooke's cognitive examination III
Covid-19	Corona Virus infected disease
NINS	National Institute of Neuroscience Hospital

Glossary

Sleeping ability	Sleeping ability mainly describes a person's sleeping pattern like refreshment after sleeping, awakening, sleep quality, sleep time etc.
ACE-III scale	Addenbrooke's cognitive examination III is mainly test which is composed of several types of skills like visuospatial ability, language, memory, attention etc.
Post Covid-19 participants	Participants who were infected by corona virus and survived.
ROCF	Rey-Osterrieth Complex Figure Drawing Test.

Chapter 1

Introduction

1.1 Background

The most dangerous and life-threatening pandemic SARS-CoV-2 has been passed but leave the whole world with its major side effects to the survivors and changed the lifestyle also. Almost four years ago people saw their loved ones to death caused by Covid-19 virus. The fear of death has been changed everything in their life. According to (Paech, 2022) many people during the Covid, reports insomnia like problems like struggle to fall asleep at night. Some recent study also shows that the Covid-19 survivors are facing more sleeping difficulties than the non Covid-19 patients. On the other hand, there are also some changes to be focused on the visuospatial ability of Covid-19 survivors than the non Covid-19 patients. According to (Paz-Rodríguez et al, 2024) significant visuospatial alterations have been reported in 24-40%. Nowadays these alterations are also being used as useful biomarkers to find out any kind neurological diseases. Visuospatial functions are very important as they attract our daily activities. Mainly this visuospatial ability has been tested by using Clock Test (CDT) and Rey-Osterrieth Complex Figure Drawing Test (ROCF). They both describes the visuospatial skills of a patient and also helps to detect any kinds of cognitive impairment. The visuospatial impairment reported in post Covid-19 patients are more in number in comparison with the non Covid-19 patients. It is also found in a recent study that patients aged lower than 50 has more severe visuospatial dysfunction. Therefore, the main purpose of this study to evaluate the comparison of sleeping and visuospatial ability between the Covid-19 and non Covid-19 patients.

1.2 Research Gap

Evaluation of sleeping habits and visuospatial abilities in Covid-19 and non Covid-19 patients is very interesting to know about the differences. It can also reveal further more information about the development of cognitive consequences in the survivors. Different types of studies performed during the Covid time already shows significance sleeping and visuospatial impairment of the Covid patients. However, the pandemic has gone but it has some serious impact on the survivors till today. Correspondingly, there is no such type of research which can evaluate and compare sleeping habits and visuospatial abilities between Covid-19 survivors and non Covid-19 patients.

1.3 Objectives

The main objective of this research is to evaluate sleeping habit and visuospatial abilities in Covid-19 survivors and non Covid-19 patients.

The evaluation of sleeping habit and visuospatial abilities includes some variables like wakefulness, sleeping time and pattern, drawing complex figures, attention, remembering images and patterns etc.

1.4 Significance

Purpose of this research is to evaluate sleeping habit and visuospatial abilities in Covid-19 survivors and non Covid-19 patients. The evaluation of sleeping habit and visuospatial abilities in Covid and non-Covid patients will help to reveal further neurological problems. It will also help in the early detection of cognitive impairment and mental health related issue. The Addenbrooke's cognitive examination III score (ACE-III) will give us information about the cognitive profile of a patient. Lastly, this study will help us to find out whether they have the possibilities to suffer in any kinds of neurological disease in future or not.

Chapter 2

Methodology

The patient database has been collected from National Institute of Neuroscience hospital (NINS) Bangladesh. I have conducted in person interview of the patients at National Institute of Neuroscience hospital and some patient interview has been taken through online video conference. Total number of participants were 60. Among them 40 were Covid-19 survivors and 20 were non Covid-19 participants. Both male and female participants were there. The age of the participants was upper than 25 years old. The ethical approval for this study has been given by the Institutional Review Board (IRB) of National Institute of Neuroscience Hospital.

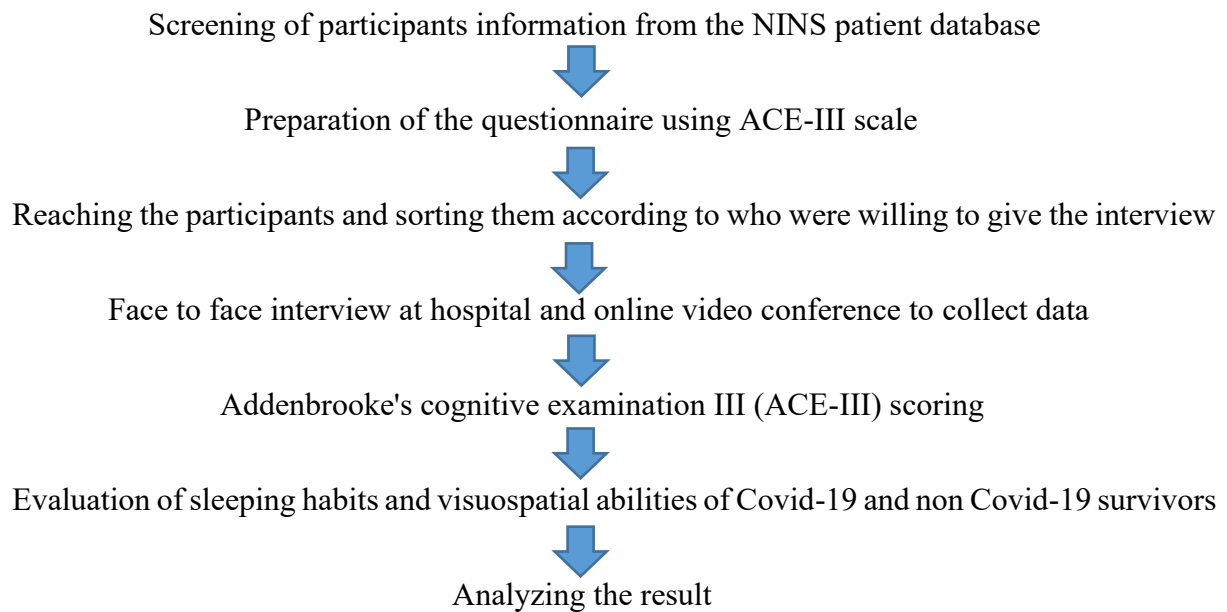
The questionnaire was prepared based on ACE-III scale. The participants were asked 6 questions for their sleeping habit and 5 questions for their visuospatial abilities.

Total number of data collected is shown in the Table 1 below:

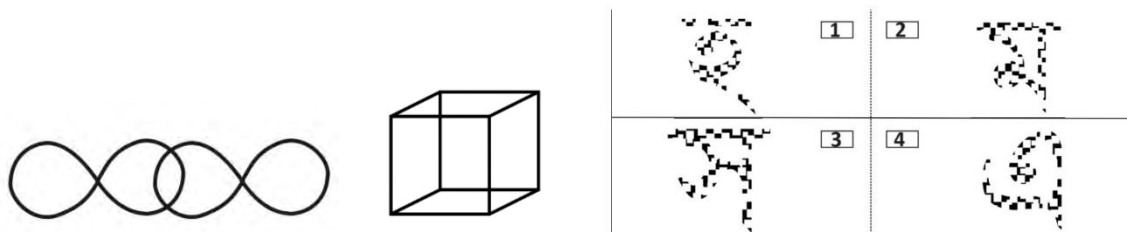
Table 1: Amount of data collected:

Number of Covid-19 participants	40
Number of non Covid-19 participants	20

Figure 1: Flowchart describing the methodology of study.



Figures that are used to test visuospatial ability:



2.1 Identification of participants

Both Covid and non-Covid were present in this study. They have been selected willingly to give the interview. The participants who lives in Dhaka has given the interview at NINS hospital and those who are living outside Dhaka were given the interview through online video conference.

2.2 The use of ACE-III scale for assessing visuospatial ability

The Addenbrooke's Cognitive Examination-III (ACE-III) is a very important test for evaluation of the cognitive function of a person. Generally, it covers five different domains in the test. Those are attention, memory, fluency, language and visuospatial abilities etc. Among these five different domain visuospatial abilities is very important which mainly focus on a person's objective orientation, drawing and understanding figures etc. In ACE-III there are five questions to assess a person's visuospatial ability level. The questions covered complex figure drawing, identifying figures, drawing clock etc. Lastly, the scoring has been performed according to their responses of the questions.

Table 2: ACE-III scoring scale

Cognitive Domain	Scores
Attention	18
Memory	26
Language	14
Fluency	26
Visuospatial ability	16
	Total ACE-III score is in 100

In ACE-III scale the total score for evaluating visuospatial ability is in 16.

Interpretation of visuospatial ability:

0-5: Significant impairment

6-10: Mild impairment

11-16: Normal functioning

2.3 Result generation

The findings from the score were analyzed. The sleeping habits and visuospatial ability of Covid and non-Covid has been compared according to the findings. This comparison is shown by generating graphs for better understand.

Chapter 3

Result

Sleeping habit and visuospatial ability has been tested using ACE-III scale among 60 patients. Among them 40 were Covid-19 survivors and another 20 were non Covid-19 participants.

Table 3: Visuospatial score of post Covid-19 participants

Participant name	Have you been infected with novel coronavirus?	Visuospatial score
Participant 01	Yes	15
Participant 02	Yes	6
Participant 03	Yes	3
Participant 04	Yes	4
Participant 05	Yes	8
Participant 06	Yes	9
Participant 07	Yes	6
Participant 08	Yes	5
Participant 09	Yes	5
Participant 10	Yes	10

Participant 11	Yes	6
Participant 12	Yes	9
Participant 13	Yes	5
Participant 14	Yes	7
Participant 15	Yes	10
Participant 16	Yes	9
Participant 17	Yes	10
Participant 18	Yes	9
Participant 19	Yes	9
Participant 20	Yes	2
Participant 21	Yes	8
Participant 22	Yes	6
Participant 23	Yes	6
Participant 24	Yes	9
Participant 25	Yes	13
Participant 26	Yes	10
Participant 27	Yes	15
Participant 28	Yes	11
Participant 29	Yes	8
Participant 30	Yes	5
Participant 31	Yes	11
Participant 32	Yes	10
Participant 33	Yes	15
Participant 34	Yes	6

Participant 35	Yes	9
Participant 36	Yes	3
Participant 37	Yes	7
Participant 38	Yes	5
Participant 39	Yes	6
Participant 40	Yes	7

Table 4: Visuospatial score of non Covid-19 participants

Participant name	Have you been infected with novel coronavirus (SARS-COV-2)?	Visuspatial score
Participant 01	No	15
Participant 02	No	14
Participant 03	No	14
Participant 04	No	15
Participant 05	No	13
Participant 06	No	14
Participant 07	No	14
Participant 08	No	14
Participant 09	No	14
Participant 10	No	14
Participant 11	No	14
Participant 12	No	15
Participant 13	No	16
Participant 14	No	15

Participant 15	No	15
Participant 16	No	15
Participant 17	No	16
Participant 18	No	15
Participant 19	No	15
Participant 20	No	16

Table 5: Visuospatial ability score in percentage

Type	Post-COVID	Non-COVID
Significant impairment	20	0
Mild impairment	57.5	0
Normal functioning	22.5	100

The graphical representation of visuospatial ability score of post Covid participant and non Covid participant showing below:

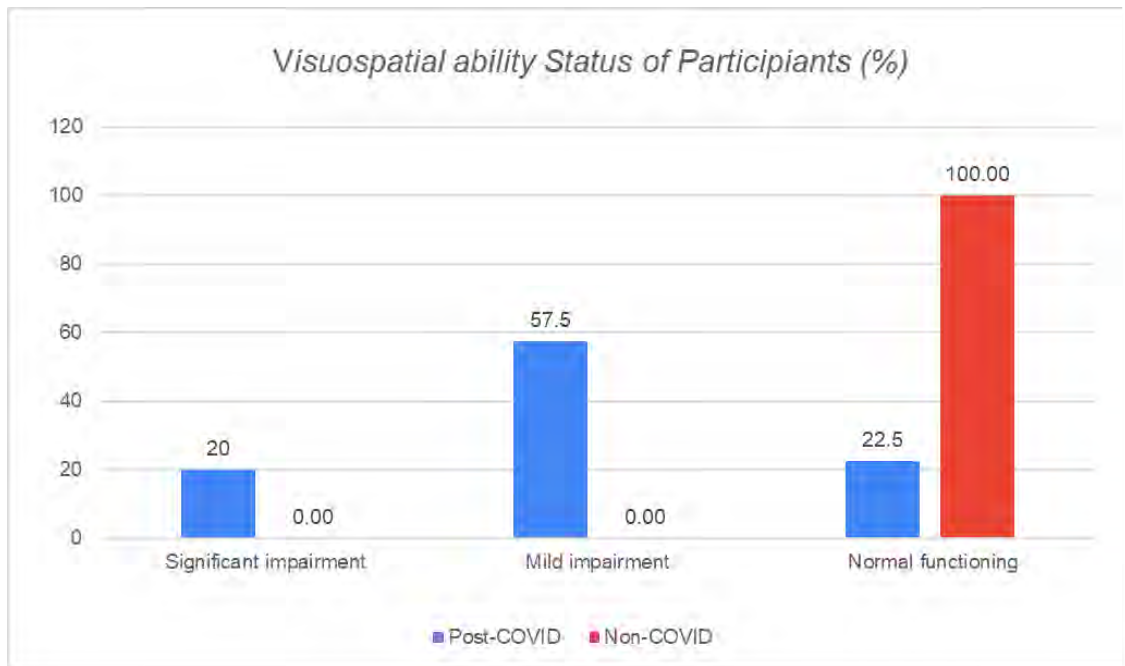


Figure 2: Graphical Representation of visuospatial ability of the participants (%)

“Trouble falling or staying asleep or sleeping too much” response of this problem of the participants showing below:

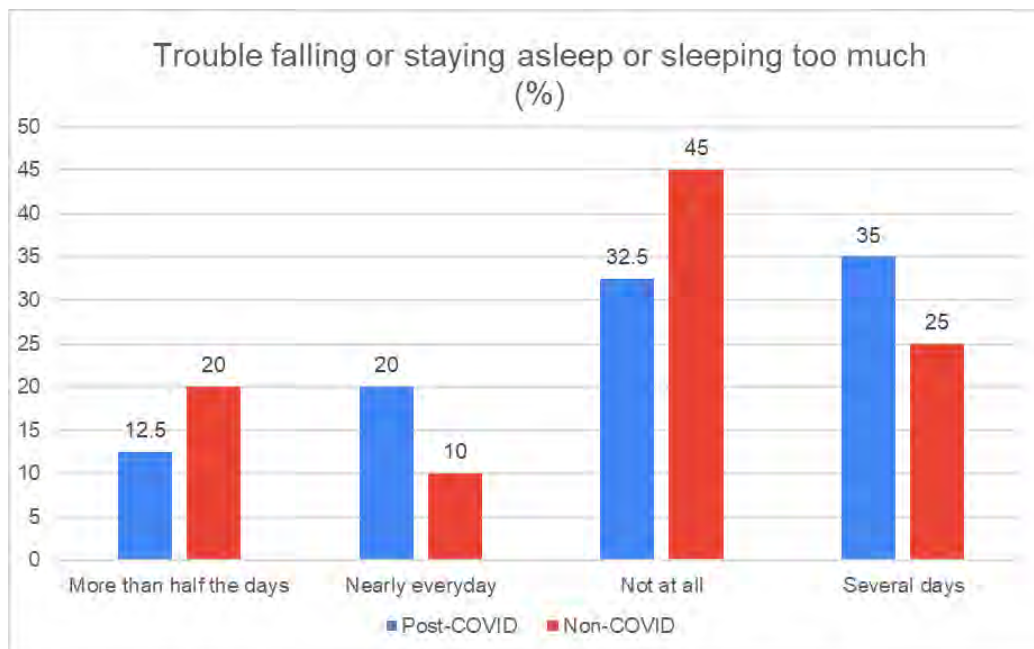


Figure 3: Graphical representation “trouble falling or staying asleep or sleeping too much” responses of the participants.

“About how many hours sleep do you get in every 24 hours ?” response of this question of the participants showing below:

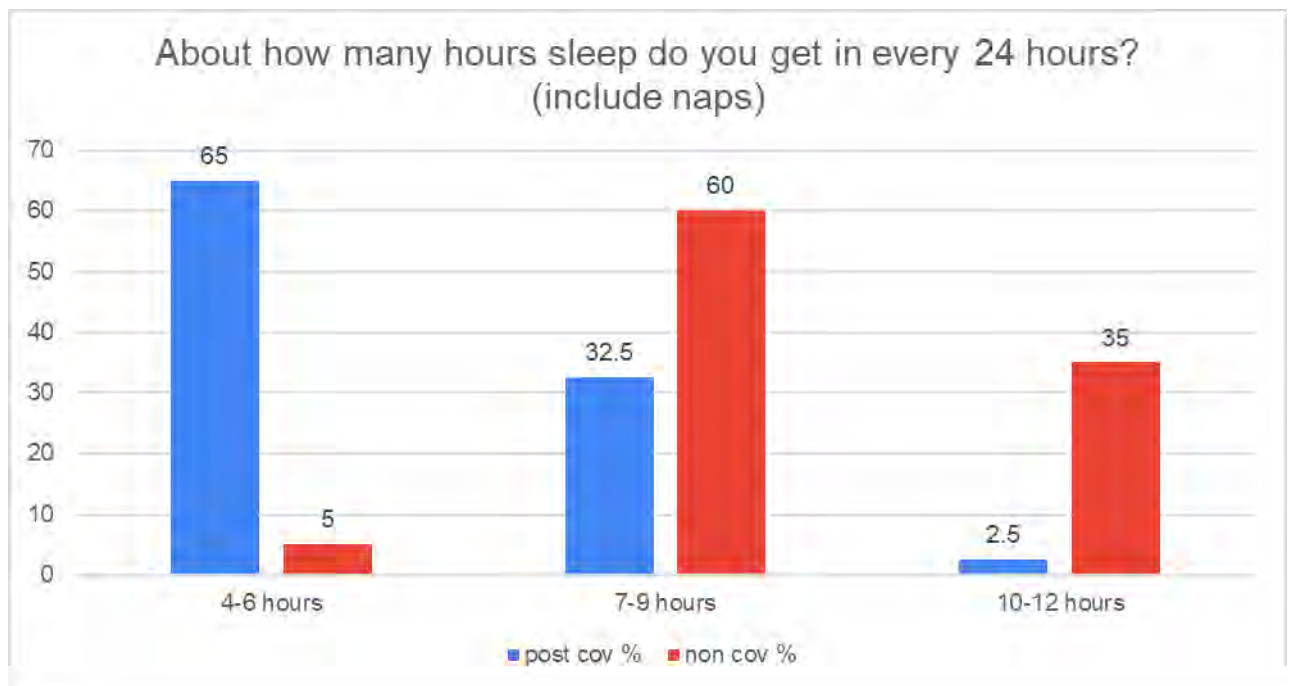


Figure 4: Graphical representation of “About how many hours sleep do you get in every 24 hours?” response of this question of the participants

“On an average day, how easy do you find getting up in the morning?” responses of this question of the participants showing below:

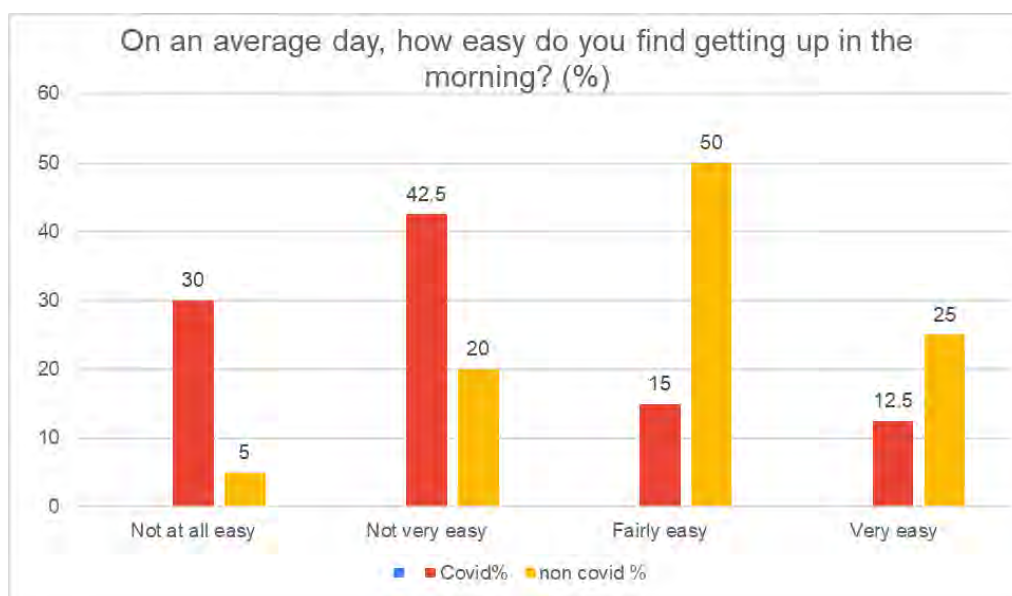


Figure 5: Graphical representation of “On an average day, how easy do you find getting up in the morning?” responses of this question of the participants

“Do you have a nap during the day?” responses of this question of the participants showing below:

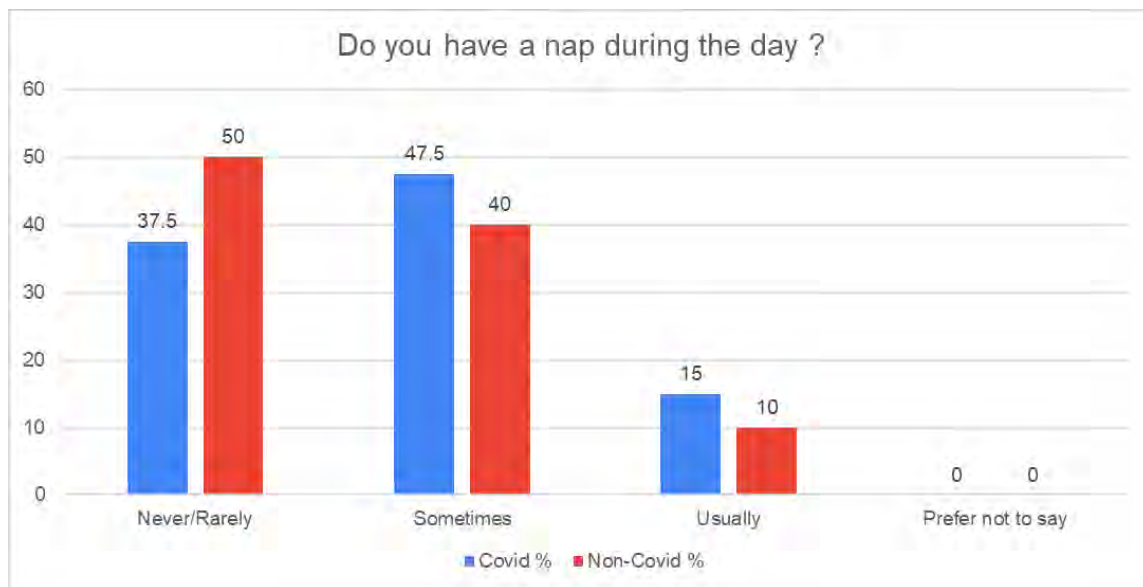


Figure 6: Graphical representation of “Do you have a nap during the day ?” responses of this question of the participants

“About how many minutes do you sleep over a daytime nap?” responses of this question of the participants showing below:

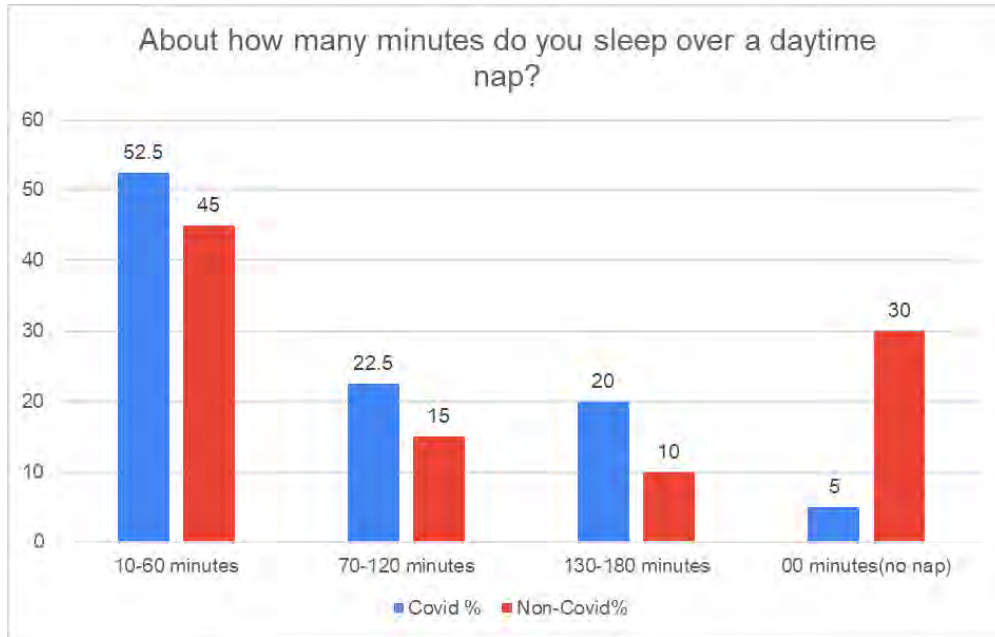


Figure 7: Graphical representation of “About how many minutes do you sleep over a daytime nap ?” responses of this question of the participants

“Do you have trouble falling asleep at night or do you wake up in the middle of the night ?” responses of this question of the participants showing below:

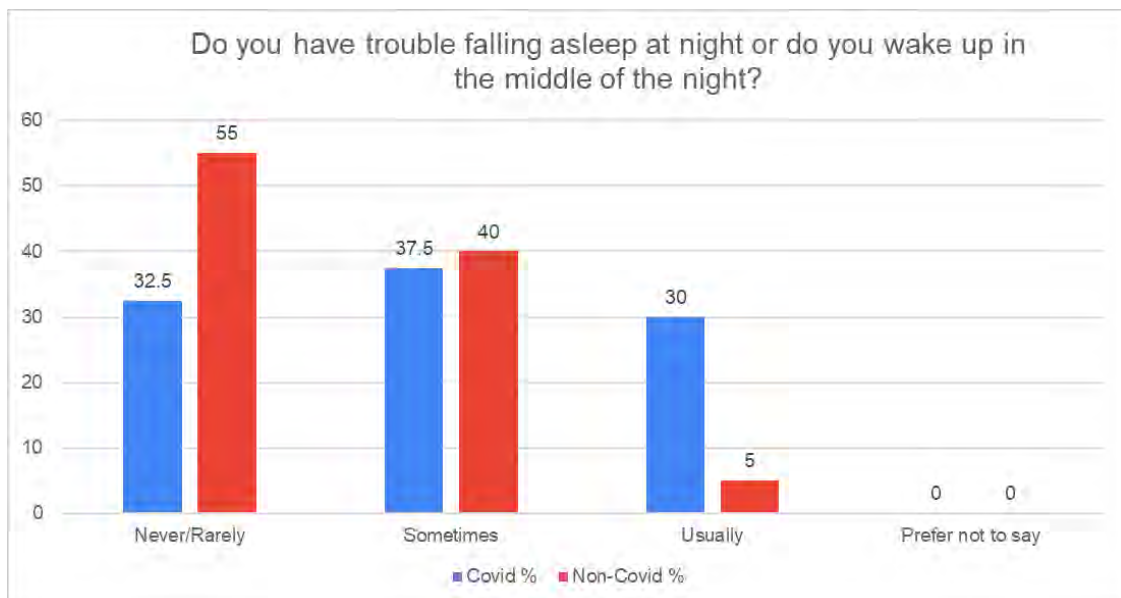


Figure 8: Graphical representation of “Do you have trouble falling asleep at night or do you wake up in the middle of the night?” responses of this question of the participants

Chapter 4

Discussion

Firstly, from figure 2 we can see the visuospatial ability status of post Covid patient is lower than those of the non Covid participant. Here in the graph, the blue colored bar stands for post Covid participants and the red colored bar stands for non Covid patients. The score is divided in three different range. Those are significant impairment, mild impairment and normal functioning. So, in these three different stages we can see from the graph that 20% of the Covid participants have significant impairment and non Covid participants have no significant impairment at all. Moreover, 57.5% Covid patient have mild impairment and non Covid patient have no mild impairment. If we notice the normal functioning range than we can see that only 22.5% of the post Covid patients are functioning normally in case of their visuospatial status. On the other hand, 100% of the non Covid participants are functioning normally than those of the others. That means the post Covid patients are facing cognitive impairment than non Covid participants. Visuospatial ability mainly describes the relationship between identify visual and spatial objects. It includes, identifying shapes and objects, drawing shapes, understanding objects by seeing, perform construction task, geometric shapes reproduction by seeing it etc. When a person has Covid then due to the infection it may hamper this visuospatial ability of a person which also indicates the risk of neurological disease may happen in future. Though it is not proven. Secondly, to evaluate the sleeping habits of the participants we used six different questions which indicates their sleeping time, quality and many more. From figure 3 we can see the participant response of the first question “trouble falling or staying asleep or sleeping too much”. There were four different options for this question. Those are more than half the days, nearly every day, not at all and several days. We can see that in the first option 12.5% of the Covid patient responded and 20% of non Covid patient responded. That means Covid patients are facing more than non Covid. In case of second option 20% of post Covid patient

responded and only 10% of non Covid patient responded. Moreover, in case of option three 32.5% of Covid participants responded and only 45% of the non Covid participant responded. However, in option four a higher percentage of Covid participants face falling in sleep which is 35% of the total Covid participant and where only 25% of the non Covid participant face trouble falling in sleep. This question actually gives us a clear view that Covid patients are facing more problem in staying asleep. Secondly, in figure 4 “About how many hours sleep do you get in every 24 hours?” responses of this questions also describe that the post Covid patients are facing more sleeping time related problems than those of the non Covid patient. 65% of the Covid patients only sleep 4-6 hours a day where only 5% of the non Covid patients sleep 4-6 hours. On the other hand, 32.5% of the Covid participants sleep 7-9 hours and only 60% of non Covid patients sleep 7-9 hours. Accordingly, 2.5% of the non Covid participants sleep 10-12 hours in a day and 35% of the non Covid participants sleep 10-12 hours in a day. These percentage of the graphs describes that Covid participants are not sleeping enough in a day and sometimes they sleep more than it’s needed where it’s the percentage of the non Covid participant is completely normal. That actually confirms that the sleeping time of a Covid patient has been altered than a normal people. Additionally, in figure 5 the third question “On an average day, how easy do you find getting up in the morning?” gives a clear view how normal a Covid participant can get up in the morning than those of non Covid. At the first option 30% of Covid patient responded and 5% of non Covid patient responded. In the second option 42.5% of Covid and 20% of the non Covid responded. In the third option 15% of Covid and 50% of the non Covid patient responded. In the last option 12.5% Covid and 25% of the non Covid participant responded. This graph gives us a clear idea that the post Covid participant is facing more difficulty to get up in the morning than those of the non Covid participants. Further, in figure 6 “Do you have a nap during the day?” the fourth question describes the day time sleep of the participants. We can see that 37.5% Covid participants and 50% non Covid

participants sleep never/rarely in daytime. On the other hand, 47.5% Covid and 40% non Covid participants sleep sometimes in a day. Furthermore, 15% Covid and 10% non Covid participants sleep usually in daytime. This graph says that Covid patients are sleeping more in day time in compare with the non Covid participants. Hence, in figure 7 describes how many minutes the participants sleep over daytime. We can see that 52.5% Covid and 45% non Covid participants sleep 10-16 minutes, 22.5% Covid and 15% non Covid sleep 70-120 minutes, 20% Covid and 10% non Covid sleep 130-180 minutes and lastly, 5% of Covid and 30% non Covid do not take nap at daytime. Finally, the figure 8 describes that how many days the participants are falling in trouble during sleep at night or the middle of the night. 32.5% Covid and 55% non Covid participants responded they face never/rarely this problem whether, 37.5% Covid and 40% non Covid participants experience this problem sometimes and 30% Covid and only 5% non Covid participants responded usually. In all the four options we can see that the number of falling trouble asleep at night is higher for the Covid participants than those of the non Covid. This may be happened due to the after effect of Covid-19 infection. Covid has left us with some major side effects. There can be also other reason as the demographic data is not same for all the participants, they are different in age, educational qualification, social position, family income etc. these demographic variables are totally different from person to person.

In a nutshell, we can say that Covid-19 has significant impact in a person's sleeping habit and visuospatial ability. Covid also alters the sleeping habit and visuospatial ability of an infected patient in comparison with a non Covid patient. A recent study also shows that Covid-19 has significant impact on sleep alterations and abnormal sleeping pattern (Pérez-Carbonell et al., 2020). Moreover, a recent published article also shows alterations of visuospatial ability in post Covid-19 patients (Olejnik et al., 2023).

Chapter 5

Conclusion and limitation

5.1 Conclusion

The research concludes that there is a major possibility that the Covid-19 infection might alter a person's sleeping habit and visuospatial ability. Because a large number of Covid participants shown sleeping related issue and also lower the visuospatial score percentage than those of non Covid participant. However, the research does not support that Covid-19 virus is the only reason for this alteration in visuospatial ability and sleeping habit

5.2 Limitation

1. There was only 60 participants participated in the research so it can be said that the researcher's data set was limited.
2. The result found from this study may not be fully accurate because the data set was very short and there may be some error due to short data set. If the sample size is larger than it can be more precise study.
3. All the graphs and calculations of scores has been performed using Microsoft Excel but still there can be error.
4. As a google form has been used to collect the data from the patients so during the time of data entry there can be error which is not intentional.

References:

1. Nouraeinejad, A. (2022). *Visuospatial impairment is of concern in patients with COVID-19*. *International Journal of Neuroscience*, 134(7), 810–811.
<https://doi.org/10.1080/00207454.2022.2145474>
2. Malik, M., Atiq, A., Tahir, M. J., Akhtar, F. K., Malik, M. I., Hassan, W., Khan, F. M. A., Akram, I., Manhas, N., Ullah, I., & Asghar, M. S. (2022). Comparison of sleep quality among COVID-19 patients and non-COVID-19 population in Pakistan: A cross sectional study during the COVID-19 pandemic. *Annals of Medicine and Surgery*, 78.
<https://doi.org/10.1016/j.amsu.2022.103894>
3. Carnes-Vendrell, A., Piñol-Ripoll, G., Ariza, M., Cano, N., Segura, B., Junque, C., Béjar, J., Barrue, C., Garolera, M., Arauzo, V., Bernia, J. A., Balague-Marmaña, M., Valles-Pauls, B., Gonzalez-Aguado, E., Tayó-Juli, C., Forcadell-Ferreres, E., Reverte-Villarroya, S., Forné, S., Bartes-Plans, A., . . . Navarro, S. (2024). Sleep quality in individuals with post-COVID-19 condition: Relation with emotional, cognitive and functional variables. *Brain Behavior & Immunity - Health*, 35, 100721. <https://doi.org/10.1016/j.bbih.2023.100721>
4. Paz-Rodríguez, F., Lozano-Tovar, S., Rodríguez-Agudelo, Y., Cruz-Narciso, B., Rodríguez-Rodríguez, M., García-Santos, A., López-González, D., Soto-Moreno, F., González-Navarro, M., González-Alonso, K., Castorena-Maldonado, A., Carrillo-Mezo, R., Marrufo-Meléndez, O., Gutiérrez-Romero, A., Del Río Quiñones, M., Arauz-Góngora, A., Ávila-Rios, S., & Chávez-Oliveros, M. (2024). Assessment of visuospatial functions in post-Covid 19 patients: Beyond the traditional paradigm. *Behavioral Brain Research*, 471, 115095.
<https://doi.org/10.1016/j.bbr.2024.115095>