ASSESSMENT OF MEMORY LOSS AMONG MEDICAL STUDENTS THAT RECOVERED FROM COVID-19 IN THE UNIVERSITY OF MEDICAL SCIENCES AND TECHNOLOGY, KHARTOUM 2024

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Abstract

Background: Memory is the process of acquiring, processing, storing, and recalling information. It consists of different types, including working memory, sensory memory, short-term memory, and long-term memory. Short-term memory holds limited information for a short duration, while long-term memory stores significant experiences and knowledge. Factors like age, trauma, and lifestyle choices can affect memory. COVID-19, caused by SARS-CoV-2, emerged as a global pandemic. Post-COVID syndrome, known as "Long COVID," includes persistent symptoms, potentially including neurological aspects.

Objectives: To assess memory function in medical students that recovered from COVID-19 in UMST.

Methodology: A descriptive cross-sectional study was carried out among undergraduate students at UMST, utilizing a self-administered questionnaire and a pilot study. The study included 151 participants, and data analysis was performed using SPSS 27. Associations were examined using the chi-square test, with a p-value threshold of 0.05 to determine statistical significance.

Results: Out of the 151 participants in the study, 65 tested positive for the coronavirus. Only a small proportion 6.8% reported hospitalization. The majority of respondents, 72.3%, experienced mild short-term memory impairment, while 61.5% exhibited mild long-term memory impairment. The correlation between the duration of symptoms and the severity of short-term or long-term memory impairment was found to be insignificant, with p-values of 0.608 and 0.121, respectively.

Conclusion: This study found that most participants experienced mild short-term and long-term memory impairment after COVID-19 infection. Surprisingly, there were no significant changes in memory over the years following the infection. The study did not establish a correlation between symptom duration and memory impairment severity. These findings suggest that COVID-19 may affect memory, but more research is required to understand the long-term effects and contributing factors.

Keywords: COVID-19, SARS-CoV-2, memory loss, cognitive impairment, Sudan, UMST

1.INTRODUCTION:

Memory is the process of taking in information from the world around us, processing it, storing it and later recalling that information, sometimes many years later. Generally, there are at least four types of memory; working memory, sensory memory, short-term memory and long-term memory. [1]

This research focuses on two primary forms of memory: short-term memory and long-term memory. Short-term memory refers to the limited capacity to retain information for a brief duration, typically around 30 seconds. It can only hold a small amount of information, such as remembering where you parked your car earlier in the day. On the other hand, long-term memory encompasses the storage of significant information and experiences that individuals can recall. Most memories belong to this category, particularly those that extend beyond the 30-second timeframe. Long-term memory can be further classified into two types: explicit and implicit memory. Explicit memories encompass personal events in an individual's life and general knowledge acquired through learning [1]. These memories are consciously recalled. Implicit memory, on the other hand, involves the retention of skills and experiences at a subconscious level, such as the ability to walk or ride a bicycle. Several factors can impact an individual's memory, including traumatic events, pathological conditions, and physiological changes. Among these factors, aging is particularly prominent and has a significant influence on memory function.

Additionally, research indicates that social factors such as social and physical activity, overall health, and lifestyle choices can also play a role in memory performance. [2]

As officially declared by the World Health Organization (WHO) COVID-19, which is also referred to as SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), is a disease that emerged in March 2020 and rapidly developed into a global pandemic.[3-5]

Post-COVID syndrome, also referred to as "Long COVID," is a term used to describe a range of symptoms that persist or recur for over one month following a COVID-19 infection .[6]This condition encompasses various extrapulmonary manifestations, which may include certain neurological components .[7,8]

1.2 Statement of Research Problem:

COVID-19 was a recent pandemic and while many studies about the symptoms present during the acute phase of the illness were carried out, studies about the long-term neurological consequences are few and far between. Some studies show that cognitive symptoms, such as memory impairment, are present even after the mildest cases of COVID-19 infection.

As most of the studies assess cognitive functions as a whole, there is a need for a more focused and detailed form of analyses for specific components of cognitive functions, such as memory, in order to better understand the severity of symptoms and possibly the pathogenesis of COVID, then aim to develop effective methods for screening and eventually treatment of these chronic symptoms.

Since the pandemic started in the year 2020, there have not been enough studies assessing the long-term consequences of COVID-19 infection past 12 months of acute infection, therefore assessing some components of post-COVID syndrome 3 years later, aids in further understanding the long-term consequences of COVID-19.

1.3 Justification:

The research done about effect of COVID-19 on memory in Sudan is scarce. This research aims to bridge the gap by assessing and measuring the effects of COVID-19 infection on memory, to better understand the long-term consequences of this infection and aid in finding an effective method for screening and treatment of these symptoms.

1.4 Research Question:

Does COVID-19 have an effect on short and long-term memory?

1.5 Hypothesis:

Null hypothesis (H0)

- COVID-19 has no effect on short or long-term memory functions.

Alternative hypothesis (HA)

- COVID-19 does have an effect on short and/or long-term memory functions.

1.6 Objectives:

1.6.1 General Objective:

• To study the effect of COVID-19 on memory functions.

1.6.2 Specific Objectives:

1. To assess the relation between severity of symptoms with degree of memory impairment.
2. To compare between genders susceptibility of post-COVID memory impairment.
3. To identify the most common form of post-COVID memory impairment.
4. To determine the association between chronic illnesses and post-COVID memory impairment.
5. To assess the association between family history of dementia and post-COVID memory impairment.
6. To determine the relationship between psychological illness and post-COVID memory impairment

2. LITERATURE REVIEW:

In a study published in Spain on the 22nd of October 2020, the authors conducted a single center cohort study that included 35 patients between 20 and 60 years of age with confirmed COVID-19 infection. They used a custom Neuropsychological battery specific for their population and found that Presence of neurological symptoms during the infection such as headache, anosmia and diarrhea were the main risk factors for cognitive impairment related with attention, memory and executive function .[9]

Similarly, a study published in South America on November 30, 2021, investigated the impact of COVID-19 on cognitive functions and its association with disease severity and risk factors. The cohort comprised 45 post-COVID patients, and extensive evaluation tools for Neuropsychology (NP) were employed. The findings revealed significant differences in cognitive composites, including memory, among these patients. Additionally, a direct correlation was observed between the severity of symptoms and the degree of cognitive dysfunction .[10]

In another study published on September 22nd 2022 in the USA, the authors carried out a longitudinal observational cohort by following three groups participants for 12 months and assessed the estimated risk for developing certain neurological disorders, including memory. They divided the participants into a group who had COVID, a contemporary control and a historic control from the year 2017 (from the period before COVID pandemic). They found that there is an increased risk in development of memory problems and Alzheimer's diseases in the first group compared to the control groups .[11]

On February 2022, a descriptive cross-sectional study was conducted in Sudan and published. The study involved two groups, one comprising 35 Sudanese adults who had no prior medical history of dementia or cognitive impairment but developed cognitive impairment after recovering from COVID-19. The researchers utilized well-validated Neuropsychological measures, which were administered by a senior consultant neurologist and senior consultant psychiatrist. Their findings revealed varying degrees of cognitive impairment in memory following recovery from COVID-19: Memory recall (22%), Memory recognition (23%), Memory encoding (24%). Based on these results, the researchers concluded that individuals who have had a COVID-19 infection are at risk of experiencing some form of cognitive impairment after recovery .[12]

Another systematic review and meta-analysis of 27 studies to investigate the cognitive effects of COVID-19 on adults without prior cognitive impairment. The evaluation period in the studies ranged from the acute phase to 7 months after infection. The results indicated cognitive impairment, including memory, in these patients compared to healthy controls during the 7-month period. However, the authors cautioned that more evidence is needed to draw a definitive conclusion.[13]

Similarly, a systematic review published on April 18, 2022, in Brazil examined articles that utilized Neuropsychological (NP) tools, primarily the Montreal Cognitive Assessment (MoCA) with a frequency of 50%, to explore the relationship between COVID-19 infection and cognitive impairment. The findings demonstrated a high frequency of post-COVID-19 cognitive impairment, but it was challenging to differentiate between mild impairment and dementia .[14]

In Italy, a scoping review published on June 11, 2022, aimed to map cognitive domain impairments, their frequencies, and associated psycho-affective disorders in individuals who had contracted COVID-19. The researchers conducted a comprehensive search of databases, including PubMed/MEDLINE, Scopus, and PsycINFO. They identified and analysed 25 records published between December 1, 2019, and February 21, 2022. The review highlighted memory, attention, and executive function as the most affected domains, with delayed recall and learning being the most impaired aspects within the memory domain .[15]

Another study published on July 1, 2022, in Italy conducted a systematic review of studies involving COVID-19 patients without comorbidities, categorizing them based on illness severity to determine the most affected cognitive functions and the most effective psychometric evaluation tools in such studies. The study revealed that memory was among the frequently impaired cognitive domains, and the MoCA and MMSE were the most commonly used assessment tools .[16]

A systematic review published on December 15, 2022, in Italy encompassed 72 studies published between January 1, 2020, and July 1, 2022, examining the relationship between post-acute COVID-19 infection and cognitive impairment. The review provided evidence of cognitive impairment in various components of cognitive function, including memory. This reinforces the general understanding of a link between COVID-19 illness and the presence of cognitive impairment.[17]

3.METHODOLOGY:

3.1Study Design: A cross sectional descriptive university-based study

3.2 Study Area

The study was conducted in the University of Medical Sciences and Technology (UMST), which is a private educational institute situated in Riyad district, Khartoum, Sudan. The university was established in 1996 and is considered one of the leading academic institutions that offers different majors in technology and social sciences. Although its main focus is medicine, it has 13 other faculties that provide undergraduate and graduate degrees in a range of healthcare specialties, including pharmacy and nursing, in addition to non-medical subjects like business administration and computer science.

3.3 Study population: The study targeted the medical students currently enrolled in the faculty across the five batches in 2024.

Inclusion criteria:

- Between the ages of 16 and 26.
- Are students of the Faculty of Medicine in UMST.
- Students who consented to take part in the study.
- Students that tested positive for COVID-19.

Exclusion criteria:

- Outside the age range.
- Have not tested positive for COVID-19.
- Does not wish to participate in the study.

3.4 Sampling:

3.4.1 Sample Size:

The sample size was calculated using the finite population formula after obtaining a list of the frequency of all batches enrolled in the faculty of medicine in UMST.

It was found that 217, 165, 217, 180 and 118 students in batches 25, 26, 27, 28 and 29 were enrolled respectively.

Formula:

n = N/1+N(e)^2

- Where:

n = the sample size to be computed

N = the population size (i.e. 899)

E is the degree of accuracy desired (or accepted margin error and is usually set to 0.05)

The sample size was calculated for UMST using the known formula population formula: 277

$$n = \frac{899}{1 + 899(0.05)2} = 277$$

3.4.2 Sample Technique:
Convenience sampling technique was implemented in this study to measure the sample size of the population.

3.5 Data collection:
Data was collected through a self-administered questionnaire. The questionnaire used was based on a standard validated questionnaire derived from a literature review. Some additional questions were included to address the study objectives. A pilot study was conducted to assess the validity and reliability of the questionnaire, and necessary modifications were made accordingly.

3.6 Data Analysis:
All collected data was displayed and computerized using Microsoft Excel '19, and statistical package for social science (SPSS23) was utilized for analysis. Descriptive analysis was presented in tables, figures, and charts, and the appropriate statistical tests were applied to address the research objectives.

3.7 Ethical Considerations:
The proposal was submitted to the Research Ethics Committee of the University of Medical Science and Technology, and permission and approval were sought. After providing a comprehensive explanation of the study objectives, participants were given well-informed consent and informed of their right to withdraw from the study at any time or decline to answer any questions they deemed inappropriate. To preserve confidentiality, anonymous questionnaires were used. Participants were assured that the collected data would not be utilized for any purposes other than the study

4.RESULTS:

The majority of participants were females in their second or fifth year of study. The average age of participants is 20 years old. (**Error! Reference source not found.**)

Table 4. 1 Sociodemographic data

		Frequency	**Percentage %**
Gender	Male	42	27.8%
	Female	109	72.2%
Year of study	First year (Batch 29)	16	10.5%
	Second year (Batch 28)	58	38.4%
	Third year (Batch 27)	9	5.9%
	Fourth year (Batch 26)	21	13.9%
	Fifth year (Batch 25)	47	31.3%
Age	17	3	2%
	18	19	12.6%
	19	36	23.8%
	20	22	14.6%
	21	25	16.6%
	22	21	13.9%
	23	13	8.6%
	24	10	6.6%
	25	1	0.7%
	26	1	0.7%

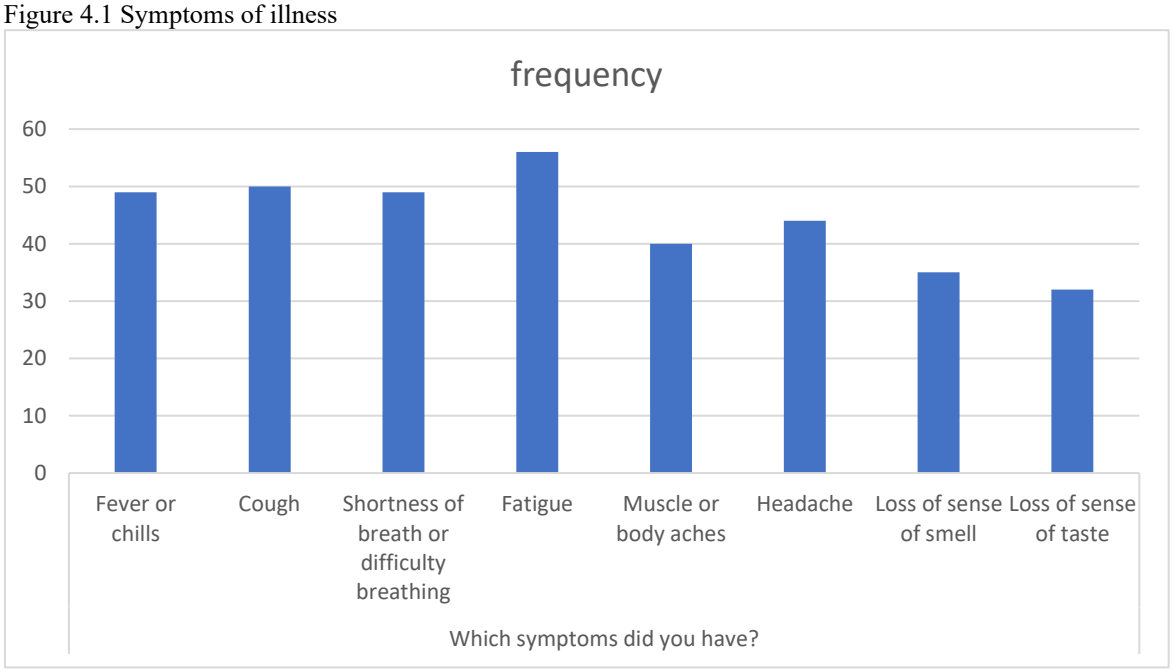
Of all respondents, only 65 tested positive for corona virus. The duration of illness varied, with almost half experiencing symptoms for 3 days to 1 week, and a third reporting symptoms lasting 1 to 2 weeks. The majority of respondents did not require hospitalization. (**Error! Reference source not found.**)

Table 4. 2 Questions about Corona illness

Questions about Corona illness		**Frequency**	**Percentage %**
Have you ever tested positive for Covid-19?	Yes	65	43.0%
	No	86	57.0%
Which confirmatory test did you use?	PCR (nasal/oral swab)	76	97.4%
	Blood serology	2	2.6%
	Other	0	0.0%
How long have you been affected?	Less than 3 days	10	14.1%
	3 days to 1 week	34	47.9%
	1 to 2 weeks	24	33.8%
	More than 2 weeks	3	4.2%
How severe were your symptoms? "5 points ranging from 1 mild to 5 severe"	1	13	18.1%
	2	20	27.8%
	3	26	36.1%
	4	11	15.3%
	5	2	2.8%
Were you hospitalized?	Yes	5	6.8%
	No	68	93.2%

The most commonly reported symptom was fatigue. (Figure 4.1)

Figure 4.1 Symptoms of illness



Majority of participants had no chronic illnesses. Only 11 individuals were certain about having a chronic illness, with asthma being the most prevalent condition among them. Additionally, 6 participants reported having psychiatric

disorders, with major depressive disorder being the most commonly reported. Four respondents indicated a history of head injury that required hospitalization. 10 individuals reported having a family history of dementia.(Table 4.3)

Table 4. 3 Past medical history

Past medical history		Frequency	Percentage%
Do you have any chronic illness?	Yes	11	15.1%
	No	59	80.8%
	Maybe	3	4.1%
If yes which one?	Diabetes	1	9.1%
	Hypertension	0	0.0%
	Asthma	8	72.7%
	Cystic fibrosis	0	0.0%
	Other	0	0.0%
	Multiple chronic illnesses	2	18.2%
Have you been diagnosed with psychiatric disorder?	Yes	6	8.0%
	No	69	92.0%
If yes which one?	Major depressive disorder	2	33.3%
	Generalized anxiety disorder	1	16.7%
	ADHD	1	16.7%
	Obsessive compulsive disorder	1	16.7%
	Bipolar disorder	1	16.7%
Do you have history of head injury that required hospitalization?	Yes	4	5.4%
	No	70	94.6%
Do you have family history of dementia?	Yes	10	13.0%
	No	57	74.0%
	I don't know	10	13.0%

A majority of respondents answered “sometimes” to the short-term memory impairment assessment segment.(Table 4.4)

Table 4. 4 Questions about short-term memory function

Questions about short-term memory function		Frequency	Percentage %
Do you decide to do something in a few minutes time and then forget to do it?	Never	6	9.2%
	Rarely	12	18.5%
	Sometimes	27	41.5%
	Quite often	13	20.0%
	Very often	7	10.8%
Do you forget to tell someone something you had meant to mention a few minutes ago?	Never	3	4.6%
	Rarely	16	24.6%
	Sometimes	23	35.4%
	Quite often	16	24.6%
	Very often	7	10.8%
Do you fail to do something you were supposed to do a few minutes later even though it's there in front of you, like take a pill or turn off the oven?	Never	7	10.8%
	Rarely	20	30.8%
	Sometimes	24	36.9%
	Quite often	10	15.4%
	Very often	4	6.2%
	Never	5	7.7%
	Rarely	15	23.1%

Do you intend to take something with you, before leaving a room or going out, but minutes later leave it behind, even though it's in front of you?	Sometimes	20	30.8%
	Quite often	18	27.7%
	Very often	7	10.8%
Do you forget something you were told a few minutes before?	Never	7	10.8%
	Rarely	16	24.6%
	Sometimes	26	40.0%
	Quite often	10	15.4%
	Very often	6	9.2%
Do you mislay something that you have just put down, like keys or glasses?	Never	10	15.4%
	Rarely	15	23.1%
	Sometimes	18	27.7%
	Quite often	15	23.1%
	Very often	7	10.8%
Do you fail to recognize a character in a radio or television show from scene to scene?	Never	22	33.8%
	Rarely	24	36.9%
	Sometimes	14	21.5%
	Quite often	2	3.1%
	Very often	3	4.6%
Do you look at something without realizing you have seen it moments before?	Never	21	32.3%
	Rarely	11	16.9%
	Sometimes	23	35.4%
	Quite often	8	12.3%
	Very often	2	3.1%

A majority of respondents answered “sometimes” to the short-term memory impairment assessment segment.(**Error! Reference source not found.**)

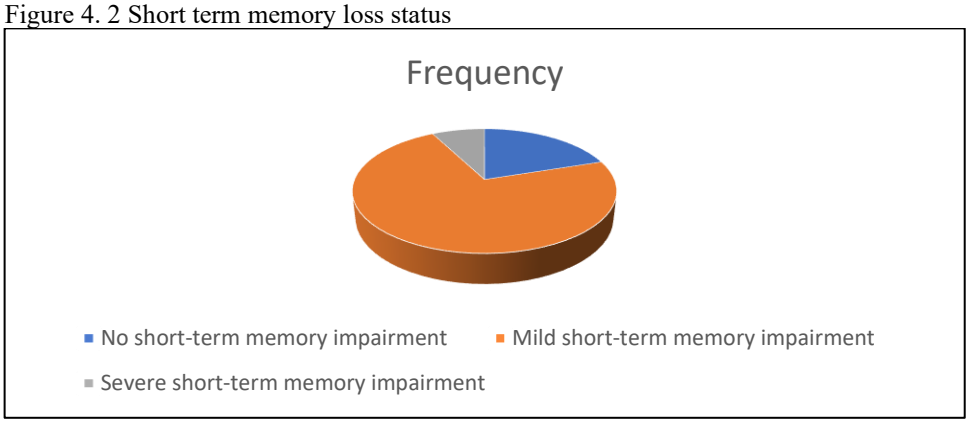
Table 4. 5 Questions about long-term memory function

Questions about long-term memory function		**Frequency**	**Percentage %**
Do you forget appointments if you are not prompted by someone else or by a reminder such as a calendar or diary?	Never	15	23.1%
	Rarely	13	20.0%
	Sometimes	25	38.5%
	Quite often	10	15.4%
	Very often	2	3.1%
If you tried to contact a friend or relative who was out, would you forget to try again later?	Never	5	7.7%
	Rarely	17	26.2%
	Sometimes	23	35.4%
	Quite often	12	18.5%
	Very often	8	12.3%
Do you forget to buy something you planned to buy, like birthday card, even when you see the shop?	Never	16	24.6%
	Rarely	18	27.7%
	Sometimes	23	35.4%
	Quite often	6	9.2%
	Very often	2	3.1%
Do you fail to mention or give something to a visitor that you were asked to pass on?	Never	15	23.1%
	Rarely	19	29.2%
	Sometimes	23	35.4%
	Quite often	6	9.2%
	Very often	2	3.1%

Do you fail to recall things that have had happened to you in the last few days?	Never	15	23.1%
	Rarely	13	20.0%
	Sometimes	25	38.5%
	Quite often	7	10.8%
	Very often	5	7.7%
Do you forget what you watched on television the previous day?	Never	22	33.8%
	Rarely	22	33.8%
	Sometimes	14	21.5%
	Quite often	4	6.2%
	Very often	3	4.6%
Do you fail to recognize a place you have visited before?	Never	38	58.5%
	Rarely	11	16.9%
	Sometimes	10	15.4%
	Quite often	3	4.6%
	Very often	3	4.6%
Do you repeat the same story to the same person on different occasions?	Never	10	15.4%
	Rarely	15	23.1%
	Sometimes	22	33.8%
	Quite often	9	13.8%
	Very often	9	13.8%

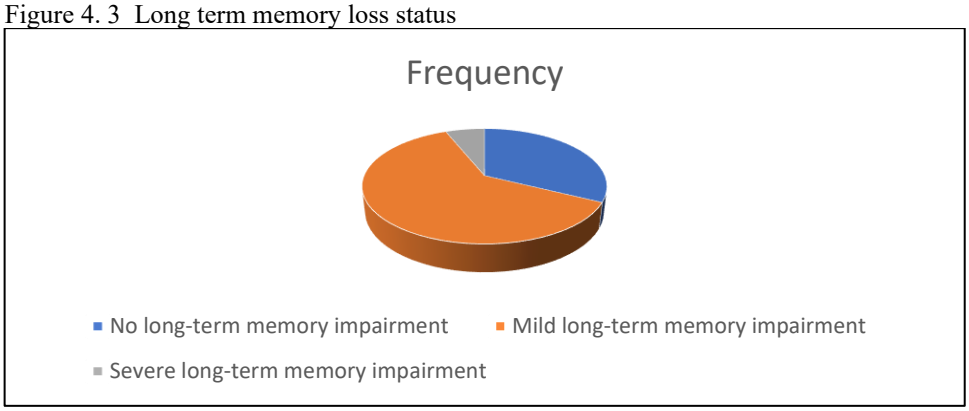
Among the participants, the majority had mild short-term memory impairment. (Figure 4. 2)

Figure 4. 2 Short term memory loss status



A third of respondents showed no signs of long-term memory impairment. A majority of participants exhibited mild long-term memory impairment. .(Figure 4. 3)

Figure 4. 3 Long term memory loss status



When assessing the impact of COVID-19 on short-term function it was found that more than half of respondents reported no difference in short-term function compared to before the infection, while almost half noticed a mild difference. Among those who noticed a decrease in short-term function, the majority reported no change in their short-term function in the years following their Covid-19 infection. (**Error! Reference source not found.**)

Table 4. 6 Change after covid in short-term function.

Change after covid in short-term function:		Frequency	Percentage %
Did you notice a decrease in this parameter in comparison to before the infection?	No difference	33	50.8%
	Mild difference	31	47.7%
	Drastic difference	1	1.5%
If yes, did you notice any improvement in the years after Covid?	Yes, it's gotten better	13	26.0%
	No, it got worse	10	20.0%
	No change	27	54.0%

The majority of respondents, reported no difference in their long-term memory after Covid-19 infection. Additionally, a majority of individuals, 57.1%, experienced no change in their long-term memory in the years following their Covid-19 infection. (**Error! Reference source not found.**)

Table 4. 7 Change after covid in long-term memory function

Change after covid in long-term memory function		Frequency	Percentage %
Did you notice a decrease in this parameter in comparison to before the infection?	No difference	34	52.3%
	Mild difference	29	44.6%
	Drastic difference	2	3.1%
If yes, did you notice any improvement in the years after covid?	Yes it's gotten better	8	16.3%
	No it got worse	13	26.5%
	No change	28	57.1%

A higher proportion of individuals with moderate severity reported mild to severe short-term memory impairment. (**Error! Reference source not found.**)

Table 4. 8 The relation between severity of symptoms and short-term memory function

The relation between severity of symptoms and short-term memory function		Short term memory loss status					
		No short-term memory impairment		Mild short-term memory impairment		Severe short-term memory impairment	
		Frequency	Percentage %	Frequency	Percentage %	Frequency	Percentage %
How severe were your symptoms? "5 points ranging from 1 mild to 5 severe"	1 "mild"	1	7.7%	9	19.1%	0	0.0%
	2	5	38.5%	11	23.4%	1	20.0%
	3	6	46.2%	17	36.2%	3	60.0%
	4	1	7.7%	9	19.1%	0	0.0%
	5" severe"	0	0.0%	1	2.1%	1	20.0%

A higher proportion of individuals with moderate severity reported mild long-term memory impairment. (**Error! Reference source not found.**)

Table 4. 9 The relation between severity of symptoms and long-term memory function

The relation between severity of symptoms and long-term memory function		Long term memory loss status					
		No long-term memory impairment		Mild long-term memory impairment		Severe long-term memory impairment	
		Frequency	Percentage %	Frequency	Percentage %	Frequency	Percentage %
How severe were your	1" mild"	4	19.0%	6	15.0%	0	0.0%

symptoms? "5 points ranging from 1 mild to 5 severe"	2	7	33.3%	10	25.0%	0	0.0%
	3	7	33.3%	17	42.5%	2	50.0%
	4	3	14.3%	6	15.0%	1	25.0%
	5" severe"	0	0.0%	1	2.5%	1	25.0%

The majority of respondents that exhibited symptoms for 3 days to 1 week experienced mild short-term memory impairment. (**Error! Reference source not found.**)

Table 4. 10 The relation between Duration of symptoms and short-term memory function

The relation between Duration of symptoms and short-term memory function		**Short term memory loss status**					
		No short-term memory impairment		Mild short-term memory impairment		Severe short-term memory impairment	
		Frequency	Percentage %	Frequency	Percentage %	Frequency	Percentage %
How long have you been affected?	Less than 3 days	2	15.4%	4	8.5%	0	0.0%
	3 days to 1 week	7	53.8%	23	48.9%	2	40.0%
	1 to 2 weeks	4	30.8%	18	38.3%	2	40.0%
	More than 2 weeks	0	0.0%	2	4.3%	1	20.0%

The majority of respondents that exhibited symptoms for 3 days to 1 week experienced mild short-term memory impairment. (**Error! Reference source not found.**)

Table 4. 11 The relation between Duration of symptoms and long-term memory function

The relation between Duration of symptoms and long-term memory function		Long term memory loss status					
		No long-term memory impairment		Mild long-term memory impairment		Severe long-term memory impairment	
		Frequency	Percentage %	Frequency	Percentage %	Frequency	Percentage %
How long have you been affected?	Less than 3 days	4	19.0%	2	5.0%	0	0.0%
	3 days to 1 week	8	38.1%	23	57.5%	1	25.0%
	1 to 2 weeks	9	42.9%	13	32.5%	2	50.0%
	More than 2 weeks	0	0.0%	2	5.0%	1	25.0%

5.DISCUSSION

SARS-CoV-2 infection can result in multi-organ failure, leading to a range of symptoms and respiratory syndromes. Neurological manifestations are common and varied [18], often including cognitive impairment[10,19]. The primary focus of this study was to describe the occurrence of long-term and short-term memory loss in relation to COVID-19 infection.

The majority of participants included in this study, who tested positive for COVID-19, exhibited mild to moderate symptoms, which resulted in the vast majority not requiring hospitalization. The most prominent symptoms reported were fatigue, followed by cough, and fever or chills. Additionally, shortness of breath or difficulty breathing was also observed as a significant symptom. In addition, significant majority of participants in this study, 80.8%, reported no previous history of any chronic diseases.

This is concomitant with a study that specifically examined cognitive performance in previously healthy adults without a history of cognitive impairment and who did not require hospitalization, The study's findings suggest that executive functions and attention were the most affected areas, while memory and language showed a relatively lesser impact [10].

Extensive research has indicated that contracting SARS-CoV-2 can potentially lead to memory impairment, persisting even in the months following recovery [20-24].

According to our study, the majority of individuals who recovered from COVID-19 infection, accounting for 72.3% of respondents, experienced mild short-term memory impairment. Similarly, 61.5% exhibited mild long-term memory impairment, while a smaller percentage of 6.2% demonstrated severe long-term memory impairment. These findings are consistent with a study conducted by German researchers, which suggests that individuals who do not perceive cognitive impairment may still encounter difficulties with memory and attention even after recovering from a mild case of COVID-19 [25]

The findings from Rogers et al., as reported in their systematic review and meta-analysis study, align with our results. Their study, which encompassed 1963 studies and 87 preprints, showed that impaired memory was a common symptom among patients hospitalized for SARS during the acute illness phase [23].

Based on findings of Søraas, A., et al., it appears that even individuals who had a mild case of COVID-19 may experience a negative impact on their memory up to 8 months later. This association between memory impairment and the disease can also contribute to a decline in overall health and the development of Post-Acute Sequelae of SARS-CoV-2 (PASC). These results strongly suggest a need to reevaluate the perception that COVID-19 is always a mild disease. Furthermore, it raises questions about the effectiveness of current home-treatment strategies in achieving optimal long-term outcomes [20]. A study investigating the impact of COVID-19 on memory in non-hospitalized individuals who were home isolated revealed concerning results. The study found that even young people who did not require hospitalization experienced potentially severe symptoms, including concentration and memory problems, dyspnea (shortness of breath), and fatigue, up to six months after infection. These symptoms, especially for students, have the potential to significantly interfere with their learning and academic progress [26].

Furthermore, Crivelli, L., et al as well as Ahmed et al., established that the severity of COVID-19 symptoms did not correlate with the severity of cognitive impairment [10,21]. Our findings align with those of previous studies, as we observed no significant association between the severity of symptoms and long-term or short-term memory function. In contrast to the findings of Hampshire et al., who reported a more pronounced effect in patients who were hospitalized or had a severe infection, our study did not find a significant association between the severity of infection and the observed cognitive impact [27].

The duration of COVID-19 symptoms was examined in relation to both long-term and short-term memory impairment. However, the study revealed that a longer symptom duration was not significantly associated with increased impairment in either memory domain. This finding contradicts a study on Post-COVID-19 Memory Complaints, which found that individuals with a longer-than-average recovery period had more severe memory impairment [21].

According to Orrù et al., it is worth noting that the observed impairment in memory functions may not be solely attributed to the viral infection itself [22]. Other factors such as measures like lockdowns, social distancing, pandemic anxiety, as well as the potential experience of grief, could have contributed to a decline in cognitive functioning[28]. These factors may have led to increased stress levels and subsequent negative psycho-physiological effects on memory.

The notable impacts on mental health observed in this study may be partially attributed to the pandemic context and the novelty of the virus. However, the specific effects of COVID-19 infection on the brain and psyche are still not fully understood[24].

6.1 CONCLUSION

This study observed that a majority of participants reported mild short-term and long-term memory impairment. However, interestingly, they did not report any changes in their long-term or short-term memory in the years following their COVID-19 infection. As a result, the study did not find a significant correlation between the duration of symptoms and the severity of memory impairment.

These findings suggest that COVID-19 infection may have an impact on memory function, with a higher prevalence of mild memory impairment among the study participants. However, further research is needed to explore the specific mechanisms and long-term effects of COVID-19 on memory. Additionally, other factors beyond the duration of symptoms may contribute to memory impairment in individuals recovering from COVID-19.

Strengths of the study: Literature regarding this topic is scant in Sudan, hence this study is considered a valuable base for evidence. Additionally this remains a crucial topic as the world continues to understand the long-term health consequences of COVID-19. Furthermore, this study can serve as the base for further studies in this aspect.

Limitations of the study: The reliance on self-administered questionnaires for data collection introduces the possibility of participation bias and response bias. Thus, the participants' knowledge of their COVID-19 status and symptoms at the beginning of the study may have influenced their willingness to participate or their responses during the follow-up period. In addition, the study's reliance on self-reported memory assessments through questionnaires lacks the objectivity and precision of formal objective memory tests. This limitation restricts the strength of the conclusions that can be drawn from the study's findings. Moreover, the study focused specifically on medical students in a particular university, the generalizability of the findings to other populations or settings may be limited. Therefore, the results may not be representative of the broader population or individuals in different educational or occupational backgrounds.

6.2 Recommendations

Future studies should consider incorporating more objective measures for data collection, such as standardized memory tests. This would provide more reliable and valid data for assessing memory loss among individuals who have recovered from COVID-19. Likewise, a more diverse study population beyond medical students in a single institution should be conducted. Including individuals from different backgrounds and settings would provide a broader understanding of the impact of COVID-19 on memory loss. Furthermore, conducting longitudinal studies would enable researchers to track memory function over an extended period of time. This would provide valuable insights into the long-term effects of COVID-19 on memory and help identify any potential recovery patterns or persistent impairments. Lastly, collaboration across multiple institutions and research centers can enhance the validity and generalizability of findings. By pooling data from various sources, researchers can obtain a more comprehensive understanding of memory loss among individuals recovering from COVID-19.

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