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Post-Covid-19 Cognitive Decline Syndrom: Designing a Questionnaire for Sensory Olfactory, Gustatory perception and Memory

عرض النكوص المعرفي ما بعد كوفيد-19: تصميم استبيان اضطراب
الإدراك الحسي الشمي والذوقي والذاكرة

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Abstract:

In this study, we evaluated cognitive abilities (sensory, olfactory gustatory perception, and memory) among patients recovered from the Coronavirus, using a cognitive decline questionnaire designed by the researcher, which enables measuring the long-term effects of Covid-19 disease on those cognitive processes. The questionnaire was administred to a sample of 50 individuals, 25 of whom were affiliated with the health sector at the Mother and Child Hospital in Setif, and 25 of whom were members of the general public, aged between (21-78) years old. Then the questionnaire was applied to 3 individuals, aged between (45-77). All of them were infected with the Coronavirus and they lived in the Setif region and its environs.

The results of the study confirmed its hypotgesis, as the infected people with the Coronavirus showed a decline in cognitive abilities (sensory, olfactory, gustatory perception, and

memory) after recovering from infection for a long period of time, but to varying degrees.

Keywords: Covid-19, Cognitive decline, Sensory olfactory and gustatory perception disorder, Memory disorder.

المخلص:

في هذه الدراسة تم تقييم القدرات المعرفية (الإدراك الحسي الشمي والذوقي والذاكرة) لدى المرضى المتعافين من فيروس كورونا باستخدام إستبيان النكوص المعرفي المصمم من قبل الباحثة لقياس الآثار طويلة المدى لمرض كوفيد-19 على تلك العمليات المعرفية. تم تطبيق الاستبيان على عينة من 50 فرداً، 25 منهم تابعين لقطاع الصحة بمستشفى الأم والطفل بسطيف، و25 منهم من عامة الناس، تتراوح أعمارهم بين (21- 78) سنة، ثم تطبيقه على 3 أفراد تتراوح أعمارهم بين (45- 77) سنة أصيبوا جميعهم بفيروس كورونا من منطقة سطيف وضواحيها. توصلت النتائج إلى أن الأشخاص المصابين بفيروس كورونا أظهروا تراجعاً في القدرات المعرفية (الإدراك الحسي الشمي، والذوقي، والذاكرة) بعد التعافي من الإصابة لمدة طويلة، ولكن بدرجات متفاوتة.

الكلمات المفتاحية: كوفيد- 19، النكوص المعرفي، اضطراب الإدراك الحسي الشمي والذوقي، اضطراب الذاكرة.

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1. INTRODUCTION

Life in the world changed after the emergence of a deadly virus with an eccentric coronary shape for the first time in the Chinese city of Wuhan on December 12, 2019, which was

named after its microscopic form the Corona virus, and quickly accelerated the spread to sweep the world within two months.

This virus, which although it was still at the beginning of its spread, began to claim the lives of millions, as its first symptoms appeared in the form of influenza, accompanied by high body temperatures, cough, cold, tonsillitis, with loss of smell and taste (Education Arab Organisation, 2020, p15) and it was highly contagious, and the first causes of death recorded on dead people were pulmonary failure with shortness of breath, kidney failure, and heart attacks, especially in the elderly and people with chronic diseases.

This led the World Health Organization to raise the flag of danger as a global pandemic (Al-Mandhari, 2022) and work to accelerate the production of the appropriate vaccine within six months to a year at most, and officials in most countries imposed quarantine measures, social distancing, sterilization, wearing a protective mask, and closing borders.

But despite all these efforts, the new strains of this mutated virus rolled to differ from Covid 19, Delta, Omicron and others, which were more dangerous than the previous one, as new symptoms appeared for patients infected with the emerging Corona virus, such as suffering from allergy-like skin symptoms, there are those who suffered from gastroenteritis, and there are those who suffered from keratitis of the eyes, and others who suffered from headache and high temperatures, loss of appetite, bedwetting and cystitis, and from High blood sugar and blood pressure disorder, and some of them have become permanent diseases, and there are those who did not suffer from any of the previous symptoms or any other symptom even

though they were carriers of the virus, and in some cases sudden death appeared for no apparent reason.

But what is noticeable is that these patients also suffered from depression, anxiety, severe fatigue, and even dementia, and decreased cognitive abilities such as memory (Fatohi, 2020), sensory perception, and attention, with some of these symptoms continuing after recovering from the infection.

2. The theoretical aspect of the study

2.1 Objectives of the study:

Find out if people infected with the Corona virus and its various strains suffer from a decline in cognitive abilities and memory – sensory, olfactory and gustatory perception - and this is after recovering from infection for more than two years.

2.2 Importance of the study:

Defining the cognitive decline occurring after exposure to Covid-19 disease and Corona virus and terminological control of the various variables of the study: Corona virus, Covid-19, post-Covid-19 syndrome, cognitive decline of memory and sensory ,olfactory and gustatory perception.

Building a tool – cognitive decline questionnaire of – memory and sensory , olfactory and gustatory perception – post Covid-19 syndrome – enables researchers to measure the long-term effects of Covid-19 disease on individuals in relation to these cognitive processes, and to conduct a field study on this topic by applying it to a sample of 50 individuals in order to measure the psychometric properties of the questionnaire and then apply it to 3 cases .

2.3 Definition of study terms:

Memory: It is a system among information processing systems that enables the storage of mental representations associated with stimuli to which humans are exposed (Zaghloul, 2011, p. 50), and there are several types of sensory memory, short-term memory, long-term memory and work memory.

Olfactory sensory perception: It is the process of interpreting olfactory stimuli and giving them their own meanings (Zaghloul, 2011, p. 110), and thus enables us to distinguish different smells.

Gustatory sensory perception: It is the process of converting tasteful sensory impressions into certain mental representations (Zaghloul, 2011, p. 111). Through which we can identify diverse tastes.

Cognitive relapse of memory, olfactory and taste sensory perception : It is a decline in cognitive abilities such as memory and sensory perception of smell and taste after they were well acquired.

Definition of virus: It is a microorganism smaller than a germ that can only grow or multiply in a living cell, using its chemical mechanisms to keep itself alive, and it may multiply with mutations, which enables it to change its shape and resistance and cause rare and dangerous infections and diseases (Education Arab Organisation, 2020, p. 96), so it can coexist in living organisms such as humans or animals.

Coronavirus: A family of viruses known to contain strains that cause potentially fatal diseases for mammals, birds and humans spread through airborne liquids droplets produced by infected individuals, and it has coronary shape and causes colds symptoms that are mostly fatal, the most important of which are

shortness of breath and blood clots (Education Arab Organisation, 2020, p. 15), leading to neurological diseases.

Consequences of infection with the Corona virus: The pathological, physical, psychological and moral disorders left by the infection with this virus after fully recovering from it.

COVID-19: A name given by the World Health Organization on February 11th (2020) to the disease caused by the emerging Corona virus, and it manifests as fever, cough, shortness of breath and fatigue, and severe cases of infection may lead to death, and the 19 indicates the year it was discovered (Education Arab Organisation, 2020), which is the most used term to express this disease.

Post-COVID-19 syndrom: The effects of COVID-19 that last for more than four weeks after diagnosis, where the elderly and patients with serious medical conditions are most likely to develop long-term symptoms of COVID-19, but even young people and healthy people may feel unwell for weeks or even months after infection (Mayo Clinic, 2020), and the persistent symptoms are: fatigue, fever, dizziness, shortness or difficulty breathing, cough, chest pain, problems with memory, concentration, sleep, rapid heartbeat, loss of smell and taste, and disturbances in olfactory and taste perception.

2. 4 The problem of the study:

Epidemics have always threatened the continuity of humanity, as they appeared in the world thousands of years ago and were deadly and dangerous every time, as they claimed the lives of millions of people, such as plague, tuberculosis, and Spanish measles, due to infection with some viruses such as the SARS virus, and this despite the development of sciences such

as epidemiology, genetics, pharmaceutical sciences and medicine since the 20th century, but it has not yet been overcome due to the emergence of new viruses every time with their shape and type constantly changing.

Therefore, when the Corona virus appeared, the whole world was troubled, and even the most developed and prosperous countries could not surround it, as it left serious negative effects and various crises, including psychological and social crises due to social distancing, introversion and isolation such as anxiety and depression, and there were economic crises due to the cessation of work, reducing the level of services and laying off some workers, and even on the academic side due to the cessation of all forms of in-person education and the reduction of its periods later, and various health and even fatal impacts, where the number of deaths reached millions, and millions suffered from neurological diseases, and this was confirmed by a faculty research team at London University (Fatohi, 2020). In 2020, they studied the effects of the disease on a sample of 43 patients with the Corona virus, ten of whom suffered from temporary brain dysfunction and delirium, twelve of them suffered from encephalitis, eight of them suffered from strokes and eight others suffered from nerve damage.

A group of doctors in the UK, also observed symptoms such as psychosis, depression or strokes in 153 coronavirus patients under 60 years of age (Fatohi, 2020).

Perhaps one of its most serious effects after death is the physical injuries and their transformation into chronic diseases and its transition from a temporary state to a chronic one, where it was noted that some pathological symptoms persist after recovering from infection, such as cognitive dysfunctions such

as (sensory memory, sensory perception , and executive functions) in some people, and this was confirmed by the World Health Organization (Al-Mandhari, 2022), who and called this type of disease the long-term Covid-19 disease. The most common symptoms associated with it include fatigue, shortness of breath, persistent cough, chest pain, fever, muscle pain, loss of smell or sense of taste, speech and sleep problems, memory and cognitive impairments such as confusion, forgetfulness, loss of mental focus or lack of clarity, depression, anxiety, and therefore it negatively affects a person's ability to go about his life such as doing daily activities, work and taking care of household affairs.

This is what we noticed in the members of the study sample, especially when the infection is cerebral neurological or sensory neurological or vascular , we also find in some cases a loss of sense of smell and taste for more than two years, and memory disorder and cognitive abilities disorder, and this is what we will try to clarify through this study where we have built a tool - cognitive decline questionnaire Olfactory and taste sensory perception and memory for Post-COVID-19 syndrome, which enables researchers to measure the long-term effects on individuals in terms of these cognitive processes based on the following question:

Do people with coronavirus experience a decline in cognitive abilities- olfactory and gustatory perception and memory- after recovering from infection for more than two years?

2. 5 The study hypothesis:

People with coronavirus experience a decline in cognitive

abilities - olfactory and gustatory perception and memory - after recovering from infection for more than two years.

3. Field Study

3.1 Methodology adopted in the study:

It is the existing descriptive approach that studies phenomena as they exist in reality, where they are accurately described, analyzed and interpreted in an organized manner and expressed qualitatively or quantitatively by collecting data about the problem under study, classifying and analyzing it and subjecting it to careful study, and this is in order to reach specific purposes such as finding solutions to some problems, or finding the relationship between variables, or interpreting some phenomena (Adhniyat & Bouhoush, 1999, p. 138). We have relied on the descriptive approach because it is the most appropriate, as it enables to describe pathological phenomenon and analyze its symptoms, effects and explain it.

3.2 Study Tools:

We used to collect data a Cognitive decline questionnaire (Olfactory and taste perception and memory for the post-Covid 19 syndrome). It is one of the research tools that allows to collect data about a phenomenon by answering a set of closed or open questions (Obaidat & Abu Nassar, 1999, p. 52).

The questionnaire was developed by the researcher (Nedjar, 2023), based on the theoretical backgrounds of the Corona virus and the effects of the infection such as the theory of Angiotensin conversion Enzyme2 ACE2 (Fatohi, 2020), and based on clinical follow-ups and observation of clinical symptoms in patients recovering from the Corona virus in the

Algerian society, region of setif since the emergence of the disease. It was directed to people who have been exposed to the Corona virus; it aimed to measure the long-term effects on those patients in terms of cognitive processes, olfactory and taste perception and memory, the questionnaire contains 30 questions, divided in to four main articles:

- Memory (long-term, working, contextual, event, semantic, sensory record, olfactory and gustatory sensory memory): items 1 and 21 to 30.
- Olfactory perception of good and unpleasant odors: 2 to 8 items.
- Taste perception of the taste of vegetables, fruits, food, spices, drinks, nuts, sweet, salty, sour, bitter, meat: from 8 to 19 items.

The questionnaire items are answered according to three statements: Yes= 2, No= 1, Undefined= 0. Scores are interpreted according to two areas, and this is based on the Likert scale (Al-Sayed, 2021), to measure opinions, judgments and feelings: from 0-30; there is no cognitive processes memory disorder - Olfactory and taste perception, from 31- 60 there is a cognitive processes memory disorder - Olfactory and Taste Perception.

3.3 Spatial and temporal boundaries of the study:

The study was conducted in the city of Setif and its suburbs in Algeria, at the Mother and Child Hospital in the neighborhood of EL-Baz Setif, and at the University of Setif2 in the neighborhood of El Hidhab, and in the laboratory of building and construction in the neighborhood of 200 housing Setif and some neighborhoods of the city of Setif neighborhood 1006, neighborhood El- Hidhab, neighborhood of Sefiha, and it extended from March 15, 2023 to December 20, 2023.

3.4 Sample of the survey study:

The questionnaire was applied to a sample of 50 individuals, as 25 of them are from the health sector at the Mother and Child Hospital in Setif, and 25 of them are from the public, all of whom were infected with the Corona virus, aged between 21 and 78 years living in Setif region and its suburbs.

Table 1. Health personnel sample

Cases	History of infection	Anam- nesis	Profession	Age	Gender	Score
1	Aug 2020	/	Doctor	24	F	30
2	Year 2020	/	Doctor	26	M	40
3	Year 2020	/	Resuscitation Physician	37	F	33
4	Mar 2021	/	Student	24	F	34
5	Year 2021	/	Manager	54	M	23
6	Augt 2021	/	Manager	40	M	25
7	June 2020	/	Accountant	57	M	30
8	May 2020	/	Nurse	52	M	30
9	Apr 2020	/	Nurse	35	M	31
10	Mar 2021	/	Student	24	F	27
11	Mar. 2020	/	Doctor	23	F	33
12	Sept2021	/	Student	24	M	31
13	Feb 2020	/	Doctor	30	F	32
14	Year 2021	/	Doctor	30	F	33
15	July 2021	/	Doctor	30	F	19
16	July 2022	/	Doctor	29	F	33
17	June 2021	/	Doctor	40	F	31
18	June 2022	Hypothyroidism	Doctor	30	F	32
19	July 2021	/	Doctor	30	F	30

20	Sep. 2020	Hypothyroidism	Pr of Medicine	44	F	47
21	Oct. 2020	/	Orthophonist	34	F	30
22	June 2020	/	Doctor	35	F	36
23	June 2020	Diabetes	Driver	37	M	45
24	Jan 2021	Diabetes	Manager	37	M	35
25	Aug 2020	Diabetes	Secretary	48	F	31

Table 2. Members of the public sample

Cases	History of infection	Anamnesis	Profession	Age	Gender	Score
26	Oct. 2020	/	engineer	43	M	47
27	Nov. 2020	/	employee	45	M	48
28	May 2021	Hypothyroidism	/	74	F	34
29	Dec. 2020	/	/	75	F	54
30	June 2021	/	engineer	45	M	31
31	Oct2020	/	professor	37	F	39
32	Oct. 2020	blood pressure	Retired	77	M	37
33	Mar. 2020	/	constructor	42	M	35
34	July 2020	/	Student	22	F	40
35	May 2020	/	Student	24	F	32
36	June 2020	/	Student	23	F	36
37	July 2021	/	/	49	F	17
38	Year 2021	Diabetes and blood pressure	/	73	F	39
39	Year 2021	Diabetes	/	45	M	26
40	Year 2021	/	Teacher	26	F	32
41	Aug 2020	/	Orthophonist	21	F	27

42	Oct 2021	/	Student	21	F	35
43	June 2021	Cholesterol	Attorney general	52	M	32
44	July 2021	Blood pressure	Guard	53	M	28
45	June 2020	Asthma	Student	20	F	29
46	July 2021	Diabetes and blood pressure	/	78	F	33
47	Year 2020	Diabetes and blood pressure	/	55	F	32
48	May 2021	/	/	21	F	36
49	July 2021	Hypothyroi dism	/	33	F	39
50	June 2021	Hypothyroi dism	/	52	F	38

3.5 Basic study sample:

The study sample included three people who suffered from the Corona virus and its mutated strain Covid 19.

Table 3. Members of the basic study sample

Cases	gender	Profession	Age	Anamnesis	History of infection	score
1	F	doctor	43	Hypothyroidism	20/09/2020	47
2	M	Retired Director	77	Heart and hyperthyroidism	13/10/2020	37
3	M	/	69	blood pressure	21/12/2020	54

4. Results of the study

Table 4. Results of the members of the basic study sample"

Cases	Scores
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1	37
2	47
3	54

The third case obtained the highest score of 54, the first case obtained the lowest score of 37 and the second case obtained a score of 47, and this explains their suffering from a disorder in cognitive processes - olfactory and taste perception and memory after a long period of time from the Corona virus.

4.1. Statistical Study:

It was based on the statistical package SPSS to calculate the psychometric properties of the test as follows.

4.1 Reliability:

Table 5. Reliability by Cronbach's Alpha

Alpha Value	Mean	Variance	N. of items	Decision
,649	102,37	58,01	30	reliable

Through Table 4, we found that the Alpha value was ,649, and the mean was estimated at 102.37, on the other hand, we find that the variance was 58,01, and according to these results, we decide that the questionnaire is reliable because the high value of ,649 (means that 61,7% is true), exceeding the set by (Anastasi, Urbina, 1997), which holds that whenever Alpha exceeds 0,70, this indicates that the questinnaire is reliable.

The vast divergence that exists between the mean and the variance indicates significant differences in individuals' responses (discrimination). The existence of the Alpha value under standard elements is a test used to estimate the weights of items in terms of Rpbis value.

Table 6. Reliability by split-half

Alpha Cronbach	First half	Value	,558
		N. of items	15
	Second half	Value	,593
		N. of items	15
	Total N. of items		30
Correlation between the two halves of the test			,665
Spearman Value	Equal length		,799
	Non Equal length		,799
Guttman Value			,758

The table. 6 we found that Alpha value of the first reached (,558), and for the second half (,593). Also, we found that there is a strong correlation between the two halves, where was estimated at (,665), which indicates that the test is fixed between its halves, and each of the values of the corrected "spearman" indicates on its side equal length (,799) considering that the questionnaire is equal in half, and the value of Guttman (,799) that the questionnaire is constant when divided into two halves.

4.2. Validity:

Table 7. Experts' validation

Experts	Affiliation	Degree	Specialization
1	Setif2 university	Lecturer A	Ortophony
2	Setif 2 university	Lecturer A	Guidance and counseling
3	Setif 2 university	Lecturer B	Ortophony
4	Setif 2 university	Lecturer B	Clinical Psychology
5	Setif2 university	Lecturer B	Ortophony

The sincerity of the two referees was relied on in order to arbitrate the questionnaire after distributing it to a group of lecturers with scientific degrees "A, B" within the specialization of psychology, educational sciences, and orthophony at the

University of Setif2, then we measured the percentage of validity according to the following equation:

Validity of the experts = the number of respondents with the validity of the test / Total number of experts $\times$ 100

Table 8. Percentages of experts' agreements

Items	Criteria	Agreements	Non-agreements	Validity ratio
Adjust the words	environment and language meaning	5/3	5/2	60%
Separation between the dimensions	According to measures of each item	5/4	5/1	80%
Formulation of items	The nature of items and appropriateness of answers	5/5	5/0	100%
N. of items measuring the dimensions	Avoiding repetition and ensuring the achievement of the goal by items	5/3	5/2	60%
Consistency of dimensions with objectives	Link each part to the property to be measured	5/4	5/1	80%
The suitability of the questionnaire	If applied with COVID-19 cases	5/4	5/1	80%
Validity of the material for the content	In terms of items	5/3	5/2	60%
Overall		74.28%		

Through the overall score of 74.28%, we conclude that the test is valid, and we also measured the subjective validity of the questionnaire based on the reliability coefficient, by calculating the square root of the reliability coefficient as a coefficient of validity (which is the maximum validity of the test that we can

estimate). Based on the above, the coefficient of self-honesty can be derived by applying the following law: The coefficient of self-validity is the square root of stability is equal to: 0,785.

5. CONCLUSION

The effects of infection with the Corona virus vary from one case to another, and this is proven by the results of the study sample members, whereas:

The first case obtained a score of 37 in the questionnaire and was suffering from a chronic defect at the level of olfactory and taste sensory perception, while retaining the olfactory and taste memory, because the case was distinguishing between current and previous smell and taste, meaning the one that was before infection with the Corona virus, while recovery from the symptoms of Corona disease was two months after infection with the virus, but some symptoms remained continuous, such as smell and taste disorder, fatigue and depression, and this is what corresponds to the results of The study of the Doctor Majed Fatohi (Fatohi, 2020) at Johns Hopkins University of Medicine in the United States of America at the Neuro Grow Brain Fitness Center Medical Center On July 31, 2020, the study aimed to find out how the emerging Corona virus affects the brain of patients, and the study was conducted on a sample of 214 patients with the Corona virus, and the study found that all patients were exposed to neurological complications ranging from loss of smell to stroke, where other symptoms were headache, dizziness, loss of consciousness, weakness, seizures, and paralysis, as when the virus spreads through particles in the air and enters the body through the nose and mouth, and the virus is likely to cross the bone in the upper part of the nose to the olfactory bulb that includes the olfactory nerve and its

branches, and if the virus damages these nerves, the person may lose his sense of smell, while if the Corona virus invades the taste buds directly, it prevents nerve fibers from sending signals to the brain and causing loss of sense of taste.

The second case got a score of 47 in the questionnaire, she suffers from difficulties in thinking, difficulties in concentration, memory disorder and inability to remember new events, with talking and acting in ways that are sometimes socially unacceptable, prostatitis, fatigue, and immunodeficiency, although recovery was after three months, it was observed that these symptoms persist chronically, and this is what agrees with the theory of angiotensin-converting enzyme by (fatohi, 2020), which states: When the Corona virus binds to the receptor of the protein called the ACE2 angiotensin converter, which is found in cells throughout the body, it works to reduce its levels in the patient's body, so blood vessels shrink and blood flow to the organs of the body decreases, so blood clots occur, and severe inflammation that occurs to the tissues due to the Corona virus can double the chances of these clots as a result of lack of blood clotting, producing strokes and may be minor and not felt by patients, which They accumulate over time and cause memory and attention disorders, even depression, anxiety, insomnia, future cognitive decline, and even death, even in young people who were in good health before contracting the virus.

While the third case obtained the highest score of 54, as she entered into a coma for 3 months and is suffering from continuous pulmonary insufficiency, chronic heart disease, fatigue and stress, swallowing disorders suffering from chronic dysfunction at the level of olfactory and taste perception, and this is what corresponds to the results of Fatohi (2020), on a sample of 43 coronavirus patients, 10 patients suffered from

temporary brain dysfunction and delirium, 12 of them suffered from encephalitis, 8 of them suffered strokes and 8 others suffered from nerve damage, and a study of doctors in the UK on a sample of 153 patients with the Corona virus observed symptoms such as psychosis, depression or strokes in these patients even those under the age of 60.

Therefore, through the results of the three cases, we note that the cognitive decline in terms of sensory defect and the decline in cognitive abilities in a long-term manner has already occurred in the three cases, and from it we conclude that the general hypothesis has been achieved, which is: People infected with the Corona virus and its various strains suffer from a decline in cognitive abilities such as sensory memory - sensory perception - executive functions after recovering from infection for more than two years, as it appeared in the three cases: The first was persistent symptoms such as complete loss of smell and taste disorder, and the second had long-term cognitive impairment in terms of memory, while the third case suffered from symptoms that became chronic such as heart disease, pulmonary insufficiency, fatigue and stress with chronic impairment of olfactory and taste perception. Therefore, we advise those in the health sector to:

- Work to intensify studies on the persistent symptoms of coronavirus disease.
- Put these patients under close medical observation because they are exposed to serious neurological diseases in the future that negatively affect their quality of life.
- Give us accurate information on how to deal with those symptoms that have become chronic diseases.
- Conducting awareness campaigns about the complications of Covid-19 and how to live with them, and enlightening them

about the available treatment methods to avoid the aggravation of these symptoms.

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