Psychiatria Danubina, 2023; Vol. 35, No. 1, pp 73-79 https://doi.org/10.24869/psyd.2023.73 *Original paper*

A SCALE DEVELOPMENT STUDY: BRAIN FOG SCALE

Derya Atik & Ayşe İnel Manav

Osmaniye Korkut Ata University, Faculty of Health Sciences, Department of Nursing, Osmaniye, Turkey

received: 6.4.2022; revised: 27.6.2022; accepted: 27.7.2022

SUMMARY

Background: *This research was conducted to objectively evaluate the level of brain fog that may develop due to many reasons.*

Subjects and methods: *This was a methodological study. This study was conducted in Turkey. Content validity ratio, EFA, CFA, Kaiser-Meyer-Olkin analysis and Bartlett's test of sphericity, Item analysis, Cronbach's alpha coefficient, Spearman-Brown, Guttman Analysis and test-retest correlations validity-reliability analysis were performed. The statistical meaningfulness level in all tests was determined as p<0.05.*

Results: *As a result of context validity, factor analysis and item analysis, a 30 item scale with 3 subscale was obtained. The variance amount explained by the 3 subscale was on a very good level (77.43%). The fact that all of the Cronbach alpha, Spearman-Brown and Guttman internal consistency coefficients of the scale and all of its subscale are above 0.70. When the test retest reliability coefficients of the scale was examined, the scale was found to present consistent results in different applications and the scale was found to be reliable with regard to the constancy coefficient.*

Conclusion: *The Brain Fog Scale consists of 30 items and 3 subscales. It is a valid and reliable instrument.*

Key words: *brain-fog - factor analysis - validity/reliability of the scale*

* * * * *

INTRODUCTION

Brain fog is characterized by moments of cloudiness, a lack of focus and mental clarity, difficulty thinking and multitasking, and problems with attention, concentration, speech, organization, and short- and long-term memory (Theoharides et al. 2016, Lucius 2021, Kolb & Whishaw 2014). Brain fog involves fuzzy thinking, a state of confusion, and decreased mental sharpness (Lucius 2021, Kolb & Whishaw 2014). It is an altered state of consciousness in which one is less wakeful and less alert than usual (Kolb & Whishaw 2014). People with brain fog describe the condition as a thick fog through which they try to access their thoughts and memories. People with brain fog work more slowly and less efficiently than usual (Lucius 2021, Yelland 2017) and experience feelings of disappointment and inadequacy, school and work problems, accidents, unhappy relationships, loneliness, low self-esteem, and various psychosocial problems (Sowers et al. 2020, Kovalchuk & Kolb 2017, Ocon 2013).

Brain fog has many different causes, such as sodium, vitamin B12 deficiency, and iron deficiency, COVID-19 disease, Hepatitis C, end-stage renal disease, cirrhosis, chronic renal disease, depression, anxiety, multiple sclerosis, systemic lupus erythematosus, postural tachycardia syndrome (POTS), rheumatoid arthritis and neurosarcoidosis, celiac disease, allergies, increased stress, changing hormone levels and fatigue during pregnancy, sleeping pills, chemotherapy, dehydration, menopause, etc. (Theoharides et al. 2016, Lucius 2021, Reed et al. 2017, Ross et al. 2013, Wardill et al. 2016, Nordvig & Noble 2021). Brain fog is common in patients with autism spectrum disorders, chronic fatigue syndrome, POTS, and mild cognitive impairment, which is the early clinical picture of Alzheimer's disease (Lucius 2021, Reed et al. 2017, Ross et al. 2013). However, brain fog is seen in people of all ages (Theoharides et al. 2016, Lucius 2021).

Recent research has shown that COVID-19 disease affects the central nervous system. Researchers argue that COVID-19 infection causes neuronal dysfunction by changing brain functions related to the stimulated proinflammatory response and hypoxia. Severe mental and cognitive changes, including brain fog, are a long-term consequence of COVID-19 infection (Stefano et al. 2021, Boldrini et al. 2021, Theoharides et al. 2021). This development turns the COVID-19 into an important environmental variable that affects public mental health (Jun et al. 2021). The pandemic also has adverse economic, social, psychological, and physiological effects, increasing the prevalence of brain fog in society.

Brain fog is a multifactorial and common condition. Treatment focuses on preventing its causes. However, intravenous saline fluid therapy, stimulant drugs, or vitamin B12 are also used to relieve symptoms. Healthcare professionals also recommend some lifestyle changes, such as regular exercise, a healthy diet, regular sleep, and a reduction in the consumption of caffeinated beverages and alcohol (Lucius 2021, Theoharides et al. 2021, Moskalev et al. 2016, Wells et al. 2018, Theoharides 2021). However, it would be wise first to diagnose brain fog and identify its severity.

Although numerous factors cause brain fog, it has been more prevalent since the onset of the pandemic. Therefore, it has received a great deal of attention from researchers, who discuss it and define and control it.

Recently, brain fog has become a significant problem. However, it is often mistaken for different health problems. We should rule out other health problems to determine the presence and level of brain fog and implement the right interventions for its treatment and management in order to improve the quality of life of people who suffer from it. However, to our knowledge, there is no standard scale for assessing brain fog. Therefore, we aimed to develop a brain fog scale. We think that the scale will contribute to the literature.

METHODOLOGY

Research Type

This was a methodological study.

Research Setting and Date

This study was conducted between April and May 2021 in Osmaniye/Turkey.

Population and Sample

The study population consisted of all people living in Osmaniye/Turkey. A common rule of thumb for scale development is to have a sample size 5-10 times the number of items in the scale (Tavşancıl 2014, Büyüköztürk 2008). The ideal sample size was between 165 and 330 because the draft scale consisted of 33 items. The sample consisted of 386 participants recruited randomly from neighborhoods of different socioeconomic backgrounds to represent the population. Confirmatory Factor Analysis (CFA; n=200) and Exploratory Factor Analysis (EFA; n=186) were performed to improve validity and reduce bias.

The inclusion criteria were as follows:

- Above 18 years of age,
- No communication problems,
- Capable of answering all questions,
- Those who have COVID-19 at least three months ago,
- Without diagnosis of psychiatric disorder,
- Agreeing to participate.

Data Collection Tools

This paper focused on developing a Brain Fog Scale. The researchers first conducted a literature review and developed a pool of 33 items. They consulted an expert for the intelligibility and relevance of the items and then revised them based on feedback. They then moved onto the validity and reliability analysis.

The Brain Fog Scale (BFS) consisted of 33 items scored on a five-point Likert-type scale ("1=never," "2=sometimes," "3=undecided," "4=often," "5=always"). There were no reverse-scored items. The scale aimed to measure the level of brain fog in the last month. Higher scores indicated higher levels of brain fog.

Data collection and analysis

Prospective participants were informed of the research purpose, procedure, and expectations. Those who agreed to participate were included in the sample. Data collection took 15-20 minutes for each participant. The data were analyzed using the Statistical Package for the Social Sciences (SPSS, v. 21.0) and Analysis of Moment Structures (AMOS). In order to ensure data security and minimize researcher bias, people who were not involved in the study transferred the data to software programs, calculated the frequency values of the variables, and checked for errors in data entry. The researchers then conducted validity and reliability tests.

Factor analysis

EFA is used when no relationship is detected between scale items. CFA is used when items are loaded on factors (Büyüköztürk 2002, Kline 2010). Therefore, EFA is used to determine the latent structure for a set of variables (Brown 2006, Schumacker 2010). The data set for CFA should be different from that for EFA (Schumacker 2010). This allows us to confirm the validity of an EFA structure through CFA on a different dataset (Schumacker 2010). EFA has four criteria: each item should load on a relevant factor; each factor should have an eigenvalue of higher than 1; each item should have a factor loading of > 40; the Kaiser-Meyer-Olkin (KMO) should be higher than 0.60. The sufficiency of the sample is decided by checking the Kaiser-Meyer-Olkin (KMO) value. The closer the KMO is to 1, the more suitable the data is for factor analysis (Akgül 2005). The Bartlett's test is said to show whether the items in a scale are appropriate for factor analysis (Tavşancıl 2006). In single component scales, the stated variance rate is expected to be at least 30%, while this number is higher in multi component scales (Büyüköztürk 2008).

Confirmatory Factor Analysis is often used to test a model (hypothesis) in construct validity research (Kline 2010). Many fit indices are used to determine model adequacy. This study adopted the fit indices of chi-square goodness of fit (CSGF), the goodness of fit index (GFI), adjusted goodness of fit index (AGFI), comparative fit index (CFI), normed fit index (NFI), relative fit index (RFI), incremental fit index (IFI), and root mean square error of approximation (RMSEA). A $\chi 2/df$ below 2 indicates a good model fit. A GFI, CFI, NFI, RFI, IFI, and AGFI of 0.90 indicates an acceptable fit and that of 0.95 a perfect fit. An RMSEA of 0.08 indicates an acceptable fit, while an RMSEA of 0.05 indicates a perfect fit (Schumacker 2010).

Item Analysis

In item selection. the level of item total score correlations is an important criterion. The item total score correlation coefficient is accepted as at least 0.25. Items between 0.30 and 0.40 are stated to be "good" while items above 0.40 are stated to be discriminative on a "very good" level and thus. reliable. The reliabilities of items increase with increasing correlation coefficients (Polit & Beck 2010).

Internal consistency analysis (Cronbach Alpha)

In order to examine internal consistency between test scores. Cronbach Alpha reliability is calculated in the case of scale items having three or more answers. The reliability coefficient being 0.70 or above is sufficient for the reliability of test scores (Büyüköztürk 2008).

Split half test reliability

"Spearman-Brown correlation value and the Guttman Split-Half value". Reliability determination processes performed by splitting data collected by a measurement tool to two pieces of equal value and comparing the scores in these halves are called split half reliability tests. The more consistent the sores obtained from these two halves. the more reliable the measurement tool is (Yaman 2012).

The test-retest reliability analysis performed in order to demonstrate time constancy is applying the same scale under the same conditions to the same group with a certain time interval and checking the relationship between the measurements through the pearson moments multiplication correlation coefficient method. In this test it is suggested to have at least two and at most six weeks between the first and second test and to perform the test with at least 30 people. The obtained coefficient is accepted as the constancy indicator of the scale scores and is expected to be at least 0.70 (Aksayan et al. 2004).

Ethical Considerations

The research adhered to scientific and universal ethical principles (informed consent, autonomy, confidentiality, anonymity, fairness, and Do No Harm). The study was approved by the Science Scientific Research and Publication Ethics Committee of Osmaniye Korkut Ata University (Date: 09.04.2021- No: 2021/2/16).

RESULTS

Validity Analysis

Content and construct validity were used for the validity analysis of the Brain Fog Scale (BFS).

Content validity

Content validity was analyzed to determine (1) whether the BFS serves the purpose it is meant to serve, that is, whether it measures the construct it is designed to measure, (2) whether the measurement follows the rules, and (3) whether the data reflects the construct the scale intends to measure. Ten experts were consulted for content validity. An "Expert Evaluation Form" was developed and delivered by hand or email to the experts, who were then asked to rate each item as "*completely essential*," "*somewhat essential*," and "*not essential at all*." They were also asked to share their suggestions about the items. Lawshe's method was used to calculate the content validity ratio (CVR) of each item. The results were compared to minimum CVR values (Table 1).

Table 1. Lawshe's minimum content validity index

Number of Experts	Minimum CVR Value
9	0.75
10	*0.62*
11	0.59
12	0.56

$$CVR = 2N_e / N - 1;$$

N_e - the number of experts indicating "essential";
N - the total number of experts

A minimum CVR value by the number of experts also points to the statistical significance of an item. All items had a CVR of greater than 0.62. Two more items were added to the scale based on expert feedback. The final scale consisted of 35 items. Some items were reworded based on expert feedback.

Before moving on to construct validity, the researchers conducted a pilot study (n=30) to correct the spelling and grammatical errors and to improve the style and tone of the items. No modification was made to the items based on the results.

Construct validity

CFA and EFA were used for construct validity. Before factor analysis, the KMO analysis and Bartlett's test of sphericity for sampling adequacy were performed. The KMO was 0.925, for which Bartlett's test of sphericity was significant (χ^2=8349.352/595. p=0.000), indicating sampling adequacy and correlation between the items for factor analysis.

Principal components analysis and varimax rotation were used for EFA. Thirty items had a factor loading of higher than 0.40, ranging from 0.895 to 0.522 (Table 2).

The factor analysis yielded a three-factor structure (λ>1) that accounted for 77.437% of the total variance. The results showed that the Brain Fog Scale consisted of 30 items and three subscales.

The researchers took the content of the items into account and named the subscales accordingly. The first subscale consisted of items on cognitive symptoms, hence the name "cognitive symptoms." The second subscale consisted of items on physiological symptoms, hence the name "physiological symptoms." The third subscale consisted of items on psychological symptoms, hence the name "psychological symptoms."

Table 3 shows the CFA fit indices (n=186). The results showed that the model fit the data.

Reliability Analysis

Reliability was assessed using item analysis and Cronbach's alpha, Spearman-Brown, Guttman, and test-retest correlations.

Item analysis, Cronbach's alpha, Spearman-Brown, Guttman internal consistency coefficients

The 30-item BFS had an item-total correlation coefficient of 0.314 to 0.750, indicating a positive correlation between the items (p<0.001) (Table 4).

Table 2. Factor structure (n=200)

Items	Factor loading		
	1 Component	2 Components	3 Components
I am forgetful in daily activities	0.754		
I want to sleep more lately		0.831	
I have difficulty falling asleep			
I wake up tired		0.874	
I feel even more tired when I move		0.815	
I have difficulty collecting my thoughts	0.395*		
I feel like my thinking process slows down.	0.880		
I have difficulty focusing	0.398*		
I have difficulty finding the right words when talking	0.849		
I have difficulty understanding what other people say	0.867		
I am easily distracted	0.854		
I have difficulty concentrating	0.692		
I have difficulty multitasking		0.830	
I make unexpected mistakes while doing something		0.812	
I have difficulty learning new skills	0.895		
I have difficulty remembering a conversation I have had before	0.880		
I have difficulty remembering a picture I have seen before	0.874		
I have difficulty remembering things I have read before	0.877		
I do not enjoy doing things I have to do			0.522
I always feel tired		0.861	
I think I need more rest		0.351*	
I have difficulty making up my mind	0.832		
I have difficulty zeroing in on something	0.875		
I have difficulty planning	0.865		
I experience a feeling of uncertainty	0.840		
I feel detached			0.727
I am reluctant to communicate with others			0.861
I feel worried			0.681
I get angry quickly			0.394*
I have difficulty finishing what I start		0.809	
I have difficulty finding my stuff	0.849		
I feel less competent in managing everyday tasks		0.829	
I do not think I am energetic		0.836	
I have difficulty controlling my emotions			0.803
I give unexpected emotional reactions			0.378*

* p<0.001

Table 3. Fit indices

Fit Indices	Value	
χ^2 (df) (CMIN/DF)	2.03	p≤0.00
GFI	0.87	
CFI	0.96	
AGFI	0.91	
RMSEA	0.07	
NFI	0.91	
IFI	0.90	
RFI	0.91	

The scale had a Cronbach's alpha coefficient of 0.945, a Spearman-Brown coefficient of 0.884, and a Guttman Split-Half coefficient of 0.874 (Table 4).

The "cognitive symptoms" subscale had an item-total correlation coefficient of 0.453 to 0.748 (internal consistency coefficients; Cronbach's alpha: 0.899; Spearman-Brown: 0.870, Guttman: 0.869). The "physical symptoms" subscale had an item-total correlation coefficient of 0.454 to 0.648 (internal consistency coefficients; Cronbach's alpha: 0.838, Spearman-Brown: 0.807, Guttman: 0.807). The "psychological symptoms" subscale had an item-total correlation coefficient of 0.438 to 0.716 (internal consistency coefficients; Cronbach's alpha: 0.837, Spearman-Brown: 0.841, Guttman: 0.819). These results indicated a positive correlation between the items (p<0.001) (Table 5).

Time constancy analysis

External reliability was assessed using a test-retest method. A sample of 30 took the test twice at a 30-day interval. The results pointed to positive correlation between the two measurements (r=952, p<0.001).

Table 4. Item analysis results pertaining to the whole of the BFS and internal consistency coefficients (n=386)

Item	Item total correlation*	Cronbach alpha if item deleted
I am forgetful in daily activities	0.462	0.944
I want to sleep more lately	0.444	0.944
I have difficulty falling asleep	0.314	0.946
I wake up tired	0.531	0.943
I feel even more tired when I move	0.492	0.944
I feel like my thinking process slows down	0.683	0.942
I have difficulty finding the right words when talking	0.608	0.943
I have difficulty understanding what other people say	0.519	0.943
I am easily distracted	0.594	0.943
I have difficulty concentrating	0.665	0.942
I have difficulty multitasking.	0.586	0.943
I make unexpected mistakes while doing something.	0.551	0.943
I have difficulty learning new skills.	0.553	0.943
I have difficulty remembering a conversation I have had before.	0.527	0.943
I have difficulty remembering a picture I have seen before.	0.459	0.944
I have difficulty remembering things I have read before.	0.498	0.944
I do not enjoy doing things I have to do.	0.517	0.943
I always feel tired.	0.607	0.943
I have difficulty making up my mind.	0.691	0.942
I have difficulty zeroing in on something.	0.750	0.941
I have difficulty planning.	0.667	0.942
I experience a feeling of uncertainty.	0.690	0.942
I feel detached.	0.638	0.942
I am reluctant to communicate with others.	0.636	0.942
I feel worried.	0.707	0.941
I have difficulty finishing what I start.	0.643	0.942
I have difficulty finding my stuff.	0.571	0.943
I feel less competent in managing everyday tasks.	0.647	0.942
I do not think I am energetic.	0.632	0.942
I have difficulty controlling my emotions.	0.644	0.942
Internal consistency coefficients: Cronbach alfa - 0.945; Spearman-Brown - 0.884; Guttman* 0.874*		

* p<0.001

DISCUSSION

The COVID-19 pandemic poses a long-lasting challenge, which not only impacts the cardiopulmonary system but links systemic infection to psychiatric disorders (Yanfei et al. 2021). The Brain Fog Scale was developed to evaluate the brain fog level in the general population. There are many triggers and modulators explaining the physiology of brain fog, and there are many methods to treat it. Brain fog is regarded as a cognitive complaint similar to mental fatigue, but it also has physiological and psychological identifiers (Ross et al. 2013). However, anyone can experience different symptoms of brain fog.

Brain fog has been a more severe and prevalent problem since the onset of the pandemic. To develop the BFS, we recruited people going through the pandemic because we thought it would reveal more effective markers.

We developed a 35-item draft scale based on a literature review and expert feedback. However, we removed five items because they had low factor loadings. The remaining 30 items were loaded on three subscales, which were named “cognitive symptoms,” “physiological symptoms,” and “psychological symptoms.” The CFA fit indices were good. The reliability analysis showed that the total scale and subscales had acceptable internal consistency and item-total score correlations. The same scale was administered to a sample of 30 twice with a 30-day interval to assess external reliability. The results indicated a strong and positive correlation between the two measurements.

To our knowledge, there is no similar scale assessing brain fog in the general population. It was only the Mental Clutter Scale developed by Leavitt and Katz (2011) on individuals with fibromyalgia. The scale has a Cronbach’s alpha of 0.95. It consists of eight items and two subscales: cognition and mental clarity.

Brain fog is caused by many factors. However, after we rule out medical causes, we can use the BFS to identify brain fog and plan and implement the necessary interventions for treatment.

Table 5. Item analysis results pertaining to the subscale of the BFS and internal consistency coefficients (n=386)

Item	Item total correlation*	Cronbach alpha if item deleted	Internal consistency coefficients
Cognitive Symptoms Subscale			
I am forgetful in daily activities	0.453	0.897	Cronbach alfa 0.899
I feel like my thinking process slows down	0.671	0.888	Spearman-Brown* 0.870
I have difficulty finding the right words when talking	0.623	0.890	
I have difficulty understanding what other people say	0.540	0.894	Guttman* 0.869
I am easily distracted	0.571	0.892	
I have difficulty concentrating	0.598	0.889	
I have difficulty learning new skills	0.573	0.892	
I have difficulty remembering a conversation I have had before	0.595	0.891	
I have difficulty remembering a picture I have seen before	0.506	0.895	
I have difficulty remembering things I have read before	0.517	0.895	
I have difficulty making up my mind	0.665	0.888	
I have difficulty zeroing in on something	0.748	0.885	
I have difficulty planning	0.666	0.888	
I have difficulty finding my stuff	0.505	0.895	
I have difficulty multitasking	0.476	0.896	
I make unexpected mistakes while doing something	0.506	0.895	
I experience a feeling of uncertainty	0.603	0.891	
Physiological Symptoms Subscale			
I want to sleep more lately	0.454	0.832	Cronbach alfa 0.838
I have difficulty falling asleep	0.554	0.821	Spearman-Brown* 0.807
I wake up tired	0.462	0.863	
I feel even more tired when I move	0.481	0.830	Guttman* 0.807
I always feel tired	0.636	0.812	
I have difficulty finishing what I start	0.607	0.815	
I feel less competent in managing everyday tasks	0.648	0.810	
I do not think I am energetic	0.604	0.815	
Psychological Symptoms Subscale			
I do not enjoy doing things I have to do	0.438	0.855	Cronbach alfa 0.837
I feel detached	0.701	0.787	Spearman-Brown* 0.841
I am reluctant to communicate with others	0.716	0.782	
I feel worried	0.703	0.787	Guttman* 0.819
I have difficulty controlling my emotions	0.647	0.802	
Internal consistency coefficients: Cronbach alfa - 0.945; Spearman-Brown - 0.884; Guttman* 0.874*			

* p<0.001

CONCLUSION

The Brain Fog Scale consists of 30 items and three subscales. It is a valid and reliable instrument that is appropriate for Turkish society. It can be used to determine the level of brain fog in the last 30 days. The total score ranges from 30 to 150 ("cognitive symptoms" from 17 to 85; "physiological symptoms" from 8 to 40; "psychological symptoms" from 5 to 25). Higher scores indicate higher levels of brain fog.

Brain fog which arises due to many reasons, has started to be discussed more with COVID-19. The brain fog scale will provide a more objective assessment of this situation, which affects people's quality of life in various dimensions.

Acknowledgements: None.

Conflict of interest: None.

Contribution of individual authors:

Derya Atik: conceptualization, data curation, methodology, resources, software, writing-review and editing.

Ayşe İnel Manav: formal analysis, investigation, writing-review and editing.

References

1. *Akgül A: Statistical analysis techniques in medical research "spss applications". 3th ed. Ankara: Emek Ofset, 2005*
2. *Aksayan S, Bahar Z, Bayık A, Emiroğlu O, Görak G: Research in nursing Policy processes and Methods. 3. Printing, İstanbul, 2004*
3. *Boldrini M, Canoll PD, Klein RS: How COVID-19 affects the brain. JAMA Psychiatry, 2021. doi:10.1001/jamapsychiatry.2021.0500*
4. *Brown TA: Confirmatory factor analysis for applied research. New York, NY: Guilford Press, 2006*
5. *Büyüköztürk Ş: Data analysis hand book. 9. Edition, Ankara: Pegem Akademi, 2008*

6. *Büyüköztürk Ş: Factor analysis: Basic concepts and its use in scale development. Educational Methods in Theory and Practice 2002;32:470-483*
7. *Jun C, Guoqiang S, Yu Z, Aifeng J: Intervention Effect of The Integration Model On Negative Emotions Of Adolescents During The Outbreak Of Corona Virus Disease 2019. Psychiatr Danub 2021; 33:86-94*
8. *Kolb B, Whishaw IQ: An Introduction to Brain and Behavior. New York, NY: Worth Publishers, 2014*
9. *Kline RB: Principles and Practice of Structural Equation Modeling. 3th ed. Pp 230-262. Guilford Press, New York, 2010*
10. *Kovalchuk A, Kolb B: Chemo brain: From discerning mechanisms to lifting the brain fog - An aging connection. Cell Cycle 2017; 16;1345-1349*
11. *Leavitt F, Robert SK: Development of the mental clutter scale. Psychological reports 2011; 109:445-452*
12. *Lucius K: "Brain Fog": Exploring a symptom commonly encountered in clinical practice. Alternative and Complementary Therapies 2021; 27:23-30*
13. *Moskalev A, Chernyagina E, Magalhaes JP, et al: Geroprotectors.org: A new, structured and curated database of current therapeutic interventions in aging and age-related disease. Aging 2016; 7:616-628*
14. *Nordvig A, Noble J: Post-COVID brain fog: A Patient registry and cross-disciplinary approach to characterization, treatment, and etiology. Neurology 2021; 96:4288*
15. *Ocon AJ: Caught in the thickness of brain fog: Exploring the cognitive symptoms of Chronic Fatigue Syndrome. Front. Physiol 2013; 4:63*
16. *Polit DF, Beck CT: Essentials of nursing research: Appraising evidence for nursing practice. Wolters Kluwer& Lippincott Williams& Wilkins, Philadelphia, 2010*
17. *Reed G, Harrold L, Pala O, et al: The impact of disease activity on patient reported cognitive dysfunction ("brain fog") in rheumatoid arthritis. Annals of the Rheumatic Diseases 2017; 76:808*
18. *Ross AJ, Meadow MS, Rowe PC, Stewart JM: What is brain fog? An evaluation of the symptom in postural tachycardia syndrome. Clinical Autonomic Research 2013; 23:305–311*
19. *Schumacker RE, Lomax RG: A Beginner's Guide to Structural Equation Modeling (3rd ed.). Routledge, New York, NY, 2010*
20. *Sowers KL, Gayda-Chelder CA, Galantino ML: Self-reported cognitive impairment in individuals with primary immunodeficiency. Disease, Brain, Behavior, & Immunity - Health 2020. doi: 10.1016/j.bbih.2020.100170*
21. *Stefano GB, Ptacek R, Ptackova H, Martin A, Kream RM: Selective neuronal mitochondrial targeting in SARS-CoV-2 ınfection affects cognitive processes to induce 'Brain Fog' and results in behavioral changes that favor viral survival. Medical science monitor: International Medical Journal of Experimental and Clinical Research 2021; 27:e930886*
22. *Tavşancıl E: Measuring Attitudes and Data Analysis with SPSS. Nobel Academic Publishing, Ankara, 2014*
23. *Tavşancıl E: Measurement and analysis of the data with SPSS transforming attitudes. 3. Printing, The Nobel Medicine Bookstores, İstanbul, 2006*
24. *Theoharides TC: Luteolin: The wonder flavonoid, BioFactors 2021; 47:139-140*
25. *Theoharides TC, Cholevas C, Polyzoidis K, Politis A: Long-COVID syndrome-associated brain fog and chemofog: Luteolin to the rescue. BioFactors 2021; 47:232-241*
26. *Theoharides CT, Stewart JM, Panagiotidou S, Melamed I: Mast cells, brain inflammation and autism. European Journal of Pharmacology 2016; 778:96-102*
27. *Wardill HR, Mander KA, Van Sebille YZ, Gibson RJ, Logan RM, Bowen JM, Sonis ST: Cytokine-mediated blood brain barrier disruption as a conduit for cancer/ chemotherapy-associated neurotoxicity and cognitive dysfunction. Int J Cancer 2016; 139:2635-2645*
28. *Wells R, Elliott AD, Mahajan R, et al: Efficacy of therapies for postural tachycardia syndrome: A systematic review and meta-analysis. Mayo Clin Proc 2018; 93: 1043-1053*
29. *Yaman S: Basic characteristics of measuring Tools: validity, Reliability and Usability. In: Küçük M, Geçit Y. (ed.), Assessment and evaluation in education. The Nobel Medicine Bookstores, Ankara, 2012*
30. *Yanfei H, Ran Y, Junlin R: The Correlation Between Psychiatric Disorders and Covid-19: A Narrative Review. Psychiatr Danub 2021; 33:76-85*
31. *Yelland GW: Gluten-induced cognitive impairment ("brain fog") in coeliac disease. J Gastroenterol Hepatol 2017; 1:90-93. PMID:28244662. doi:10.1111/jgh.13706*

Correspondence:
Derya Atik, PhD
Osmaniye Korkut Ata University, Faculty of Health Sciences, Department of Nursing
Osmaniye, Turkey
E-mail: deryaatik09@hotmail.com