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Original Article

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Relationship Between Mental Workload and Cognitive Function in the Academic Staff of Shahid Sadoughi University of Medical Sciences, Yazd, Iran, 2022

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Abstract

Background: Academic staff have different roles which may impose a high mental workolad on them and affect their cognitive function. This study was designed to assess different subscales of mental worklaod and cognitive function in university academic staff.

Methods: This was a cross-sectional study on 86 faculty members of Shahid Sadoughi University of Medical Sciences. Stratified sampling was used to select participants from different schools. The participants were divided into basic sciences and clinical faculty members. Mental workload was assessed by National Aeronautics and Space Administration-Task Load Index (NASA-TLX). Cognitive function was assessed by Stroop test. Data were analyzed by SPSS 26 using Shapiro-Wilks test, Student's T-test, Mann Whitney U test, univariate ANOVA, and Kruskal-Wallis test. The level of significance was 0.05.

Results: Mean age and work history of the participants was 43.6±8.6 yr. and 11.7±9.1 yr., respectively. Mental workload, especially two aspects of mental demand and performance, was high and it was significantly higher in the participants from school of medicine and among those with executive/administrative responsibilities. From subscales of mental workload, physical demand was significantly higher among clinical than basic sciences faculty members ($p<0.05$). Among different aspects of cognitive function, only numbers of congruent errors were significantly higher among clinical faculties. Mental workload and cognitive function were not significantly correlated.

Conclusion: This study showed a high level of mental workload in university academic staff, especially in clinical faculty members, but this high mental workload did not affect their cognitive function.

Keywords: Attention, Cognition, Faculty, Memory, Stroop test

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Introduction

Different tasks have been defined for university academic staff which should be done in a demanding environment. Studies have shown that a considerable number of university employees have problem with their workload (1). Many faculty members have prolonged work time and working overtime at home for completing their various roles (2), which may affect their health, especially mental health and cognitive function (3). Faculty members in the medical universities in our country have different responsibilities, including teaching, research, and counseling along with some executive and administrative tasks. In our country, health services have been combined with medical education in the ministry of health and medical education, thus clinical faculty members in medicine, dentistry and nursing faculties have the responsibility of patients' medical care in university hospitals as well.

Different variables, such as social and economic factors, frequent changes in rules and regulations of faculty improvement, and introducing new roles may impose an extra mental load to faculty members which may affect their workload and cognitive function. Besides, rewarding and improvement mostly for research activities and publications, not for teaching effectiveness, is also a concern for many faculties (4). Workload is a complex and multi-dimensional issue which consists of physical and mental loads (5). When the usual task of an employee is complex and needs concentration, mental workload increases (6,7). Nowadays, due to new technologies, cognitive and mental demands of jobs have increased which imposes a high mental workload to the individuals. Mental workload is among the most effective factors on behavior, performance and productivity of workforce (8,9). Studies have demonstrated that high mental workload leads to mental fatigue, reduced efficiency and performance, and disturbance of mental processing which eventually may increase human errors (10,11). Mental fatigue is usually caused by depletion of cognitive energy. Some factors in the workplace may increase mental workload, naming some of them: increased working hours, critical responsibilities, deadline and emergency decision making, shift work, type of employment, task difficulty and time pressure (9,12-14).

Many researchers have assessed mental workload in different jobs. High mental workload in faculty members, surgeons, nurses and teachers has been shown (11,12,14-16). Fan J *et al* in a large study on different jobs found that workload increases fatigue and affects worker's performance (17). Ghasemi *et al* in a study on nurses found a positive correlation between workload and emotional fatigue which did not affect individual's peroformance (14). It is also proved that mental workload may affect quality of life (18).

Cognitive functions are mental processes such as working memory, perception, attention, data processing, *etc*. which can improve individual's performance, especially when the task needs urgent and exact response (7,19,20). Improved cognitive function, considering human cognitive capabilities and limitations, can reduce human errors (21).

The association between mental workload and cognitive function is important for job performance and safety. Therefore, mental workload and cognitive capabilities are probably inter-related. A person with a high cognitive function can probably tolerate a higher mental workload, and conversely a high mental workload may negatively affect an employee's cognitive function.

Several studies have shown a difference in workloads between various employees in the universities (22,23). Hence, this study was conducted to assess different subscales of mental workload in faculty members and its association with their cognitive function.

Materials and Methods

This was a cross-sectional study on 86 faculty members of Shahid Sadoughi University of Medical Sciences. At first, faculty members were devided into two strata, *i.e.*, basic sciences and clinical faculties, and stratified sampling was used to select participants from each stratum. Then simple random sampling was used to select the participants by random digits Table. Inclusion criterion was at least one year experience of working as a faculty member. Those with documented psychiatric and sleep disorders were excluded from the study. The participants were selected from medicine, pharmacy, dentistry, public health, nursing and paramedicine schools.

Data collection

Demographic data including age, gender, level of education, academic degree, school, employment status, work history, and working hours per day were collected using a researcher-made questionnaire.

Mental work load assessment

Mental workload was assessed by NASA-TLX (National Aeronautics and Space Administration -Task Load Index) which is a subjective tool and determines mental workload imposed to the individual by different tasks (2,24). Validity and reliability of this questionnaire was confirmed in previous studies on Iranian population (25). NASA-TLX consists of two parts: the first part includes six subscales (mental demand, physical demand, temporal demand, performance, effort, and frustration).

The participants should rate themselves in each subscale in 5-point steps from very low to very high and the last score is between 0 and 100. Interpretation of the results is as the following: Low: 0-9, Medium: 10-29, Somewhat high: 30-49, High: 50-79, and Very high 80-100 (25).

The second part includes pairwise comparison of the subscales, so as the participant compares two subscales and weighs the subscale which is more relevant to his (her) workload and scores it from 0 to 15. The total mental workload score is calculated by multiplying this weighting score by the subscale score divided by 15, and scores higher than 50 are acceptable.

Cognitive function assessment

Cognitive function was assessed by Stroop test. Stroop color–word test was developed in 1935 for the assessment of interference effect. It is used to assess selective attention and response time (26). It has a preparatory stage and the main test. In order to reduce the test time and learning effect, preparatory stages that had no effect on the results were omitted in this study and only the main stage was performed. In this test, four words (green, blue, red, and yellow) are displayed on the monitor screen for 2 seconds with a time interval of 0.008 seconds. 48 words with congruent color (*e.g.*, blue with blue color) and 48 words with incongruent color (*e.g.*, blue with red color) are displayed. The individual who is tested should respond to the color of the stimuli regardless of its meaning and press the specified button on the keyboard.

Attention is calculated by computing the interference score, which is obtained by subtracting the number of correct incongruent word-color responses from correct congruent word-color responses, and the response time is calculated by the interference time, which is obtained by subtracting the response time to incongruent from congruent word-color items.

Statistical analysis

Data were analyzed by SPSS 26 (IBM Corp., Armonk, New York, USA). Mean (SD), frequency (percent) and median [Interquartile Range (IQR)] were used to summarize data. Shapiro-Wilks test was used to check normal distribution. To compare mental workload score, cognitive function and test time based on categorical demographic variables such as gender, Student's T-test, Mann Whitney U test, univariate ANOVA, and Kruskal-Wallis test were used. The level of significance was considered 0.05. Student's T-test was also used to compare the mean score of different aspects of cognitive function between clinical and basic sciences' faculty members, and Pearson's correlation coefficient was utilized to calculate the correlation between the mental workload score and score of cognitive function.

Ethical Considerations

The study was the result of a master's thesis in occupational health and was approved by ethics committee of Shahid Sadoughi University of Medical Sciences (code: IR.SSU.SPH.REC.1399.112). An informed consent was obtained from all the participants.

Results

Totally, 86 faculty members from six schools of Shahid Sadoughi University of Medical Sciences entered the study. Mean age and work history of the participants was 43.6±8.6 yr. and 11.7±9.1 yr., respectively. Table 1 shows demographic information of the participants.

Mental workload and its aspects followed a normal distribution ($p>0.05$), but cognitive function and its aspects showed a non-normal distribution.

Table 1. Demographic information of the faculty members (n= 86)

Variable	Frequency	Percent
Faculty		
Medicine	44	51.2
Dentistry	11	12.8
Pharmacy	7	8.1
Paramedicine	5	5.8
Public health	15	17.4
Nursing	4	4.7
Employment		
Temporary contracts	30	34.9
Permanent and official contracts	56	65.1
Education		
Ph.D. and specialist	70	81.4
Subspecialist	16	18.6
Age (yr)		
29-40	37	43
41-52	31	36
53-64	18	21
Gender		
Male	49	57
Female	37	43
Marital status		
Married	75	87.2
Single	11	12.8
Academic degree		
Lecturer	1	1.2
Assistant professor	49	57
Associate professor	26	30.2
Professor	10	11.6
Administrative tasks		
Yes	48	55.8
No	38	44.2
Work history		
≤10	51	59.3
11-20	15	17.4
≤21	20	23.3
Discipline		
Clinical	40	46.5
Basic sciences	46	53.5
Mean working time (h/week)		
24-57	77	89.5
58-91	8	9.3
92-124	1	1.2

Demographic variables did not affect cognitive function, but the school and having administrative and executive tasks significantly affected mental workload.

Table 2 demonstrates mean mental workload and cognitive function of the faculty members according to the demographic variables.

Mean total score of workload was high (71.5) in all the participants. The highest score was observed in mental workload (78.66) followed by performance (75.58) and temporal demand (73.02), and the lowest score was observed in frustration aspect (48.90) followed by physical demand (55.7). Mean score of all the subscales of mental workload except for temporal demand was higher in clinical faculty members, although only the difference in physical demands was statistically significant. Figure 1 shows different subscales of mental workload in faculty members and compares them between clinical and basic sciences faculty members.

Gender, age, education, and discipline did not significantly affect different aspects of cognitive function ($p>0.05$). Table 3 compares the score of different aspects of cognitive function between clinical and basic sciences' faculty members.

There was no correlation between mental workload score and score of cognitive function ($r= -0.066$, p-value = 0.549).

Discussion

In this study, mental workload and cognitive function of faculty members were evaluated using NASA-TLX and Stroop test. Mental workload, especially mental demand and performance, was high and it was significantly higher in participants from school of medicine and among those with executive/ administrative responsibilities. From subscales of mental workload, physical demand was significantly higher among clinical academic staff than basic sciences faculty members. Among different aspects of cognitive function, only numbers of congruent errors were significantly higher among clinical faculties. Cognitive function score was lower in basic sciences faculties. Mental workload and cognitive function were not significantly correlated in faculty members. Previous studies have assessed mental workload in different occupations, especially teachers and nurses

Table 2. Mean mental workload and cognitive function of the faculty members according to the demographic variables

Variable	Categories	Mental workload score		Cognitive function		Cognitive function test time	
		Mean±SD	p-value*	Median (IQR**)	p-value***	Median (IQR)	p-value***
Age	29-40 41-52 53-64	69.32±12.17 72.89±10.10 73.57±13.07	0.312	0.00 (1) 0.00 (1) 1 (2)	0.167	38 (40) 41 (75) 69 (74)	0.196
Gender	Male Female	71.75±12.32 71.16±10.96	0.820	0.00 (1) 0.00 (1)	0.322	50 (68) 37(56)	0.466
Work history (yr)	≥10 11-20 ≥21	62.21±10.59 74.51±13.45 75.08±12.17	0.088	0.00 (1) 0.00 (1) 1 (2)	0.467	38 (52) 64 (76) 41 (81)	0.077
Education	PhD and specialist Subspecialist	70.21±11.29 77.12±11.22	0.419	0.00 (1) 0.50 (1)	0.255	44.5 (54) 48 (77)	0.681
Faculty	Medicine Dentistry Pharmacy Paramedicine Public health Nursing	74.51±10.72 61.51±7.68 66.95±14.54 74.2±14.58 69.91±11.93 35.7±33.76	0.017	0.00 (1) 0.00 (1) 0.00 (1) 0.00 (1) 1 (2) 0.00 (2)	0.750	39 (69) 45 (90) 74 (145) 69 (46) 46 (39) 33.5 (102)	0.750
Academic degree	Lecturer Assistant prof. Associate prof. Professor	96.00±0.00 70.15±11.85 74.13±10.71 68.83±1087	0.073	- 0.00 (1) 0.00 (1) 0.50 (3)	0.853	- 40 (66) 44.5 (45) 75 (99)	0.723
Executive tasks	Yes No	74.58±11.37 67.6±11.03	0.005	0.00 (1) 0.00 (1)	0.483	40.5 (55) 45.5 (72)	0.657
Discipline	Clinical Basic sciences	72.6±12.45 70.54±11.03	0.419	0.00 (1) 0.00 (1)	0.439	52 (74) 40.5 (52)	0.439
Working time (h/week)	24-57 58-91	70.94±11.35 76.71±15.02	0.419	0.00 (1) 1.00 (2)	0.922	45 (64) 40.5 (66)	0.922

*Parametric test: Student's t-test, ANOVA. ** IQR: Interquartile range. *** Non-parameric test: Mann Whitney U test, Kruskal-Wallis test.

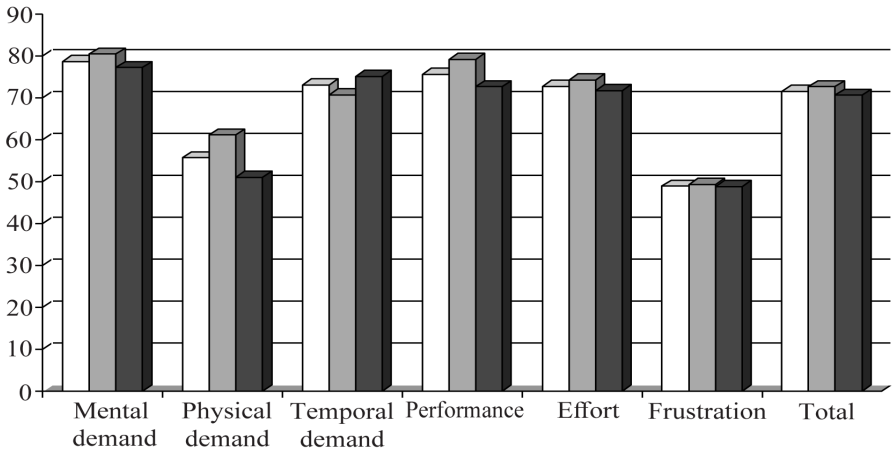

Figure 1. Frequency of different subscales of mental workload among all (white column), clinical (gray column) and basic sciences (black column) faculty members.

Table 3. Comparison of median (interquartile range) of different aspects of cognitive function between clinical and basic sciences faculty members

Variables	Median (IQR*)		Test statistic**	p-value
	Clinical faculty members	Basic sciences faculty members		
Cognitive function test result	0.00 (1)	0.00 (1)	838.5	0.439
Test duration	52 (74)	40.5 (52)	870.5	0.688
Congruent response time	47.5 (10)	49 (6)	873	0.673
Number of congruent errors	0.00 (0)	0.00 (0)	802	0.031
Number of unresponded congruent items	0.00 (1)	0.00 (0)	872.5	0.582
Number of correct congruent responses	48 (1)	48 (0)	799.5	0.184
Total congruent response time	984 (199)	1024.5 (135)	862	0.616
Incongruent response time	51 (14)	50.5 (8)	904.5	0.893
Number of incongruent errors	0.00 (0)	0.00 (0)	909.5	0.893
Number of unresponded incongruent items	0.00 (1)	0.00 (1)	796.5	0.197
Number of correct incongruent responses	48 (2)	48 (1)	822.5	0.350
Total incongruent response time	1066 (255)	1050.5 (161)	920	0.990

* IQR: Interquartile range. ** Mann-Whitney U test statistics and p-value.

(12,14,27). We found few studies assessing mental workload in faculty members (15,23). In the current study, overall mental demand was high in faculty members which was consistent with the results of Zamanian *et al*'s study on faculty members (15) and Malekpour *et al* on teachers (12), and among subscales of workload, mental load had the highest score, frustration the lowest score, and clinical faculties had a significantly higher physical demand than their basic sciences counterparts. Kalantari *et al* found that clinical employees had the highest workload in comparison to office and service workers (28), which was consistent with the results of the present study.

Studies have shown that mental workload conversely affects physical capacity and performance (17,29). Previous studies have represented a positive correlation between working hours in the week and increased mental workload (30,31), which was inconsistent with the results of the current study. This can be explained by fluctuating working hours of the faculty members which is affected by time of the year (beginning or end of the semester), and some other factors.

In the current study, mental workload increased by increasing age and work experience, although the effect was not statistically significant, which was consistent with the results of Mohammadian *et al*'s study (31), but Xiao *et al* found a significant correlation between age and mental workload among teachers (32).

One of the most important factors which had a significant impact on mental workload was having executive responsibilities. Most of the faculties with executive responsibilities were basic sciences academics, but when comparing clinical faculty members (with less executive tasks), and higher, though not significant, it can be concluded that mental workload should be much higher in clinical faculty members regardless of executive or administrative tasks, since in addition to teaching, they have the responsibility of medical care in the university hospitals as well, and some of them work in private hospitals or their private offices in their free times, which may impose an additional mental and physical workload on them. However, their cognitive function was not lower than basic sciences faculty members, except for numbers of congruent errors.

In the current study, mental workload was higher

in subspecialists than specialists and PhD faculty members, which can be explained by this fact that all the subspecialists were clinical faculty members with a high responsibility of medical care in the hospitals, although Mohammadian *et al* and Malekpour *et al* found no significant effect for education level on mental workload of the teachers (12,31).

In the current study, mental workload was not different between two genders, which was inconsistent with the results of Malekpour at al., Mohammadian *et al*, and Xiao *et al* on teachers who found a higher mental workload in female teachers (12,31,32).

Cognitive function consists of different domains of memory, attention, executive functions and language (33). Stroop test is a short psychologic test which evaluates cognitive interference (26). In this study, mean score of cognitive function was not different regarding age, education, and gender. Previous studies have demonstrated that gender does not affect cognitive function (34,35), but some studies have shown that increasing age may negatively affect cognitive function (35,36); although in the current study, the participants were faculty members with a probably high level of cognitive function.

This study had some limitations. In this study, only Stroop test was used to assess cognitive function, thus some aspects of cognition such as working memory were not assessed. It was not possible to perform test in the same day of the week for all the participants, so it may have affected the results.

Conclusion

This study indicated a high level of mental workload in university academic staff, especially in clinical faculty members, but this high mental workload did not affect their cognitive function. It is recommended to perform studies with a higher sample size and assess all aspects of cognitive function.

Conflict of Interest

There is no conflict of interest.

References

1. Kinman G, Jones F. 'Running up the down escalator': stressors and strains in UK academics. QHE 2003;9(1):21–38.

2. Arellano J, Martinez J, Perez J, Alcaraz J. Relationship between workload and fatigue among Mexican assembly operators. Int J Phys Med Rehabil 2015; 3(6):1-6.

3. Donders NCGM, van der Gulden JWJ, Furer JW, Tax B, Roscam Abbing EW. Work stress and health effects among university personnel. Int Arch Occup Environ Health 2003; 76(8):605–613.

4. Leslie DW. Resolving the dispute: teaching is academe's core value. J Higher Educ 2002;73(1): 49-73.

5. Estes S. The workload curve: subjective mental workload. Hum Factors 2015; 57(7):1174-87.

6. Ryu K, Myung R. Evaluation of mental workload with a combined measure based on physiological indices during a dual task of tracking and mental arithmetic. Int J Ind Ergonomics 2005;35(11):991-1009.

7. Vidulich MA, Tsang PS. The confluence of situation awareness and mental workload for adaptable human–machine systems. J Cogn Eng Decis Mak 2015;9(1):95-7.

8. Michalski R, Jach K. The subjective analysis of the main workload dimensions in the company from the transportation industry. 1st Int Conf Hum Factor Sustainable Infrastructure 2014;2:63.

9. Galy E, Cariou M, Mélan C. What is the relationship between mental workload factors and cognitive load types? Int J Psychophysiol 2012;83(3):269-75.

10. Biebuyck JF, Weinger MB, Englund CE. Ergonomic and human factors affecting anesthetic vigilance and monitoring performance in the operating room environment. Anesthesiology 1990;73(5):995-1021.

11. Ardestani-Rostami R, Ghasembaglu A, Bahadori M. Evaluation of workload and performance of nurses in ICUs

of teaching hospitals of Tehran. S J Nursing Midwifery Paramed Faculty 2019;4(3):63–71.

12. Malekpour F, Mehran G, Mohammadian Y, Malekpour A, Mirzaee V. [Assessment of mental workload in teachers of Hashtrud City using NASA-TLX mental workload index.] Pejouhandeh 2014;19(3):161–5. Persian.

13. Sarsangi V, Saberi H, Hannani M, Honarjoo F, Salim Abadi M, Goroohi M, et al. [Mental workload and its affected factors among nurses in Kashan province during 2014.] JRUMS 2015;14(1):25-36. Persian.

14. Ghasemi MS, Valizadeh N, Dehghan N, Shalbafan MR. Workload and burnout among nurses of a public referral psychiatric hospital in Tehran, Iran: a cross-sectional study. J Iran Med Counc 2022;5(3):363-70.

15. Zamanian Z, Roshan Sarvestani M, Sedaghati M, Ghatmiri M, Kouhnavard B. Assessment of the relation between subjective workload and job satisfaction in university faculty and staff. Iran J Ergon 2016;3(4):1-10.

16. Zheng B, Jiang X, Tien G, Meneghetti A, Panton ONM, Atkins MS. Workload assessment of surgeons: correlation between NASA TLX and blinks. Surg Endosc 2012;26(10):2746-50.

17. Fan J, Smith AP. Human Mental Workload: Models and Applications. Springer; 2019. Mental workload and other causes of different types of fatigue in rail staff; p. 147-59.

18. Zakerian SA, Abbasinia M, Mohammadian F, Fathi A, Rahmani A, Ahmadnezhad I, et al. The relationship between workload and quality of life among hospital staffs. J Ergon 2013;1(1):43-56.

19. Hart SG, Staveland LE. Development of NASA-TLX (Task Load Index): results of empirical and theoretical research. Adv Cogn Psychol 1988; 52:139-83.

20. Cabeza R, Nyberg L. Imaging cognition II: An empirical review of 275 PET and fMRI studies. J Cogn Neurosci 2000;12(1):1-47.

21. Hollnagel E. Cognitive ergonomics: it's all in the mind, Ergonomics 1997;40(10):1170-82.

22. Gillespie NA, Walsh M, Winefield AH, Dua J, Stough C. Occupational stress in universities: staff perceptions of the causes, consequences and moderators of stress. Work Stress 2001;15(1):53–72.

23. Houston D, Meyer LH, Paewai S. Academic staff workloads and job satisfaction: expectations and values in academe. J Higher Educ Pol Manag 2006;28(1):17–30.

24. Young G, Zavelina L, Hooper V. Assessment of workload using NASA Task Load Index in perianesthesia nursing. J Perianesth Nurs 2008;23(2):102-10.

25. Mazloumi A, Kazemi Z, Eivazlou M. [Validation and reliability study of Farsi version of work ability index questionnaire.] J Public Health Res 2014;12(1):61-74. Persian.

26. Scarpina F and Tagini S. The stroop color and word test. Front Psychol 2017;8:557.

27. Malekpour F. Assessment of relationship between quality of life and mental workload among nutses of Urmia Medical Sciences University hospitals. Nurs Midwifery J 2014; 12(6):499-505.

28. Kalantari R, Zamanian Z, Kamrani M, Bakhshi E, Rostami M, Mortazavi Mehrizi M, et al. The relationship between mental workload and work-related musculoskeletal symptoms in different working groups in a hospital. J Health Sci Surveil Syst 2019;7(2):67-72.

29. Mehta RK, Agnew MJ. Influence of mental workload on muscle endurance, fatigue, and recovery during intermittent static work. Eur J Appl Physiol 2012;112(8):2891-902.

30. Smith B. Test your stamina for workplace fatigue. Nurse Manag 2004;35:38-40.

31. Mohammadian Y, Malekpour F, Malekpour A, Zoghipour S, Malekpour K. Study on mental workload of teachers and its correlation with their quality of life. J Educ Manag Stud 2015; 5(2):145-9.

32. Xiao Y, Wang Z, Wang M, Lan Y, Fan G, Feng C. [Study on mental workload of teachers in primary schools.] Chin J Ind Hyg Occup Dis. 2011;29(12):930-2. Chinese.

33. Zarghi A, Zali A, Tehranidost M, Zarindast MR, Khodadadi SM. [Application of cognitive computerized test in assessment of neuro-cognitive domain.] Pajoohandeh 2011;16(5):341-245. Persian.

34. Malek A, Hekmati I, Amiri S, Pirzadeh J, Gholizadeh H. The standardization of Victoria Stroop color-word test among Iranian bilingual adolescents. Arch Iran Med 2013;16(7):380-4.

35. Ghimire N, Paudel BH, Khadka R, Singh P. Reaction time in Stroop test in Nepalese medical students. J Clin Diagn Res 2014;8(9):BC14.

36. Gajewski PD, Falkenstein M, Thönes S, Wascher E. Stroop task performance across the lifespan: High cognitive reserve in older age is associated with enhanced proactive and reactive interference control. NeuroImage 2020;207:116430.