



A Comparison of executive functions among smokers, hookah users and ordinary people

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Abstract: The main purpose of this study was to compare the executive functions among smokers, hookah users and ordinary people. This is causal-comparative research. The population of this study includes all consumers of cigarettes, hookahs and ordinary people aged 18 to 60 years in Mashhad. The samples were also 90 members of the community were selected by available sampling. Tools used in this research include the Tower of London and n-back test to investigate the executive actions of study subjects. Data obtained from research were analyzed through SPSS statistical software and using descriptive statistics such as mean and standard deviation and inferential statistics such as ANOVA. Based on the findings of this study, the total time of test in the Tower of London in smokers and hookah users was significantly more than ordinary people. Also among smokers and hookah users there was no deference on the total time of test. Planning time in the Tower of London in smokers and hookah users was significantly more than ordinary people. Also among smokers and hookah users there was no deference on planning time. The number of movements in the Tower of London in smokers and hookah users was significantly more than ordinary people. Also among smokers and hookah users there was no deference on the number of movements. False movements in the Tower of London in smokers and hookah users were significantly more than ordinary people. Also among smokers and hookah users there was no deference on false movements. Based on the results of the n-back test on executive functions on the number of mistakes of smokers, hookah and ordinary it is demonstrated that in n-back test smokers and hookah users had significantly more mistakes than ordinary people. Also among smokers and hookah users there was no significant difference on the number of mistakes. Also based on the results of the n-back test on executive functions the mean reaction times of smokers, hookah and ordinary it is demonstrated that there is no significant difference among the three groups.

Keywords: Executive actions, smokers, hookah users, ordinary people

Introduction

Smoking is undoubtedly one of the most preventable causes of early death and disability in the world (World Health Organization, 2010). Meanwhile, according to data collected from countries around the world, tobacco consumption in recent years has been highly prevalent (Maziak et al., 2014). Smoking and its related diseases are responsible for about 20 percent of deaths in the United States and imposes cost about 2.97 billion dollars a year for the country (Emami et al., 1389). Among tobacco products we can point out to addiction and tobacco (Khalil, 2009). About 2 billion people around the world use tobacco products that its continuous use accounts for the 4 million deaths per year worldwide (Durrazo et al., 2010). Hookah and Cigarette smoking is the most popular method of using tobacco. Tobacco is a plant with broad green leaves that grows in warm climates. Tobacco is available in dry, wet and natural form, and is used through cigarette, cigar, pipe and hookah for smoking (smoking), chewing (smokeless tobacco) and as a powder for inhaling through the nose (snuff). All methods of use of tobacco cause a lot of nicotine goes into the bloodstream of the consumer. Nicotine is itself one of the four thousand known chemicals in tobacco products. This material is one of the main components of tobacco and one of the most known addictive substances (Khalil, 2009). Addiction to cigarette smoking and

hookah in the world is due to the misperception about its safety and increase in its consumption is also due to social acceptance, availability of different flavors and relatively low cost (Mary et al., 2011). On the other hand, the main cause of addiction to tobacco is the nicotine in it. For this reason, people who regularly consume cigarettes and hookah are addicted to it and can not leave it (Khalil, 2009). Nicotine acts as both a stimulant and a sedative. Immediately after consumption of nicotine some certain parts of adrenal gland stimulated and thus the amount of adrenaline is released. The rush of adrenaline stimulates the body, causing a sudden release of glucose as well as an increase in blood pressure, heart rate and respiration. Nicotine indirectly causes a release of dopamine in the brain regions that control pleasure and motivation, therefore, smokers feel pleasure. This reaction is similar to that seen with other abused drugs—such as cocaine and heroin. As mentioned, nicotine can also exert a sedative effect, depending on the level of the smoker's nervous system arousal and the dose of nicotine taken (Benowitz, 2013). The negative effect of hookah on the brain is far more than cigarette smoking. Hookah is contains both nicotine and also there are dozens of toxic materials on its smoke. Harms and disadvantages of hookah are several times than cigarette and tobacco, toxic material that leads to disturbances in the functioning of the brain. The brain function is divided into the different aspects and executive action is one of these dimensions. Executive action refers on a set of mental activity coordinated in the frontal lobe. Executive actions includes skills such as time management and attention, switch the focus, planning and organizing, remembering details, restrict behavior, and apply past experiences in current operation. When problems occur in executive action, behavior control is reduced, and this can affect individual performance (Heishman et al., 2010). The results provided by Dorazo et al (2010) have shown that tobacco use such as cigarettes is associated with mental problems, including brain atrophy, and structural and biochemical abnormalities in the anterior frontal, cortex and white matter. As well as other problems related to tobacco use such as cigarette includes reduced cognitive flexibility, impaired intellectual abilities and generally, learning and / or memory, and reduced information processing speed. Dwyer et al (2009) in a research also concluded that nicotine is associated with dysfunction in autonomic core brain stem functions and also cause changes in the activity of the neocortex, hippocampus, and the cerebellum. Jasinsca et al (2014) in a research also concluded that the continuous use of tobacco can lead to reduce flexibility in the brain and disturbance in information processing speed. Thus, according to the above issues and multiple research findings on the effects of hookah and cigarette smoking on brain systems and dysfunction in brain functions, and considering the importance of psychological-nerve injury rates during the consumption of tobacco, tobacco, the nicotine in cigarettes and hookah, the main question in this research would be that what is the differences between executive actions among smokers, hookah users and ordinary people?

Methodology

Considering that this study act to compare the executive actions of smokers, hookah users and ordinary people thus this study is among the causal-comparative studies. . The population of this study includes all consumers of cigarettes, hookahs and ordinary people aged 18 to 60 years in Mashhad. The samples were also 90 members of the community were selected by available sampling. It is worth noting that of the 30 people were in smokers group, 30 people in hookah users group and 30 people in ordinary people group. Tools this study includes two tests to assess the executive action of samples as follows:

- A. The Tower of London: In this study, the Tower of London, handheld form has been used. Tower of London first in 1982 was designed by Shallice to assess the ability of planning in patients with frontal lobe damage. Test is composed of three rods, which are fixed on a flat base and three beads with different sizes. Participants must move the beads on the rods and convert the initial position to the target position. With seven movements marbles can be moved from position A to position C. For grading the test, the number of movements that the subject intended to resolve the issue (points), the number of errors that the subject has been committed during test and the time spent to solve the problem are calculated (Lezak,2004). Brain imaging studies using methods of MRI, FMRI PET indicated that the Tower of London is sensitive to frontal lobe damage (Khalaf Beygi et al., 1392).
- B. n-back test: A cognitive task performance measures related to executive actions and because that it includes both storing information and their manipulation it is known as more appropriate to measure

working memory and widely used. The general trend is that the sequence of stimulants (usually visual) in step-by-step form is offered to subject and subject should investigate whether the current stimulus is consistent with the stimulus of step before it or not. This test is done with different values of n and with increasing n the task will become more difficult (according to the Nazarboland et al., 1390). In the present study computerized version of 1 n-back task has been used in which 120 numbers contains the digits 1 to 9 as semi-random for 2 seconds intervals were appeared on the display screen center. Each number display time on the screen was 1500 milliseconds and 500 milliseconds after its disappearance the next number was appeared on the screen. The numbers were presented in a quasi-random method and it was designed such that one-third of the answer be correct. The overall score for this task is the sum of correct responses and incorrect responses and unanswered material were subtracted from it. The total score, incorrect responses and reaction time for correct responses were recorded in this task. Data obtained from research were analyzed through SPSS statistical software and using descriptive statistics such as mean and standard deviation and inferential statistics such as ANOVA.

Findings

Table1. Demographic information

Variables	Frequency	frequency	Percentage
Gender	Female	18	20.00
	Male	72	80.00
Degree	diploma	46	51.11
	Bachelor	29	32.22
	MSc	15	16.66
Age	Under twenty years	16	17.77
	Twenty to thirty years	41	45.55
	Thirty to forty years	22	24.44
	Forty to fifty years	7	7.77
	Fifty to sixty years	4	4.44
total	90		

According to the figures in the table above 20.00 percent of the participants were women and 80.00% of the participants were male. According to the figures in the table above 51.11 percent of participants have diploma degree, 32.22 percent have bachelor degree and 16.66 percent have graduate studies, respectively. According to the figures in the table above 17.77% were under twenty years, 45.55% between twenty to thirty years, 24.44% between thirty to forty years, 7.77 per cent between forty to fifty years and 4.44 per cent between fifty and sixty years of age, respectively.

Table2. Mean and standard deviation of scores of the Tower of London indexes

	index	Cigarette smokers	Hookah users	Ordinary people
The total test time	mean	28.11	29.12	16.33
	standard deviation	14.94	15.86	4.77
Planning time	mean	16.14	16.19	10.18

	standard deviation	9.78	8.89	2.77
The number of movements	mean	17.75	17.22	9.14
	standard deviation	7.33	8.89	2.29
Wrong movements	mean	7.87	8.56	4.91
	standard deviation	3.21	3.71	1.34

According to the figures in the table above the mean and standard deviation of total time of test respectively for group of smokers, hookah users and ordinary people are 28.11 and 14.94, 29.12 and 15.86, 16.33 and 4.77. According to the figures in the table above the mean and standard deviation of planning time respectively for group of smokers, hookah users and ordinary people are 16.14 and 9.78, 16.19 and 8.89, 10.18 and 2.77. According to the figures in the table above the mean and standard deviation of the number of movements respectively for group of smokers, hookah users and ordinary people are 17.75 and 7.33, 17.22 and 8.89, 9.14 and 2.29. According to the figures in the table above the mean and standard deviation of the wrong movements respectively for group of smokers, hookah users and ordinary people are 7.78 and 3.21, 8.56 and 3.71, 4.91 and 1.34.

Table3. Analysis of variance between executive actions of the brain in Tower of London

	Total squares	Degrees of freedom	Mean square	F value	Significance level (Sig)
The total test time	12343.12	2	6171.56	3.52	0.000
Planning time	786.45	2	393.22	2.88	0.001
The number of movements	8791.88	2	4395.94	4.17	0.000
Wrong movements	564.78	2	282.39	3.76	0.000
Total rate	26.78	2	13.39	1.042	0.040

- Examining the figures listed in table 3 indicate that there was a significant difference on total time of test among three groups (F-value = 3.52). So we can say with 99% confidence that there is a significant difference between three groups of hookah users, smokers and ordinary people. Given the importance of differences between these three groups on total time of test, follow-up test to further investigate these differences is essential. In this section the Scheffe test was used to determine the difference between these three different groups. Scheffe test results show there is a significant difference between mean scores of smokers, hookah users and ordinary people. So that the mean score of smokers is 28.11 and mean score of ordinary people is 16.33. So we can say with 99% confidence that the total time of the test in the Tower of London in smokers was significantly more than ordinary people. While there is no significant difference between the scores of smokers and hookah users.

Also the mean score of hookah users is 29.12 and mean score of ordinary people is 16.33. So we can say with 99% confidence that the total time of the test in the Tower of London in hookah users was significantly more than ordinary people. Also Scheffe test results show there was no significant difference between mean score of smokers and hookah users on total time of the test.

- Examining the figures listed in table 3 indicate that there was a significant difference on planning time among three groups (F-value = 2.88). So we can say with 99% confidence that there is a

significant difference between three groups of hookah users, smokers and ordinary people. Given the importance of differences between these three groups on planning time, follow-up test to further investigate these differences is essential. In this section the Scheffe test was used to determine the difference between these three different groups. Scheffe test results show there is a significant difference between mean scores of smokers, hookah users and ordinary people. So that the mean score of smokers is 16.4 and mean score of ordinary people is 10.8. So we can say with 99% confidence that the planning time in the Tower of London in smokers was significantly more than ordinary people. While there is no significant difference between the scores of smokers and hookah users.

Also the mean score of hookah users is 16.19 and mean score of ordinary people is 10.18. So we can say with 99% confidence that the planning time in the Tower of London in hookah users was significantly more than ordinary people. Also Scheffe test results show there was no significant difference between mean score of smokers and hookah users on planning time.

- Examining the figures listed in table 3 indicate that there was a significant difference on the number of movements among three groups (F-value = 4.17). So we can say with 99% confidence that there is a significant difference between three groups of hookah users, smokers and ordinary people. Given the importance of differences between these three groups on number of movements, follow-up test to further investigate these differences is essential. In this section the Scheffe test was used to determine the difference between these three different groups. Scheffe test results show there is a significant difference between mean scores of smokers, hookah users and ordinary people. So that the mean score of smokers is 17.75 and mean score of ordinary people is 9.14. So we can say with 99% confidence that the number of movements in the Tower of London in smokers was significantly more than ordinary people. While there is no significant difference between the scores of smokers and hookah users.

Also the mean score of hookah users is 17.22 and mean score of ordinary people is 9.14. So we can say with 99% confidence that the number of movements in the Tower of London in hookah users was significantly more than ordinary people. Also Scheffe test results show there was no significant difference between mean score of smokers and hookah users on the number of movements.

- Examining the figures listed in table 3 indicate that there was a significant difference on the wrong movements among three groups (F-value = 4.17). So we can say with 99% confidence that there is a significant difference between three groups of hookah users, smokers and ordinary people. Given the importance of differences between these three groups on wrong movements, follow-up test to further investigate these differences is essential. In this section the Scheffe test was used to determine the difference between these three different groups. Scheffe test results show there is a significant difference between mean scores of smokers, hookah users and ordinary people. So that the mean score of smokers is 7.88 and mean score of ordinary people is 4.91. So we can say with 99% confidence that the wrong movements in the Tower of London in smokers were significantly more than ordinary people. While there is no significant difference between the scores of smokers and hookah users.

Also the mean score of hookah users is 8.56 and mean score of ordinary people is 4.14. So we can say with 99% confidence that the wrong movements in the Tower of London in hookah users were significantly more than ordinary people. Also Scheffe test results show there was no significant difference between mean score of smokers and hookah users on wrong movements.

Table4. The mean and standard deviation scores of the n-back test

	Index	mean	standard deviation
Cigarette smokers	The number of mistakes	22.75	17.22
	Mean react time	20.33	8.89
Hookah users	The number of	24.54	19.12

	mistakes		
	Mean react time	21.18	14.86
Ordinary people	The number of mistakes	8.87	8.56
	Mean react time	19.11	3.71

According to figures listed in Table 4 mean and standard deviation of smokers' mistakes was 22.75 and 17.22 respectively, mean and standard deviation of hookah users mistakes was 24.54 and 19.12 respectively, mean and standard deviation of ordinary people's mistakes was 8.87 and 8.56, respectively. According to figures listed in Table 4 mean and standard deviation of smokers' react time was 20.33 and 8.89, respectively, mean and standard deviation of hookah users react time was 21.18 and 14.86 respectively, mean and standard deviation of ordinary people's react time was 19.11 and 3.71 respectively.

Table5. Analysis of variance between the brain's executive actions on n-back test

	Total squares	Degrees of freedom	Mean square	F value	Significance level (Sig)
The number of mistakes	28221.06	2	14110.53	14.65	0.040
Mean react time	1291.11	2	645.55	1.18	0.067

Examining the figures listed in table indicate that there was a significant difference on the number of mistakes among three groups (F-value = 14.65). So we can say with 95% confidence that there is a significant difference between three groups of hookah users, smokers and ordinary people. Given the importance of differences between these three groups on the number of mistakes, follow-up test to further investigate these differences is essential. In this section the Scheffe test was used to determine the difference between these three different groups. Scheffe test results show there is a significant difference between mean scores of smokers, hookah users and ordinary people. So that the mean score of smokers is 22.75 and mean score of ordinary people is 8.78. So we can say with 95% confidence that the mistakes of smokers in n-back test were significantly more than ordinary people. Also the mean score of hookah users is 24.54 and mean score of ordinary people is 7.87. So we can say with 95% confidence that the mistakes of hookah users in n-back test were significantly more than ordinary people. Also Scheffe test results show there was no significant difference between mean score of smokers and hookah users on the number of mistakes.

Examining the figures listed in table 5 indicate that there was a significant difference on the react time among three groups (F-value = 1.18).

Discussion and conclusion

The main purpose of this study was to compare the executive actions among smokers, hookah users and ordinary people. Based on the findings of this study, the total time of test in the Tower of London in smokers and hookah users was significantly more than ordinary people. Also among smokers and hookah users there was no deference on the total time of test. Planning time in the Tower of London in smokers and hookah users was significantly more than ordinary people. Also among smokers and hookah users there was no deference on planning time. The number of movements in the Tower of London in smokers and hookah users was significantly more than ordinary people. Also among smokers and hookah users there was no deference on the number of movements. False movements in the Tower of London in smokers and hookah users were significantly more than ordinary people. Also among smokers and hookah users there was no deference on false movements. Based on the results of the n-back test on executive functions on the number of mistakes of smokers, hookah and ordinary it is demonstrated that in n-back test smokers and hookah users had

significantly more mistakes than ordinary people. Also among smokers and hookah users there was no significant difference on the number of mistakes. Also based on the results of the n-back test on executive functions the mean reaction times of smokers, hookah and ordinary it is demonstrated that there is no significant difference among the three groups. The results provided by Jasinska et al (2014), Goriounova & Mansvelde (2012), Gons et al (2011), Dorazzo et al (2010) Dwyer et al (2009) suggest that continuing tobacco consumption is effective on reducing brain's executive functions. As previously mentioned, tobacco use such as cigarette and hookah has led to disturbances in the functioning of the brain. The brain function is divided into the different aspects and executive action is one of these dimensions. Executive action refers on a set of mental activity coordinated in the frontal lobe (Hishman et al, 2010). Also as mentioned in this study tobacco dependent people in their executive action (in the Tower of London test and test-n-back) compared with ordinary people faced with limitations and weaknesses. The results provided by Dorazzo et al (2010) in this regard has shown that problems related to tobacco consumption such as cigarette smoking includes reduced cognitive flexibility, impaired intellectual abilities and generally, learning and / or memory, and reduced information processing speed. Jasinska et al (2014) in a research also concluded that the continuous use of tobacco can lead to reduce flexibility in the brain and disturbance in information processing speed. While in all components of Tower of London and n-back test no difference was observed on executive action among cigarette smokers and hookah users. Accordingly it seems that both cigarette and hookah are effective on executive action of the brain and both result in dysfunction in the brain executive functions. In fact the addictive effect of smoking and hookah is more subject to the effects of nicotine. Nicotine is a stimulant of the central nervous meaning that brain stimulates nerve centers and public activity increases. Concentration and learning increases and subject experience more creation and become more relax. In the short term cigarette smoking and hookah increase brain's blood flow and in the long run will reduce brain flow(Jasinska et al (2014)). So cigarette dependent people think that cigarette smoking and hookah assist to do the intellectual tasks and action and brain functions. While this is a temporary stimulation wave and shortly after taking the above-mentioned effects will be disappeared and the subject will require to continues cigarette smoking and hookah consumption. Therefore, the claim of increased activity of brain and nervous system in long-term is not logical. In fact, long-term consumption of cigarette and hookah will damage the nervous system and brain structure and this leads to disruption in its activities such as executive action. Witness to claim is lie in comparison of smokers and hookah users with ordinary people, such that ordinary people than those two groups show more optimum and normal performance in executive action components, thus smoking and hookah is significantly associated with dysfunction in brain executive actions, such that these subject on test total time, planning time, the number of movements, wrong movements and the number of mistakes in tests related to executive action exhibited poor performance than ordinary people and this itself highlights the cigarette smoking and hookah effect on executive function of the brain. Thus, considering executive actions of smokers and hookah users should become first line of medical attention.

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